TOWARD A MORE EFFICIENT FARM MACHINERY INDUSTRY

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AN ABSTRACT OF A

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ABSTRACT

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FARM MACHINERY INDUSTRY

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Against a background of favorable trends in U.S. farming income and farm-machinery sales during the first half of the 1960's, farm-machinery manufacturers at mid-decade manifested long-range optimism by accelerating their investment expenditures and proclaiming their readiness to cooperate toward meeting the expanding future food requirements of an exploding world population. By 1967, however, it became increasingly apparent that the existing productive capacity of the nation's farms would continue to exceed effective demand, at reasonably satisfactory prices, for years to come. In the same year, profits of leading machinery-producers were substantially lower on slightly higher sales; and a small but potentially growing chorus of farmers' complaints was raised against further machinery-price increases imposed in the face of an incipient farm-income decline. These developments, along with rather obvious questions as to the

validity of prevailing assumptions regarding long-range machinery-demand prospects, suggest a need to examine whether requirements for viability of the farm-machinery industry's present market structure are consistent with the requirements of economically efficient operation and structural change in American agriculture.

This study rejects the notion that "workable competition" is an adequate performance-standard for an industry that administers development and application of the only rapidly-changing agricultural technology which is incorporated in extremely expensive and "lumpy" durable farm inputs. Instead, performance--and structure, insofar as it appears to affect performance--is pragmatically evaluated in terms of efficiency, measured by effects upon economic efficiency in the farming aggregate and among differentiated groups of farmers. It is recognized that the major manufacturers are committed in principle to the objective of promoting agricultural efficiency, but that in practice this commitment is qualified by the requirements of the competitive situation as fundamentally determined by the industry's structure.

Selected USDA statistical time-series on inputs and outputs are merged and compared to establish a presumption as to whether, in the aggregate, farmers' economic efficiency in the use of machinery and equipment has been improving or deteriorating in recent years. A

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theoretically-derived conceptualization of two contrasting general types of inefficiency--overcommitment, or decreasing returns, and undercommitment, or increasing returns--is proposed as a framework for further analysis. The dynamics of these respective categories are examined in terms of contributing factors, documented and illustrated with citations of fact and opinion from various sources, and with emphasis on the relevance of farm-machinery acquisition and use, where applicable. Next, burdens of internal inefficiency within the farm-machinery industry are deductively related, and implications with respect to market power and strategy are inductively related, to consideration of the industry's structure. Finally, first long-range probable consequences, and then shorter-range and more clearly foreseeable consequences, of the prevailing major thrust of strategy are projected and evaluated for their bearing on whether the strategy is intrinsically viable.

Principal findings of the study are as follows:

- The economic efficiency of farm-machinery use has been deteriorating in the aggregate.
- Deterioration appears to be occurring in both the overcommitted and undercommitted dimensions.
- The technological orientation, prices, terms, and conditions of services of and related to farm machinery contribute to such deterioration by fostering overcommitment and hampering efforts to correct undercommitment.

- The major manufacturers have ample market power to exploit these tendencies, but they lack the market power required to curb them, consistent with the imperatives of competitive market rivalry.

- The market power to exploit tendencies toward inefficiency is complemented by the requirements of a characteristically short-range market strategy based upon the mutual undesirability of full-scale market competition where merger is precluded.

- A monopolistically-organized industry would appear to have the advantages of both greater internal efficiency and sufficient market power to pursue profitably a long-range strategy of developing stable future demand based on efficient use of machine services at lower cost. Its structure would be more viable and its performance would be more responsive to the pressure of public opinion.

- Strategy based upon exploiting tendencies toward inefficiency is not viable in the long run. Neither is there viability in an industry structure which depends upon such strategy. Hence, further concentration of full-line farm-machinery manufacturing is predictable, whether through merger or by other--probably slower, less efficient, and therefore less desirable--means.

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My name appears as author of this paper, and its shortcomings are mine alone. If it has any significant merit, however, the responsibility therefor must be widely shared.

The Ford Motor Company assisted my study by granting my request for leave of absence to pursue it, free of any restriction upon the direction it might take. Perhaps even more important were the many opportunities granted me, during my years with Ford, to observe at fairly close range--and not infrequently as an active participant--the difference which adequate information, sound planning, and thorough coordination make between good and poor economic achievement.

Dr. Richard Feltner and Dr. John Brake provided sympathetic guidance, constructive criticism, and patient encouragement toward shaping a worthwhile, individualized academic program, and combining its fruits with my previous experience in a meaningful way to produce this paper.

Dr. Glenn Johnson is representative of the several men of intellect whose teachings and writings have

stimulated me and lighted my way, and whose ideas I have freely appropriated to my own use.

Virginia, my wife, not only provided financial support without which my studies might have been cut short, but also bravely carried most of the other burdens of parenthood during what seemed an eternity of trial and tribulation.

Carole Carter produced a typescript the appearance of which may well be superior to its content.

Chauncey Edgar Cooper, my late father--farm-machinery dealer and farmer--left me the memory of a life in which both men and machines mattered very much.

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I. INTRODUCTION; THE UNCERTAINTY OF LONG-RANGE DEMAND FOR FARM MACHINERY

This essay is conceived as a wide-ranging argumentative analysis of the influence of market structure in the agricultural machinery industry upon the character of that industry's contribution toward technological advance and economic change in farming.[1] Evaluation of that contribution proceeds from the premises that (1) economic efficiency is the primary--in fact, central--criterion of performance in a dynamic system, and (2) the test of efficiency in the farm-machinery industry consists in determining how the industry's conduct reacts upon efficiency in the agricultural economy.

The business of developing and supplying farm machines is of unparalleled importance, from the standpoint of its potential influence upon the efficiency of economic progress in farming. Alone among all other agricultural input industries, the farm-machinery industry

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[1]Clodius and Mueller have pointed to the advantages of an integrative, inter-industry approach to market-structure analysis (25:530-533).

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both controls the evolution of an essential, dynamic technology and incorporates the results of that technology in (increasingly) expensive durable producers' goods.[2] The industry's products are both durable and costly, but the technology upon which their value-in-use so greatly depends is decidedly nondurable.

Implicit in undertaking a study of this nature is a readiness to re-examine, and then either accept or reject, any of the various established academic views and popular notions that appear to have a significant, direct bearing on the subject. Among the more familiar conceptions and assumptions herein re-examined, directly or indirectly, are the following:

- That the goal of promoting the American farmer's economic efficiency has been, and seems likely in the future to be, well served by a farm machinery industry operating under the constraints imposed by a "workably competitive", oligopolistic market structure.

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[2]Kaysen has made the following relevant comments: "In (producers' durables) markets, the products are sold to other industries, and so affect not only prices but the production decisions . . . of other industries . . . The final result (of a monopolistically maintained price for a producers' durable) is a widespread change of economic efficiency rather than a simple passing on of a higher price to the consumer . . . Departures from a competitive resource allocation in markets located further back in the productive process have an amplified effect through the distortions introduced into the resource allocations of the buying industries . . . In terms of progress, changes in prices (in producers' durables) industries are more likely to generate the secondary changes in other industries which magnify their impact" (151:547-548).

- That the industry itself could not operate more efficiently under any other structural arrangement, with the possible exception of one created by breaking up the larger firms into smaller units.
- That the industry's profitability could not be improved except at the farmer's expense.
- That, regardless of findings on the foregoing, the wider public interest is best served by preventing further consolidation or cooperation among the industry's leaders.

In effect, this study constitutes an effort to evaluate the manufacture, distribution, ownership, and use of farm machinery as a total system, in order to determine whether it is functioning well, if not why not, and what, if anything, might reasonably be done to optimize its functioning in the future. Admittedly, the results achieved through an effort so broad in scope and unorthodox in approach may well prove inconclusive as well as controversial in a number of respects. If, nevertheless, the findings are sufficiently meaningful and persuasive to provide a groundwork for more intensive and scholarly research, or to elicit some purposeful discussion among men concerned with positive action, the study's purpose will be well served.

In a sense, the paper is addressed to what is believed to be the industry's own need for broad, potentially constructive, albeit challenging criticism. This goes somewhat beyond, yet is analogous with, the kind of economic-intelligence need described by Scofield:

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> The supply industries have increasingly expressed their needs for economic intelligence in recent years. They want general guidelines as to future demands and market potentials for specific inputs. They are intensely interested in probable future trends in the number and size of farms, in geographic patterns of input requirements, in the obstacles to adoption of their products, and in likely changes in farm programs and policies that directly affect their businesses. . . . Although much has been written regarding the technological revolution in agricultural production, the role of the supply industries in the development and merchandising of such technology has not as yet been appraised (128).

Almost at the time when these words were written, the Iowa State University published a brief study in which some useful beginnings were made toward an appraisal of the role, problems, and performance of the agricultural machinery industry (115). Nevertheless, there remains a substantial amount of uncertainty and disagreement with respect to the contribution which the industry has made to the nation's agricultural economy, and the role which it can reasonably expect to play in the future.

The remainder of this introductory section is devoted to a critical review of certain well-publicized views with respect to the industry's long-range demand outlook. This problem is of central importance in any consideration of objectives--public or private--strategies, and policy alternatives.

The World Food Gap and Future Export Demand

During the last few years the continuing rapid increase of world population has often been cited as a major reason for optimism regarding long-range growth in farm-machinery demand in this country (135; 111). It has gradually become apparent, however, that optimism on this ground may be considerably more hopeful than realistic.

In 1967, after wheat acreage allotments were increased 32 per cent in view of the vanishing U. S. surplus and the prospect of mass starvation in countries such as India, American farmers produced record crops--not only of wheat, but also of feed grains and soybeans. Favorable weather, moreover, contributed to better harvests also in the U.S.S.R., the rest of Europe, Australia, and even in India. The cash export market fell off sharply; Public Law 480 shipments increased but little; and Congress, meanwhile, enacted into law a new policy under which a country's eligibility for United States food assistance is conditioned upon positive measures being undertaken to increase its own food output (168). By October, furthermore, it was reported that authorities in the Department of Agriculture no longer see the population explosion as the major ground for vast increases in U. S. food production:

> There'll be no mass starvation around the world by 1975. Birth control will really take effect in emer-

ging countries by then. Transportation and marketing of food in those countries will be as big a problem as production. The biggest hurdle ahead is to get our food into prosperous countries over 'trade barriers'. Our food exports will climb from the present near $7 billion to around $10 billion by 1980, with more of it for cash, less as 'give-away' (148).

The new food-aid policy apparently reflects growing Congressional awareness of a number of reservations that have been voiced concerning the PL 480 program as it had been conceived and implemented:

- In the long run, if population continues to increase in the underdeveloped nations, it seems likely that those countries themselves must provide most of the necessary food-supply increases (18; 24). According to one observer, "countries like India, Pakistan, Thailand and the Philippines appear to have enough land resources to feed the populations expected by the year 2000, if crop yields can be increased to levels now realized in Japan" (23). There is a serious question, however, whether--in the absence of needed internal policy adjustments--PL480 imports may tend (a) to eliminate incentives for governments of receiving countries to stimulate agricultural development, and (b) directly to discourage private initiative in activities supporting that objective (177).

- To the extent that PL480 allocations to a given country substitute for forms of economic assistance specifically shaped to fit the beneficiary's developmental needs, the benefit that results is less than might be achieved at the same cost. Similarly, equivalent benefit could be conveyed at lower cost (177).

- The shape of the PL 480 program is dictated primarily by the need to dispose of commodities of which U.S. surpluses happen to exist. But such a program cannot serve equally well the complementary motive of remedying dietary deficiencies, sometimes more qualitative than quantitative, in receiving countries (24). Thus, PL 480 reportedly has done little to reduce the apparent substantial protein deficiencies especially prevalent in South Asia (177). The National Council on Marine

Resources and Engineering Development last year reported a finding that the world's protein shortage can most readily be met by further accelerating the harvest of food resources from the sea, which has been doubling every ten years (32).

. The program owes its persistence and growth in large measure to consideration of its effect in bolstering farm incomes, adversely affected by the "cost-price squeeze". This justification has been criticized from an economic standpoint because, on the one hand, most of the income benefits are received by those farmers who need them least; and, on the other, supplementing the incomes of relatively inefficient farm operators tends to delay adjustments that would make the farming economy more efficient (26). More important, perhaps, are indications that agricultural policies which are economically objectionable have become also less necessary or defensible politically. This development mirrors a weakening of the farm bloc's power, brought about by the reapportionment decisions and by a waning of the Congressional power of the Old South (68).

Yield Improvement, Farm Disappearance and Farm Enlargement

Other factors that have been cited (135) as supporting a confident view of long-range farm-machinery market prospects include the following:

. A relatively static amount of cultivable land, and the necessity for raising the agricultural yield of that land, at least partially through increased mechanization of farms and use of larger and more sophisticated machinery,

. Prospects for greater utilization of available farm acreage as a result of declining domestic crop surpluses, and

. The decreasing number of farms and subsequent increase in their average size.

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On these points too, there are dissenting voices and contrary evidence. Based on experience in Japan, where per-acre yields are extremely high, yield increases are achieved mainly through improvement of plant varieties, tillage methods, and crop programs; more efficient control of water; and better use of fertilizers, pesticides, weed-killers, and rodenticides. Mechanization, where higher yield is the prime objective, must be adapted more toward doing the farming job better in the land-productivity dimension than toward performing it with less labor expenditure (87).

A study of Iowa corn yields, reported in 1965, indicated that "Iowa alone could supply the nation's entire output of feed grains if only all farmers improved their practices to the standard currently observed by the most advanced managers" (63).

The strong trend in recent years toward larger tractors, powered by cheaper fuels, is closely linked with a parallel trend toward larger machines of other types, and is undoubtedly fostered in part by the trend toward larger farms. How far these trends will go remains to be determined, however, as questions have arisen as to the optimum size of farms and farm tractors and as to whether supplementary power needs can better be met by larger units or by additional units (111; 100; 79; 163).

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A study published in 1966 indicated that purchases of new-tractor horsepower are significantly dependent upon horsepower on farms, crop production, price and income variables, size of tractors purchased, ages of tractors on farms, and the number of farms. Decreasing marginal-purchase effects were found to be associated with larger quantities of horsepower on farms and with higher levels of crop production; and negative purchase effects were associated with reduction in the number of farms (which is of course related to increasing farm size). Under assumptions stated in the study, purchases for 1970 were projected at about 8 million horsepower. This would be about 7 per cent higher than the 7 1/2 million level recorded in 1962 (the terminal base-year for the study), and compares with a previous peak of over 11 1/2 million, attained in 1951 (62).

It should be noted that the 1970 horsepower-sales projection, which was based on actual purchases and related conditions through 1962, assumed gradual yearly increases along a smooth curve. The actual sales curve shows considerable year-to-year fluctuation, tending to reflect the rise and fall of farm income but with wider swings (115; 91). Thus it would be reasonable to infer that the sizable tractor sales increases achieved in the 1963-66 period (138:23) reflected partly an actualization of previously deferred demand and partly, in effect, the

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immediate purchase of anticipated future power needs. Against this background, a slackening of the sales pace during the next few years after 1966 was perhaps foreseeable, even if an immediate deceleration had not been induced by the 1967 farm income decline (147). A Michigan State University study released in 1966 concluded that "the trend of tapering demands for large numbers of new machines is expected to continue, but at a progressively slower rate, through 1980" (173).

Technological Advance and the Growth of Farm Machinery Demand

Speaking to a May, 1967, conference on international agribusiness, Massey-Ferguson's group vice president for farm machinery declared

> In this industry we are highly competitive, responsible, and innovative, and therefore I will advance the conclusion that we will always serve the requirements of agribusiness in North America sufficiently to maintain the growth that agribusiness has maintained in the past.
>
> In fact, the progress of mechanization that will take place over the next few decades in all of the developed countries will help the farmer become a more efficient agribusinessman (133).

It is not clear whether, by "maintaining the growth that agribusiness has maintained in the past", the speaker meant that he expects the agricultural machinery industry in particular to maintain its recently experienced

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rate of sales growth. If that is what he meant, it is logical to assume he foresees that both of the following conditions will be satisfied:

- That there will be a fairly wide-ranging acceleration of the pace of technological advance in the design and application of farm equipment, and
- That future technological improvements will be widely translatable into improved economic efficiency for farm operators--i.e., that cost factors will not make them impracticable.

The need for acceleration of technological improvement, as a precondition for maintaining an upward sales trend, is fundamentally related to the law of diminishing returns. Farmers who have more nearly maximized the gains achievable with a given technology will tend to make a smaller aggregate investment in that technology, as compared with those who have lagged in its adoption. As illustrated in Table 1, for example, the 1959-1964 increase of tractor ownership was much less, for states where tractor-concentrations per 100 farms were above average in 1959, than for states where concentrations were below average.

It is relevant not only that farmers in the more heavily-equipped states bought fewer additional tractors, proportionally, than were purchased by farmers in other states, but also (1) that their average farm size showed a smaller increase both relatively and absolutely, and (2) that they nevertheless maintained their share of

Table 1.--Tractor ownership in 5 midwest states, 1964 v. 1959

Table 1.--Tractor ownership in 5 midwest states, 1964 v. 1959

	1959 Tractors per 100 Farms	1964 Tractors on Farms		1964 Average Farm Size		Share of 48-States' Farming Income[a]	
	(Units)	Number (Thous.)	% Incr. Over 1959 (Percent)	Acres	% Incr. Over 1959 (Percent)	1959[b] (Percent)	1964[c] (Percent)
5 Selected Midwest States[d]	187	1371	3.3	185	13.3	17.3	17.3
Other, excluding Alaska & Hawaii	127	4110	7.9	390	16.4	82.7	82.7
All, excluding Alaska & Hawaii	138	5481	6.7	351	16.0	100.0	100.0

[a]Net income of farm proprietors, farm wages, and farm "other" labor income, less personal contributions under the old age, survivors and disability insurance program.

[b]Statistical Abstract of the United States, 1961.

[c]Statistical Abstract of the United States, 1966.

[d]Illinois, Indiana, Iowa, Michigan, and Ohio.

Source: Data from the 1964 Census of Agriculture, Farm Journal, Inc., Dec. 1966 (except as noted).

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total farming income received in the 48 contiguous states.

In his agribusiness-conference talk mentioned previously[3], Massey-Ferguson's representative explicitly acknowledged the great importance of cost factors, where problems of mechanization in developing countries are concerned:

> If mechanization were the fundamental need of every developing agriculture, it might be argued that farm machinery manufacturers could make their most significant contribution by, quite simply, selling more equipment . . . Unfortunately, the case for mechanization is far from being so clear-cut. . . . Even in straightforward economic terms we cannot say, without qualification, that mechanization is desirable. We must always bear in mind that any increase in production must be worth at least as much as the cost of attaining it. This balance is not always easy to achieve in a developing country (133).

Obviously, costs associated with technological change are everywhere subject to economic justification, no less certainly in developed than in developing countries. This paper will explore some of the practical implications of a somewhat less obvious but related proposition: As the technology of farm mechanization becomes more complex, and more expensive in relation to the value of other inputs and of the product, its economic efficiency is increasingly dependent on economies of size, and these become increasingly difficult to realize as the scale of operations expands, for the following reasons:

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[3]Refer to p. 10.

- Increasing technological complexity in itself tends to make increasing demands on the limited human capacity for planning, observation, coordination and control. (This problem has to be countered with still more expensive technology.)

- Increasing scale and speed of operations further compounds the problem of human limitations, by broadening the required span of observation and control and by quickening the pace at which they must be effective. (Remedy: again, more expensive technology.)

- Even as the requirements imposed upon the human factor tend to grow more strenuous and exacting, the economic penalties resulting from error or oversight--as well as from mechanical failures and the effects of other imperfectly controllable variables--become more severe. This is a consequence of superimposing the costs of ever-larger equipment upon the costs of increasingly expensive technology.

The reason for introducing this rather pessimistic-sounding proposition at this point is not to suggest that there are no workable solutions to the problem it poses. Rather, at this stage it is relevant to observe that the problem does exist--in some combination of immediate and latent manifestations--and that it contributes to uncertainty regarding the long-range outlook for farm-equipment demand in the United States.

II. THE FULL-LINE COMPANIES--
PRELIMINARY ASSESSMENT

Before entering in the next section upon analysis of efficiency-problems among farm operators, discussion turns at this point to consideration of conditions and problems among the farm-machinery manufacturers themselves, with particular reference to the industry's leading firms. These conditions and problems, as will be seen, have been the subject of conflicting interpretations.

Full-Line Companies and Their Position in the Industry

The extreme dependence of farm-machinery demand upon farm income--in a market in which since 1954 "the demand for new tractors and machines has been principally for replacement purposes" (173)--seems likely to acquire increasing significance for the full-line manufacturers.[1]

[1]Full-line companies--Deere & Company, International Harvester, Massey-Ferguson, White Motor (Oliver, Minneapolis-Moline and Cockshutt), Allis-Chalmers, Ford, and Case--are those manufacturers offering a line of tractors plus a sufficiently broad array of complementary equipment items to give a dealer full-time employment.

Domestic sales data are not normally disclosed by the full-line firms, but published estimates indicate that their share of total industry sales in the domestic market, after reaching a high of almost 74 per cent in 1948 (27), had declined to about 65 per cent by 1961 (134). Although the accuracy and comparability of these estimates may be questioned, the direction of the indicated trend would appear to be consistent with growth in the number of smaller, or short-line, companies, which increased from approximately 1,050 in 1947 (157) to 1,481 in 1963 (156). The full-line firms have largely left to these lesser companies the development and production of specialized equipment, including that which comprises the rapidly growing field of mechanized agricultural "systems" such as those for grain-handling and -feeding, egg production, dairy production, livestock environmental control, irrigation, barn cleaning and waste disposal. "Looking to the future, there is some question as to whether the facilities of the large national companies will be the most logical ones to exploit [the] trend toward agricultural systems" (111).

Taking note of problems of excess capacity, seasonal schedules, production-scheduling difficulties related to widely varying lines, and unpredictable demands, one study reports that members of the industry as well as interested observers have raised the question of whether

there will be room for all of the full-line companies already in the market, even if the more hopeful long-range market estimates are realized (111). Phillips has observed that "the merger of three firms under White Motor (1960-63) had aspects of a shake-out of excess capacity from the industry," and had the further result of extending the already well-established trend toward diversification so that, for the first time, all full-line firms are heavily engaged in production other than farm machinery (115).

Machinery Prices and the Cost-Price Squeeze in Farming

"In their pricing policies, farm equipment makers must recognize not only the farmer's sensitivity to cost but also his political strength" (111). In view of changes in the political balance, mentioned earlier, there may be greater future significance in the movement toward farmer-organization for collective economic action. In January, 1967, it was reported that the Farmers Unions in Iowa and North Dakota, with 45,700 members, had joined in a boycott against the purchase of all new equipment--including cars and trucks as well as agricultural machinery--produced by large farm-implement makers. It was announced that the strike would be maintained until constructively answered

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by manufacturers' action to lower prices or governmental action to lower interest rates or raise farm incomes. A spokesman explained the campaign as a protest against recent increases in farm equipment prices, and high interest rates generally, at a time when a 5 per cent decline in farm profits was expected for 1967, while large farm implement makers such as Deere and International Harvester were reporting record sales and earnings (54).

It is altogether understandable if the full-line companies are extremely reluctant to heed protests of this nature. They, like their farmer-customers, operate under a "cost-price squeeze". The hyper-response of machinery sales to farm-income changes, furthermore, has contributed to "a somewhat fatalistic 'seven lean years' philosophy which has accounted for much of the diversification into other product lines, and has had a distinct bearing on price policy" (115). The manufacturers know from experience that industry-wide price reductions do not bring forth fully compensating sales increases during periods of low farm income (115). When, they might well ask, could they hope to raise prices in order to recover some part of their rising costs, if not at a time when their customers have just realized the income from a record harvest (such as that of 1966)?

The customer, however, does appear to have a material basis for his discontent. The value of domestic

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Table 2.--Relationship of farm equipment shipments to farm income, 1956-1965

Year	Value of Farm Equipment Shipments as Percentages	
	Of Gross Farm Income (Percent)	Of Net Farm Income (Percent)
1956	3.8	11.1
1957	3.9	11.3
1958	4.7	15.0
1959	4.5	13.5
1960	3.7	12.2
1961	4.0	12.9
1962	4.1	12.9
1963	4.3	14.2
1964	4.8	16.3
1965	5.6	18.3

Source: Standard & Poor's Corp., Industry Surveys, "Machinery--Agricultural: Basic Analysis", Apr. 13, 1967, p. M-6. (Originally from U.S. Departments of Agriculture and Commerce.)

farm equipment shipments, reflecting steady increases in quantities and product-content as well as basic price-indices, has been rising much more rapidly than farm incomes (See Table 2).

Percentage rises in the machinery-cost share of farm incomes are, in principle, at least compensated by declining labor requirements or by higher outputs for given labor expenditures. As suggested previously, however, the practical application of this principle seems likely, sooner or later, to elicit diminishing returns.

More detailed examination of empirical aspects of the diminishing-returns problem is presented in the sections subsequent to this. Purely as a matter of logic, a tendency for returns to diminish is to be expected under any of the following conditions:

- If more machinery is acquired than can be given reasonably full employment, or
- If the prevailing mode of adoption of newer technologies of mechanization tends to create or reinforce a bias toward overproduction in farming, and thus to contribute toward a lowering of farmers' selling prices, or
- If the total costs involved in applying new technology--including costs for additional increments of complementary inputs such as increasingly expensive land or more highly skilled labor--rise faster than the effects of any attendant cost savings or output-value increases, or
- If the scale and complexity of operations required for efficient application of new technology impose unrealistic demands upon workers' capabilities or managerial capacity.[2]

The Industry's Changing Near-Term Outlook

Predictably, the views of the industry's leaders with respect to its past achievements and its future prospects are influenced more strongly by the trend of

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[2]"It is already fairly common for the farmer, in planting, to have as many as 32 separate mechanisms, in addition to the tractor, under his control simultaneously. If the trend to combined till-planting continues, additional soil-conditioning mechanisms will appear to divide his attention even more" (80).

industry profits than by developments which appear to have a less direct, certain, or immediate impact. Thus, attitudes of recent years have been conditioned by the fact that leading farm-machinery manufacturers experienced booming sales and earnings during the period from 1962 through 1966 (See Table 3).

Table 3.--Composite operating data, selected farm machinery companies, 1958-1966

Year	Sales per Share (Dollars)	Earnings per Share (Dollars)	Return on Book Value (Percent)
1958	57.26	2.20	6.21
1959	68.15	3.61	9.44
1960	62.16	.73	1.96
1961	62.12	1.14	3.08
1962	68.91	2.36	6.19
1963	75.51	3.17	8.19
1964	86.81	4.50	10.81
1965	94.05	4.27	9.85
1966	101.41	5.16	11.31

Note: Companies included are Case, Deere, International Harvester, and Massey-Ferguson.

Source: Standard & Poor's Industry Surveys, "Machinery--Agricultural: Basic Analysis", April 13, 1967, p. M-13.

Against this background of growing success, leading executives representing the principal North American farm-machinery manufacturing companies contributed uniformly optimistic appraisals of the industry's ten-year

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outlook, to a special survey published in September of 1966 (108). Manufacturers' shipments increased by 16 per cent in 1966, making it "the biggest and best year in the farm equipment industry's history" (147). Significantly, 1966 was also a year in which net farm income was at a near-record level; but, according to a Department of Agriculture source, "the sharp rise in farm income in 1966 should be viewed as a special situation" (34).

Conditions since 1966 have been less conducive to optimistic expectations. Manufacturers' shipments in 1967, stimulated by January 1st order-backlogs and the presence of 1966 harvest-proceeds in farmers' bank accounts, showed a 3 per cent increase over 1966 (147), notwithstanding a 10 per cent decline in realized net farm income (34). But sales gains of such modest proportions were not enough to offset the industry's rising costs. Earnings (reflecting overseas farm equipment operations and both domestic and foreign industrial and construction-equipment business, as well as domestic farm-equipment sales) contracted by 11.2 per cent for Deere, 39.1 per cent for Massey-Ferguson, and 86.3 per cent for J. I. Case, as compared with 1965-66 averages (147). With the shape of this outcome already fairly clear, the president of Case remarked in October that the 1967 sales year "will go down in the record books as one not particularly favorable to the manufacturers of farm and construction

equipment" (47).

For 1968, with respect to farm income, "prospects indicate little improvement . . . Moreover, farmers' incomes will not keep pace with expected gains in the rest of the economy" (34). Deere & Company's chairman Hewitt, referring to the agricultural equipment sales outlook, said in January, "We anticipate more uncertainties and crosscurrents than usual in 1968" (147). At about the same time, International Harvester's executive vice-president McCormick expressed the view that "As to farm equipment . . . it is not probable that there will be a large increase in unit sales . . . in the 1968 season . . . I would say perhaps 5 per cent or less." He related this prediction both to an unfavorable price situation and to an accumulation of new equipment in dealers' hands at year end, reflecting a lag in retail selling rates as compared with wholesale shipments during 1967 (99).

The preceding section introduced discussion of problems that give rise to uncertainty regarding the magnitude of long-range demand for farm equipment. Even if such problems could safely be disregarded, a closer look at past returns on investment suggests it may be unduly optimistic to characterize the industry's prospects as "glittering" (147). (See Table 4)

Only in 1964 and 1965 were average returns in the farm, construction, and materials-handling equipment

Table 4.--Returns on net worth in equipment and other manufacturing, 1959-1966

Year	Selected Manufacturing Companies Accounting for High Percentages of Total Sales by Industry: Composite Percent Return on Net Worth, 1959-1966		
	Farm, Construction and Materials-Handling Equipment Manufacturing (Percent)	Automobile and Truck Manufacturing (Percent)	All Manufacturing (Percent)
1959	11.2[a]	16.9	11.7
1960	4.2[a]	15.8	10.5
1961	5.8	13.2	9.9
1962	7.9	19.4	10.9
1963	9.6	19.6	11.5
1964	13.7	19.9	12.6
1965	14.4	23.4	13.9
1966	14.6	17.8	14.9

[a]Agricultural-implements manufacturing only.

Source: First National City Bank of New York, Monthly Economic Letter, April issues, 1961, 1963, 1964, 1966, and 1967.

industry group higher than the average for all manufacturing companies represented in these data. Even in those years, furthermore, the favorable differences were minor, particularly as compared with the sizable above-average differences which are consistently apparent for automobile and truck-manufacturing companies.

The Special Position of Deere & Company

Averages, of course, can be very misleading. Deere & Company, which for years has held a commanding or consistent lead in both manufacture and sale of farm equipment within the United States, fairly regularly has enjoyed the widest profit margins among the full-line companies, despite large foreign losses in recent years. This significant fact is reflected in Table 5.

Table 5.--Profitability of Deere & Company and composite selected companies, 1958-1966

Year	Net Income as Percentage of Net Sales		Earnings as Percentage of Book Value	
	Deere & Co. (Percent)	Composite Selected Companies[a] (Percent)	Deere & Co. (Percent)	Composite Selected Companies[a] (Percent)
1958	8.9	3.8	12.9	6.2
1959	8.9	5.3	13.9	9.4
1960	3.8	1.2	5.0	2.0
1961	6.3	1.8	8.6	3.1
1962	6.7	3.4	9.2	6.2
1963	7.0	4.2	11.1	8.2
1964	7.3	5.2	12.6	10.8
1965	5.8	4.5	10.1	9.8
1966	7.4	5.1	13.1	11.3

[a]Deere, Case, International Harvester, and Massey-Ferguson.

Source: Standard & Poor's Industry Surveys, "Machinery--Agricultural: Basic Analysis, April 13, 1967, pp. M-13 and M-16.

Based on the comparisons shown above, it appears that poor or unimpressive profitability, as compared with the experience of other manufacturing industries such as automotive vehicle production, is not so much a problem of full-line farm-machinery manufacturing, per se, as it is a problem of smaller members of the group.

Summarizing, the industry's sales and profits record contains considerable factual support for the following generalizations:

- Presumably because of characteristics of cost structure, the full-line companies apparently cannot maintain given levels of profitability unless they achieve substantial sales increases each year.
- The smaller firms generally do not achieve very notable financial success even in peak sales years; and the profit-depressing influence of sales downturns affects them with particular severity. To the extent that their survival depends on their participation in the agricultural economy, it might be said that, like many farm operators, they are only marginally viable.

Divergent Evaluations of Structure and Performance

Academic studies and legislative inquiries into the industry's status have rather uniformly proceeded from a common basic assumption. This assumption, rooted in the antitrust tradition, is that conditions in the industry can be evaluated adequately by determining whether

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oligopolistic structure or a monopolistic tendency, among the full-line companies, has led or could lead to an excess of harmful competitive practices. The writers who follow a structuralist approach have been inclined toward affirmative conclusions. These they base essentially on findings that the level of ownership-concentration, and related conditions of market structure, imply a considerable potential for engaging in undesirable market behavior (38; 39; 94). The performance-minded observers, with a more limited commitment to structuralist doctrines, have directed their efforts toward establishing whether in fact the industry has operated (1) in a reasonably competitive atmosphere and (2) with constructive or at least socially acceptable results (115; 172; 27; 130; 132; 19; 113). These less dogmatic critics focus most of their attention on the industry's record with respect to progressiveness, promotional efforts, price behavior, exclusionary activities, distribution arrangements, and profit levels. In general, they find that record very satisfactory, at least in recent years, although there is some difference of opinion among them regarding the extent to which acceptable behavior has been compelled or induced by various antitrust actions in the past or by the possibility of renewed efforts of this type (172; 2).

The approach taken in this paper is purely pragmatic: performance is adopted here as the central

criterion, but a less traditional approach is followed in evaluating it. It would appear, from the facts cited thus far, that conditions and prospects in the relationship between the full-line machinery manufacturers and their farming-industry clientele have a tendency to become increasingly worrisome. If, nevertheless, conditions in the industry are deemed satisfactory as measured by standards of competitive market behavior, perhaps the time has arrived for determining whether such standards may have diminishing relevance or usefulness for those who are most vitally concerned, i.e. the market participants themselves--buyers as well as sellers. The end, efficient service to the market, may be more important than the means, competitive behavior, which has been sanctioned as supposedly serving that end.

In view of the industry's close dependence upon the profitability of farming, each full-line company's management is well aware that its marketing success ultimately and most importantly depends upon how effectively the company contributes toward <u>improving, or at least maintaining, the economic efficiency of its customers</u>. As Phillips has noted, "The full-line companies are acutely conscious of the industry's great contribution toward farm productivity" (<u>115</u>). Massey-Ferguson has, in part, ascribed the success it has achieved to "aggressive marketing methods focused on the farmer's actual needs

instead of what the manufacturer would like to sell" (111). Referring to International Harvester, Whitney says "A breadth of outlook taken by this corporation as 'leader' of the industry has sometimes been mentioned by observers and even competitors" (172). Ford has made contributions toward improving farmers' economic knowledge and managerial efficiency in the pages of the Ford Almanac.[3] Good intentions notwithstanding, the efficiency of results actually experienced among farmers is subject to objective verification and evaluation.

For purposes of the further inquiry pursued in following sections, the following propositions are assumed as matters of fact: each of the full-line firms operates within the legal and economic limitations imposed by an industry structure that is unquestionably oligopolistic yet "workably competitive" in the view of antitrust advocates and enforcement authorities. Each company, furthermore, has done and continues to do its individual, non-collusive best to promote farmers' efficiency in the

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[3]Titles of some of the brief but helpful and informative articles presented in the 1960 edition include the following: "Small Farms: They Will Pay If"; "Can You Afford More Land?"; "Figure Profits Before You Expand"; "Team with Neighbors for More Profit"; "Part-Time Farming --Money-Maker or Taker?"; "Help in Financing Part-Time Farming"; "From $500 to 160-acre Farm in 5 Years"; "Opportunities for Farm Boys Who Can't Farm"; and "Installment Buying Is Very Expensive" (139).

acquisition, use, and disposal of machinery, subject to what it conceives as the limitations imposed by the "workably competitive" situation.

III. THE MEASURE OF ECONOMIC EFFICIENCY IN FARM MACHINERY USE

Those who write or speak publicly concerning the state of modern American agriculture have generally concurred, regardless of their differences on other aspects of the subject, in recognizing the central importance of the industry's remarkable gains in operating efficiency. Efficiency, of course, cannot be measured until it is defined. It is a neutral concept and can be defined in various ways, depending upon which productive inputs are identified as scarce factors that should be economized (126).

Trends of Average Efficiency in Labor and Machine Use

It has been customary, for purposes of illustrating the beneficial effects of large-scale mechanization, to choose savings in man-hours of labor as the most appropriate yardstick of efficiency gains in agricultural production. The measure of achievement in these terms is impressive, to say the least. Farm production per man-

hour increased more than five-fold between 1910 and 1965. In 1965, farm-product requirements for 37 persons were supplied per average farm worker in the United States, almost ten times the number of persons supplied per worker in 1820--and about half of this increase had come in the last ten years (120; 152:461, 463).

As Solomon Fabricant has pointed out, however, "It is better not to limit productivity indexes that purport to measure changes in efficiency to a comparison of output with a single resource. The broader the coverage of resources, generally, the better is the productivity measure" (73). The Department of Agriculture's indices of total farm output per unit of input[1] have met the indicated need (at least approximately) for an agricultural productivity measure that relates output to the combined consumption of all resources.

This study, however, is not primarily concerned with combined physical productivity gains per se, but rather with how the economic efficiency of farming enterprises has been affected by changes in the employment of machinery and labor. The following premises seem logical and useful as a basis for inquiry into this problem:

. Improvement of efficiency in terms of physical productivity conveys no tangible benefits to the

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[1]See, for example, Table 663, p. 458, in Agricultural Statistics, 1966 (152).

individual farm operator, or to society, unless it is associated with a gain in economic efficiency, i.e. in the ratio of value of product to value of total resource expenditure.

- Since labor savings and machinery cost-increases result from tradeoffs accomplished in order to increase productivity, labor and machinery costs are classifiable as joint costs when the results of these tradeoffs are evaluated.

It is desirable to distinguish among three alternative performance measurements in terms of which efforts to improve agricultural efficiency may be appraised, within a dynamic context of technological change:

- Differences between the technical input-output ratios theoretically possible under a new v. an older state of technological development. This is an important concept for purposes of engineering study, but conveys no practical economic meaning.

- Differences between actual technical efficiency, as measured during a given span of time, and what theoretically might have been possible under the synchronous phase of technological development. This meaning has abstract interest, but implies nothing about whether there has been either technological or economic progress.

- Differences in absolute measures of aggregate economic efficiency over a given time period. This is a pragmatic approach, and is the one employed in this study. It reflects recognition of the fact that efforts to develop and apply improved technology involve costs and are confronted with obstacles that have an important bearing on their economic consequences. It recognizes also that the effects of interaction between these costs and obstacles extend into the agricultural economy, and continue in time, far beyond the stage at which new technical potentials are first being achieved in some commercial farming operations. In effect, two aspects of efficiency-change--changes in technical possibilities, and economic performance relative to these changing possibilities--are merged in a total view of changing economic performance.

It is presupposed herein that neither credit nor blame for progress, or lack thereof, should be assigned to the development and application of agricultural technology as a whole, since these are not under single or even coordinated management. Accordingly, the contribution of farm-machinery technology is subject to evaluation on its own merits. Unless its net contribution to cost-efficiency throughout agriculture is favorable over time, the achievement of any related savings for society is debatable at best.

It is axiomatic that judicious substitution of machinery for labor (and of larger for smaller-capacity equipment) can and in many cases does result in savings for farm operators. Nevertheless, it is desirable to have an answer to the empirical question of whether the farming industry as a whole has been becoming more efficient in the use of machinery and labor. Comparison of the following indices (Table 6) will lead toward at least a tentative answer to this question.

Machinery and labor, of course, are used in the production of both crops and livestock. It is therefore significant that, between 1957 and 1965, the rate of gain in production per dollar of machinery and labor expense falls substantially short of the concurrent rate of gain per farmed cropland acre and does not significantly exceed that per livestock breeding unit. The upward thrusts of

Table 6.--Selected farm productivity indices, 1957-1965

(1957-9 = 100)	Crop Production per Acre of Cropland[a]	Livestock Production per Breeding Unit[a]	Total Physical Output Per Unit of All Inputs[b]	Total Physical Output Per Dollar of Machinery and Imputed Labor Expense[c]
1957	93	96	96	96
1958	105	100	103	104
1959	102	104	101	100
1960	109	105	105	103
1961	113	108	106	107
1962	116	108	107	108
1963	119	111	110	111
1964	116	112	109	111
1965	124[d]	110[d]	112[d]	112[d]

[a]Source: Agricultural Statistics, 1966, p. 460.

[b]Source: Agricultural Statistics, 1966, p. 458.

[c]The indicated expenses include those for repairs, operation, depreciation, and imputed interest charges on farm machinery and motor vehicles, and imputed cost of family and hired farm labor at average hourly wage rates applicable to hired workers with 25 or more days of farm wage work during the year. For details of computation and statistical sources, refer to Appendix A.

[d]Preliminary.

both types of biological yield-increase, furthermore, are reflected in the indices of machinery and labor productivity. Based solely on comparison of these aggregative indices, therefore, it would appear doubtful that the net effect of changes in machinery and labor usage and costs, upon average-farmer efficiency, has been favorable during the last few years.

Relationships among these particular indices, however, do not disclose a conclusive answer to the question posed. Just as more intensive fertilization and improved livestock practices are reflected in higher output per dollar of machinery and labor expense, so outputs per acre and per livestock breeding unit are enhanced by the direct contributions of modern farm equipment toward higher yield. Examples of such contributions include more precise seeding; better control of soil moisture, improved methods of fertilizer-application and seed-bed preparation; timelier planting, tillage and harvesting; more precise feed-administration, and more effective control of livestock environment. On the other hand, it surely is beyond argument that productivity gains attributable to mechanization, although certainly important, have been on the whole far less substantial than those derived from other, more direct-acting, types of yield improving technology.

The problem of gauging the economic effects, at the average farm-unit level, of changes in machinery and labor usage and cost can be approached more directly by means of indices which relate (1) levels of machinery investment, and (2) amounts of machinery and labor expense, to quantities of labor input. In Table 7, these indices are presented together with indices of total physical output per man-hour, employing 1960-62 as the base period in order to facilitate comparison of trends since the end of

Table 7.--Index relationships of physical output, machinery and imputed labor expense, and machinery investment, to farm labor input, 1957 - 1965 (1960-1962 = 100)

Year	Physical Output per Man-Hour[a]	Machinery and Imputed Labor Expense per Man-Hour[b]	Machinery Investment per Man-Hour[c]	Crop Output per Man-Hour[d]	Tractor HP per 100 Crop-Growing Man-Hours[d]
1957	75	85	78	76	78
1958	85	88	81	88	84
1959	88	94	91	88	88
1960	95	98	96	96	94
1961	99	99	98	100	99
1962	105	104	105	104	106
1963	112	107	109	111	110
1964	118	112	121	112	120
1965	127[e]	122[e]	137[e]	123	128

[a]Source: Agricultural Statistics, 1966, p. 461.

[b]Computed from statistics shown in Appendix A.

[c]Computed from data and indices presented in Agricultural Statistics, 1965, p. 439; 1966, pp. 442, 491.

[d]Changes in Farm Production and Efficiency: A Summary Report, 1967. USDA Statistical Bulletin No. 233.

[e]Preliminary.

the last decade.

Relationships among the above index series, of course, reflect the influence of many variables. At first glance, the reader might be led to infer that the rise of machinery and labor expense per man-hour has been kept well in check, as gauged in relation to a directly related rise in productivity. Such an interpretation would have little validity, because the indices of physical output per man-hour reflect also biological yield-improvements due to all causes--i.e., not only the rise in working efficiency and the contributions made by improved machinery design and use toward increasing yields.

The import of these index comparisons, therefore, appears to be that manpower-productivity gains related exclusively to mechanization have been occurring at a rate substantially slower than the rate of increase in machinery and labor expense per man-hour; and it is evident also that continuing increases in aggregate farm-machinery investment have been running considerably ahead of the rate of increase, attributable to all causes, in output per man-hour. In crop-raising specifically, a striking illustration of the latter point is implicit in the comparative index trends of crop output and tractor horsepower, as related to man-hours expended in growing crops; and the implication would be even more forcible if presented in economic rather than technical terms. The USDA's composite

index of crop prices received by farmers was almost the same in 1965 as in 1950 (152:475); but the price index of tractor horsepower rose some 56 percent during the same period (135:M-10).

A Conceptual Model: The Dual Aspects of Macro-Inefficiency in the Application of Machine Technology

Before proceeding to identify and examine specific factors related to economic inefficiency in the utilization of machinery, it will be helpful to establish an appropriate conceptual framework. It is probably not very useful to focus attention on either the micro (firm) or the macro (aggregate) aspects of inefficiency unless this is done within a rationally structured view of mutual relationships and implications.

Technology is a unifying concept which may, conveniently and not unreasonably, be used to account in a broad sense for most of the variables[2] that differentiate the more from the less efficient operators. Using this concept as a tool of simplifying abstraction and aggregation, it is possible to visualize the diverse pattern of

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[2]The term variables is employed here in the long-run sense to connote factors that are for any reason differentially employed as among different operators.

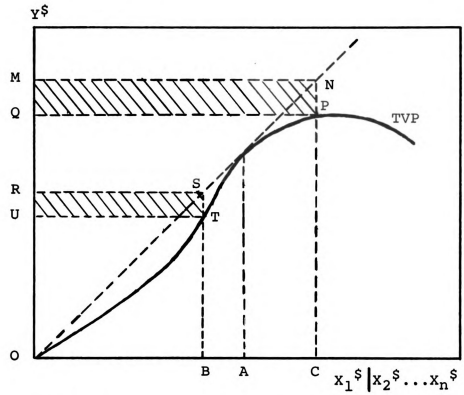

Figure 1.--Inefficient machine inputs on the scale of variable proportions

inefficiency among American farm firms in terms of the above graphic model (shown in Figure 1).

This is a static model of a production function for the farm firm in a long moment of time during which, for expository purposes, it is assumed that the state of technology is fixed, but the complex of productive factors which embody it and give access to it is variable.

These technology-bearing factors and associated complementary inputs--i.e. modern machines, services, fertilizer, seed, technical information, land, hired

machine-operators, working capital or credit, etc---are collectively represented by the proxy variable, $X_1^{\$}$. Other assumptions are as follows:

- All farm operators face identical production functions, defined by the given state of technology and by identical situations with respect to feasible enterprise choices and endowment with fixed factors.
- The fixed factors ($X_2^{\$}....X_n^{\$}$) are those which are primarily competitive rather than complementary with the inputs that directly embody modern technology. The leading contemporary example is the manpower of the operator and his family. Land, although fixed in total, is variable to the individual operating unit and is an essential complement of factors which incorporate new technology. Product price is not affected by output.[3]

The level of $X_1^{\$}$ input corresponding to optimum efficiency is OA, at which the marginal product of one $X_1^{\$}$ input unit has a one-dollar value. If, however, the inputs of all producers were plotted along the abscissa, many observations would appear below the OA level and a large number of others above it. Assuming that OB is the average of all observations below OA, the average cost of inefficiency among corresponding producers is represented by the rectangle RSTU; and the related total cost amounts RSTU multiplied by the number of those producers.

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[3]It is, of course, so affected. This aspect receives specific consideration in the discussion that follows, but incorporating it into the basic model would make the latter needlessly cumbersome relative to its intended purpose.

In terms of the law of variable proportions, the costs of inefficiency associated with $X_1^{\$}$ inputs of less than OA may alternatively be explained as reflecting too little use of $X_1^{\$}$ or too much use of $X_2^{\$}...X_n^{\$}$. The general interpretation employed in this paper is that the system under which machinery is developed and used is inefficient to the extent that $X_1^{\$}$ inputs of less than OA reflect bias in the system.

Making a similarly arbitrary assumption that OC is the average of all observations greater than OA, the average cost of inefficiency among supra-optimal producers corresponds to MNPQ; and the related aggregate cost is MNPQ multiplied by the number of such producers. Theoretically speaking, inefficiency in this category signifies that too much $X_1^{\$}$ is being used, or, too little $X_2^{\$}....X_n^{\$}$. Here, again, interpretation is required. The position taken here is that the system surrounding machinery-utilization is inefficient in the degree that it fosters, or fails to discourage, use of too much $X_1^{\$}$.

The nature of this model should not be misconstrued. It is, in essence, a static picture of the consequences of a thoroughly dynamic system, and, as such, its significance is rather descriptive than normative. Implicitly, static theories of perfect competition have rather limited applicability to the dynamic system to which it relates. Farm firms are significantly unequal

with respect to market power in the purchase of many key inputs; mobility of firms and resources is limited; the state of technology is not fixed and the implications of its development are not neutral; uncertainty is the rule rather than the exception; economic and technical information is unevenly distributed; influence of government (likewise uncertain as well as uneven in its effects) is pervasive.

What has been graphically represented is, in effect, a bi-modal, average-firm-level, status report on the unending contest between what may be characterized as centripetal and centrifugal forces affecting efficiency. Centripetal forces, associated with the law of diminishing returns, are those which by imposing penalties for inefficiency would drive every surviving producer's input up or down to an optimum level if the conditions of perfect competition prevailed. Centrifugal forces, associated with the exceptions to purely competitive conditions, are those which tend to promote inefficiency as a side-effect, reward it, obstruct or retard adjustments to eliminate it, or deflect or mask the economic penalties to which it gives rise. These centrifugal forces are associated with inefficiencies of two general kinds, those of decreasing returns and those of increasing returns.

Analysis of the causes of inefficiency is an obvious prerequisite for formulating and evaluating alter-

natives directed toward reducing it. In subsequent discussion, separate consideration will be given to the centrifugal forces or factors associated with decreasing returns, and to those associated with increasing returns.[4] The converse relationship between these two general types of inefficiency should be kept in mind, as well as the contrasting implications with respect to rational demand or economic need for farm machinery services.

Certainly it is not intended to suggest that perfectly or purely competitive conditions are possible of achievement; and the attempt to do so would surely be more costly than beneficial to society. It is, nevertheless, clear that important reductions of inefficiency could be achieved in many areas of economic activity without impeding desirable kinds of progress.[5]

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[4]It will be noted that some of the same factors are relevant in consideration of both decreasing and increasing returns. In both situations, of course, the influence of these factors on marginal value products runs in the same direction, but the practical effects tend to be different because of fundamental dissimilarities in the surrounding circumstances.

[5]The indicated finding that economic efficiency in the use of machine inputs has been deteriorating is to be understood in the broad sense of absolute change, not merely in the limited context of decline relative to a rising level of technical possibilities.

Efficient Technology and Marginal Value Product

Contrary to what might have been inferred with respect to the conceptual model presented earlier, technology-bearing inputs are of course not homogeneous. Broadly speaking, for example, larger farm operators use (and buy) new, large, modern equipment; whereas small operators use (and buy) older, smaller, less-modern equipment. In view of the key role of modern technology in conveying opportunities for increasing economic efficiency, this fact has special significance.

Efficiency depends both on (1) acquiring the most advantageous quantities of the potentially most efficient inputs and (2) on employing them economically. But the degree to which the second condition can be fulfilled is heavily dependent on the extent to which the first one is met. Decisions on purchasing inputs which incorporate modern technology are, therefore, of central importance in determining how efficiently farmers can operate in the future. These are new inputs and, since they add to the existing stocks of comparable inputs (new and old) within the farming economy, they are marginal inputs. The dynamics of change in agricultural efficiency, then, fundamentally consist in the interacting influence of factors which affect individual decisions on, and collective

implications of, marginal purchases of new technology. Dynamism in the system implies that some of these factors may at times tend to invalidate (from an efficiency standpoint) decisions that have already been made.

The most useful criterion for evaluating the economic efficiency implications of acquiring a marginal input is its marginal value product (MVP) (96:274).[6] In general a factor which increases the MVP of an input tends to act as a stimulus to purchases; a factor which reduces MVP tends to discourage purchases of the input. A distinction must be made, however, between MVP to a prospective individual purchaser and MVP of his prospective purchase as measured by the effect upon farmers considered collectively. Since individual and collective MVP-effects may be opposed, and since farmers do not make purchase decisions as a committee of the whole, the direction of probable influence on collective MVP does not indicate whether purchases are likely to be made. It does, nevertheless, indicate the direction of any influence on aggregate efficiency.

The MVP concept, obviously, cannot be employed without some risk of ambiguity. Its further use in this

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[6]In this study the term MVP is used to mean (except where the problem of lumpiness is considered) the addition to total receipts that results from a one-dollar increment in expenditure on additional inputs, per unit of time. "Total receipts" here is given the broad meaning of present value (which may be somewhat subjective) of the expected stream of all immediate and future benefits.

paper normally has the primary connotation of measuring or evaluating economic incentive for individual decisions on acquiring inputs. Exceptions are indicated where a broader meaning is introduced or clearly implied.

IV. THE DYNAMICS OF OVERCOMMITMENT

Generally speaking, only fragmentary scholarly attention has been given to the dynamic aspects--underlying causes and wider, cumulative ramifications--of decreasing returns in the use of purchased durables used in agriculture. A principal reason appears to be that these problems relate mostly to larger-scale farm operators, those who buy the largest quantities of new technology-bearing inputs and who make the leading contribution toward increasing farm output. Preoccupation with the problem of inefficient small farming operations seems to be mirrored in a comparative lack of concern about the problem of inefficient large farming operations.

Herein, the broad problem of economically inefficient machinery use is examined first at the decreasing-returns end of the scale. Empirical evidence as well as simple logic points to this as the end at which economic inefficiency in the form of overly-rapid or distorted growth is actively fed into the total system. Decreasing returns, in the specified context, largely reflect the taking of inefficient choices; increasing returns largely reflect failure or inability to take efficient choices.

Tendency Toward Over-Commitment in Machinery Capacity

Farm machinery is definitely included among the resources to which Breimyer referred in writing that

> . . . it is the excess of nonfarm capital inputs, not of farm labor, that contributes most to excess production. Surplus labor in agriculture makes life dismal for the persons who are surplus but does not kick in much to gross output . . . The overapplication of nonfarm capital inputs lowers the realized marginal return for farm labor and overstates its apparent surplus . . .
>
> When (imputed) fixed costs are partly or wholly disregarded in making decisions as to variable inputs, a bias enters into the decisions. Commonly, it is an upward bias on use of those inputs--and on total inputs and farm output . . . Overspending on capital inputs may make highly skilled farm labor more valuable but otherwise biases farm-labor values downward. Failure to impute sufficient cost for farm machinery may lead to overuse of seasonally variable inputs such as fertilizers that require machinery for their application.
>
> . . . If dollars spent for durable capital inputs often lead to overspending on other inputs and therefore are not fully recovered, why do farmers spend so generously for them? One reason lies in the well-known phenomenon of cyclicality. Much overspending for durables takes place during the boom period of a cycle--or during any temporary good times. And to the extent that such new spending comes in waves, the fact that each farmer sees his output as not affecting price amplifies the spending. Further, perhaps farmers have a weak resistance to salesmanship (16).

The most systematic explanation of persistent tendencies toward over-production in agriculture is the fixed-asset theory of Glenn Johnson (85), which provides a more formal theoretical foundation for Breimyer's

remarks quoted above. Johnson proceeds from the observation that supply curves, as conceived in elementary theory of demand-supply equilibrium, are not perfectly reversible, except under the improbable condition that acquisition cost and salvage price are equal. If such equality did exist, it would be rational, whenever for any reason the MVP of a given resource falls below acquisition cost (equivalent to salvage value), to dispose of that quantity of the resource the elimination of which would establish a new equality of MVP with acquisition price, at a lower point on the supply curve. But, since salvage prices for most inputs (and especially for purchased farm inputs) ordinarily are less than acquisition costs, it is usually rational to continue use of the resource in production until it is used up, unless its MVP falls below salvage price. A resource the MVP of which is below acquisition cost but above salvage price may be said to be trapped in production.

The trapped-resources phenomenon would have relatively little importance in explaining persistent overproduction by farmers, if all such resources were normally expended during a single productive cycle. A large and increasing portion of the modern farmer's total resource commitments, however, is in the form of durable inputs, representing permanent investment (land) or expended gradually over a period of years (own and family labor,

machinery, buildings). Where a portion of an operator's durable resource commitment has, in effect, been captured in a fixed-asset trap, with MVP less than acquisition cost, he is saddled with unavoidable capital losses. The extent of such losses can be minimized only by employing the fixed resources in optimum combinations with other inputs--i.e., by producing continuously at output levels for which MVP's are below actual or imputed marginal costs. Loss-minimizing adjustments toward this end often can result in even further expansion of production, where full utilization of an overcommitted resource requires additional investment in other fixed and/or variable inputs. (For example, the owner of under-utilized tractor power and machinery capacity is a likely customer for marginal land that could be brought under cultivation with heavy doses of irrigation or fertilizer, or for other land that may be priced above its MVP.)

Since no entrepreneur would deliberately involve himself in capital losses, fixed-asset entrapment is broadly attributable to errors of over-commitment, according to Johnson. But, given the high degree and manifold nature of imperfect knowledge and inherent uncertainty accompanying farm-input decisions, as he points out, a very large number and aggregate amount of errors are

unavoidably made by farmers, collectively, each year.[1] These include, of course, errors of undercommitment as well as those of overcommitment. Some errors of undercommitment, however, are completely correctable; and the effects of many others can be limited to the consequences of delay in making corrections; but errors of overcommitment are in no case fully correctable, and in general are less nearly correctable than those of undercommitment. Hence, even assuming a random initial distribution of the two kinds of errors, the consequences of overcommitment tend to accumulate, year after year.

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[1]Aside from the fact that the buyer of supra-optimal machinery bears only an infinitesimal portion of the revenue-reducing consequences of his decision (as a usually negligible offset to his own revenue increment), he faces difficult problems in evaluating the probable effects on his own profitability. These problems arise from what Breimyer has called "a difficulty inherent in the decision-making process--that of associating, for several kinds of capital input, incremental units of input with those of output" (16). "There are two principal forms of this structural weakness. One, the more familiar, . . . arises from the temporal hiatus between capital-input decisions and realized output . . . A second form . . . is the spending on durable goods which last several seasons, and in fact on all capital goods that have multiple products. This is the category of fixed overhead costs and of joint costs . . . Any spending for a capital good that lasts through two or more production cycles introduces an arbitrary element into the annual production function. It interferes with the whole concept of marginal cost, which basically applies to variable costs determinately associatable with output. Sunk costs establish no minimum marginal return that must be met, other than salvage value. In short-term marginal analysis, sunk dollars don't count" (16).

Even in a year of severely depressed prices, in which imputable MVP's of many fixed resources fall below salvage values, probably only a limited amount of excess capacity will be shaken out, as many operators who are financially able will absorb current operating losses and maintain existing plant in the expectation or hope of better days. Johnson, interpreting the results of research performed by Quance (118)--which are supported by the work of VanGigch (161) and of Wirth and Nielson (176: 18-31)--observes that

> Over the 1917-65 period, overcommitments of specialized farm or non-farm produced, durable capital have not been followed by liquidations, as the salvage value of such capital outside of agriculture is virtually nil. Instead, these items have remained in production at substantial capital losses to farmers (83).

To this it might be added that, where salvage value to the current owner is determined by acquisition value to another farmer, the same forces which bring about a lowering of MVP will, ipso facto, have a similar effect on the salvage or transfer price. Under the assumption that buyers as well as sellers make rational, well-informed economic decisions regarding prospective transfers, farmers who sell their excess durable resources to others do not avoid or shift any part of the capital loss resulting from their own errors. On the other hand, farmers who can effect loss-minimizing adjustments--acquiring additional complementary inputs and expanding their outputs

--do thereby succeed in shifting portions of their burden to other farmers, through the price-depressing effects of what they consequently add to market supply.

Moreover, in the latter case the economic losses that eventually result for the farming industry as a whole are greater in aggregate than the capital losses that would be suffered _in toto_ if no portions thereof could be shifted by those immediately affected. This is because of (1) inelastic demand for farm products, (2) the long-continuing productive role of durable resources, and (3) what might be termed a "domino effect". That is to say, the reduction of MVP's that results from lower product prices implies an overcommitment condition with respect to resources already owned. The existence of such a condition, in turn, increases the probability of further commitment errors (when thereafter prices of farm products fluctuate upward for some exogenous reason[2]) as well as further loss-minimizing adjustments.

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[2]Phillips declares that "on the demand side, the outstanding feature of market structure (in the farm-machinery industry) is the high sensitivity of farm machinery sales to farm income and their low sensitivity to price" (115:337). Cromarty, on the other hand, found in 1959 that a 10 percent increase in machinery prices had been accompanied by a 10 percent decline in purchases, and a 10 percent increase in net farm income had been associated with only a 5 percent increase in machinery purchases (33:40). On a more practically meaningful level, however, both Cromarty (33:48) and Fox (62:25) have confirmed that tractor purchases have a strongly negative relationship to changes in the ratio of tractor prices to prices received by farmers.

Lumpiness of New-Machine and Labor Purchases

Much of the specific relevance of Johnson's fixed-asset theory to overcommitment, as related to farm-machinery inputs, derives from the fact that machinery services, in the form in which they usually are acquired, are "lumpy" resources:

> A farmer can use a little more or a little less seed or gasoline, but tractors and combines come in large units. . . . Where machinery is important, there is a tendency for family-operated farms to adjust to the size that a family can take care of in rush seasons, with the kinds of equipment available. . . . The power unit has been outstanding among machines in setting the pattern of farm sizes (129:391).

Yet,

> It is not imperative that farmers adjust to the maximum acreage that can be handled with their equipment. Per acre costs for each machine tend to go down as acreage is increased, but the additional reduction tapers off into insignificance as maximum acreage is approached (129:392).

Nevertheless, given a fundamentally positive attitude toward operational growth, fostered by a technologically dynamic environment, the availability of a new tool of growth clearly acts as a challenge:

> The size of farm does not respond at once to new innovations, however. Instead, great stresses are set up in the structure of farming. Farmers mechanize; then they find that they have the machine capacity to handle more land. The search for additional land may cause them to move, to rent additional land, or to bid up the price of neighboring tracts (129:391-2).

Labor inputs too are "lumpy" in the physiological and cultural senses; and in the American culture they are increasingly so also in an economic sense. This factor may contribute significantly toward explaining why many of the high-capacity machines developed in years past have not been of such a nature as directly to displace laborers, but rather have made it possible to do more work with the farm family's own labor resources. In more recent times, as the pace of farm-unit expansion has grown faster, as heavier fixed investment has increased the pressure for full capacity-utilization, and as farming has tended to become more specialized, big-farm operators need considerable hired manpower. Many of them, furthermore, are prepared to pay wage-rates that are much improved over those of not too long ago.

An important difficulty, however, is that highly specialized operations, especially in crop-raising, are likely not to lend themselves to full year-around employment. In such cases it would be advantageous for managers of such operations to be able to buy labor in hourly, daily, weekly, perhaps even monthly increments in order to balance the use of both equipment and labor against their paid-for capacities. If, however, full employment of his own fixed resource is equally important to the well-qualified prospective employee, it is not hard to understand why much complaining is heard about the

scarcity of skilled farm workers (stoop-crop labor aside).

To the extent that this somewhat speculative interpretation has basis in fact, it would appear that the dual "lumpiness" of machinery and hired labor may have contributed materially to diminishing individual returns of farmers who expanded too hastily. The condition could quite readily manifest itself either in the form of fully-utilized machine capacity with under-utilized manpower, or vice-versa. It might be expected, in view of the relatively greater flexibility and reversibility of commitments for hired labor, that underutilization of machinery would be the more common situation, as among farmers who have acquired more equipment than they and their families can physically operate.

Response of Farm-Product Prices to Aggregate Output Changes

When the collective economics of agriculture are considered, it becomes apparent that overcommitment in an aggregate sense is likely to result not only from individual choices that reflect private mistakes, but also from rational, error-free individual input-decisions.

Demand for most farm products, as stated earlier, is inelastic with respect to price changes. The broad

implication of this fact, as it applies to marginal value products of farm inputs, is that, given an assumed or expected condition of short-range supply-demand equilibrium, the MVP of incremental inputs will be negative for the industry, though very possibly not for the individual farmer utilizing the input increments.

Total revenue for all farmers, for any particular year, is affected by a number of factors over which they have little or no control, either individually or collectively, such as weather conditions, insect infestations, demand fluctuations, and monetary inflation or deflation. The factor which is most decisive in the long run, however, is one over which they do exercise some control, individually but not collectively: the summation of all input decisions which they make individually.[3] As a seller in a purely competitive market, the individual operator correctly assumes that variations in his own output (hence also in his inputs) will not significantly affect his market price. If, however, the collective effect of such individual decisions is a total output that significantly exceeds that commonly assumed as a basis for the average anticipated selling price, the collective

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[3]The benefits of new technology are implicitly included among the inputs which a farmer may decide to purchase.

result will be a negative MVP for inputs corresponding to the excess output.

To the extent, therefore, that additional expenditures on farm machinery services contribute to reductions in product price below an average expected equilibrium level, the MVP of such expenditures will be negative to the farming economy as a whole, though not necessarily to the owners of the additional inputs.

Governmental Policies and Programs

Ceteris paribus, overcommitment may be expected to be less prevalent if it is attended by direct economic penalties, more prevalent if it is not penalized, and most prevalent if it is encouraged or subsidized.

Under Johnson's asset-fixity theory, strong and persistent tendencies toward cumulative overcommitment of purchased farm durables are expected, even under the limiting assumption that individual errors are directly penalized. But, as noted previously, losses in aggregate farm revenue that result from input increases by some farmers may be borne largely by other farmers, so that overcommitment is not significantly penalized. Furthermore, when the influence of long-established governmental policies and programs is taken into account, it appears

there has been powerful inducement toward and subsidization of increasing farm inputs and outputs.

A great deal of scholarly attention has been devoted by agricultural (as well as other) economists to the effects of governmental action upon agricultural production and resource use. A review of the literature on this subject would lead too far afield and therefore is not attempted here. It seems virtually self-evident, in any case, that individual incentives for expanding resource commitments in farming have been strongly fostered and enhanced by a wide range of programs, policies, and practices such as the following:

- Price-support programs
- Subsidies for approved conservation practices
- Bases employed for determining acreage allotments
- Land-reclamation and irrigation projects
- Investment tax-credits
- Export subsidies and import curbs
- Agricultural research, extension, and marketing services
- Tax-differential on petroleum-product use
- Road-building programs
- Rural electrification
- Exemptions from minimum-wage and fair labor-standards legislation
- Preferential treatment with respect to freight-rate regulation.

Assuming that the level of farm income is the major variable (technology aside) associated with changes in farm-machinery demand (115:337-8),[4] it follows that government programs that raise or support income from farming operations tend thereby to boost or maintain machinery-demand, contributing to the overcommitment potential. This contribution, moreover, derives special potency from the fact that the largest share of program benefits falls upon the class of operators who are most able to increase their resource commitments.

The relationship of government programs to overcommitment of farm resources has two other important, interdependent aspects:

- Overcommitment that comes about as a result of governmental action is additional to the overcommitment that would occur in any case; hence its costs are incremental and therefore higher in the range of decreasing returns.
- These high incremental costs are borne largely by by (1) the non-agricultural economy and (2) farmers who are not in a position, or otherwise fail, to take substantial advantage of the related benefits.[5] Thus, it often happens that such costs are overlooked in discussion of economic efficiency-

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[4]Refer to footnote 2, p. 54.

[5]A contemporary analogy which has received somewhat greater attention is that involved in urban traffic congestion: "Normal automobile charges do not reflect the high costs of streets and highways in the large urban areas. Hence a substantial part of the cost of cars does not fall specifically upon the vehicles causing the urban congestion. This has led to talk of systems for metering urban highway use by individual vehicles" (175).

gains achieved by farmers who expand their operations aggressively.

Rapidity of Technological Change and Shifting of Obsolescence Costs

Possibly the most mischievous popular misconception with respect to technological change in agriculture is the notion that a rapid pace of change can be equated with rapid gains in economic efficiency, and hence with rapid economic progress, among American farmers. Such a belief would be well-founded only if there were no costs accompanying the benefits and if the benefits were rapidly disseminated and promptly and thoroughly exploited among all or most bona-fide[6] farmers. These stipulations are, of course, widely at variance with the facts--so far that it appears worthwhile considering whether, within some areas of resource technology, the very rapidity with which change is promulgated may tend to result in negative net effects on agricultural efficiency.[7]

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[6]The term "bona fide farmers" is used here, in contradistinction to "commercial farmers", to ensure inclusion of part-time and other smaller-scale farmers who have an authentic economic interest in farming, without regard to the possibility of an unfavorable outlook as to their economic survival in farming.

[7]As Johnson has observed, technological advances are represented by inputs that cost money; and when this fact is taken into account there is an implicit possibility that rates of adoption may be excessive (83:11).

Technology as rapidly developed and disseminated by the farm machinery industry[8] affords an apt illustration of the problem. Fundamental considerations are that

- R & D expenditures are substantial.[9]
- Inevitably, considerable lost motion (i.e. waste) is involved in R & D efforts.
- R & D activities presumably provide the impetus, directly or indirectly, for a large share of the industry's new capital-expenditures, which totaled $109 million in 1966 (155).
- The allocated product-unit share of R & D and new capital expenditures is additional to all of the other manufacturing cost and markup which the buyer (or successive buyers) must recover through his (or their) operations before farm-business profit can be realized on the investment.
- Acceleration of R & D tends to accelerate the rise of (potential) value-product incorporated in new equipment, as well as to increase the cost of effort expended to achieve it and the capital investment committed to its exploitation;--all three factors being reflected in the selling price.

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[8]Deere and Company, to cite a leading example, reportedly has more than tripled its annual outlays for product research and development in the last ten years (138).

[9]It was reported that the industry spent over $130 million on research and development in 1966, and planned to exceed this level by more than 8 percent in 1967 (76). The $130 million cost in 1966 corresponds to $577 per tractor buyer (146). The distortion contained in this statistic is relatively moderate, considering that (1) more tractors are sold than any other farm-machinery product, (2) their value is a major share of total machinery sales for farm use (about 40 percent of the 1963-65 average (138: Table 2), and (3) many tractor purchasers buy other equipment also.

- Assuming that the product is utilized at a maximum practicable rate (an unrealistic assumption, in view of the prevalence of operational inefficiency), recovery on the investment is a function of time-in-service, provided that subsequent technological (or other) developments do not erode value-productivity (and market value) by imposing obsolescence on the product in use.

- Time-in-service required for recovery of the investment (and for subsequent realization of profits corresponding to expectations implied in payment of the purchase price) is a function of purchase-price, annual value-product, and market or disposal value of the machine.

- Ceteris paribus, annual value-product, for a machine incorporating given technology, is a function of farm-product prices and physical depreciation.

- Disposal value is a function of expected value-product or of scrap value, whichever is greater.

- Farm-product prices, again ceteris paribus, are a function of farmers' aggregate output, which is a function of the quantities and combinations of resources used in production.

- Except for older equipment that is kept in reserve to provide backup capability, farm machinery is not finally retired from productive service until its expected value product (net of maintenance and repairs) is reduced to the level of its ultimate salvage value.

Based on the analysis outlined, a meaningful synthesis emerges. Continuously high levels of R & D expenditure are associated with rapid increases in expected MVP's for successive models--and quite possibly with shorter time-lapse between new-model introductions. Expected-MVP increases induce strong new-model demands. Heavy purchases of new models increase the downward pressure of farm output on price, because older models are retired

from production at a slower rate, relative to productive capacity. The decline (absolute or relative) of farm-product prices accelerates the depreciation of expected value-products, and market value, of older equipment. Acceleration of depreciation on older units lengthens the time-in-service needed for recovery of investment plus some profit on them. But, physical depreciation sets a more or less fixed limit on the time period that is available for such recovery; and rapid obsolescense may impose an even earlier limit.[10]

Finally, continuously high R & D expenditures imply another consequence, the acceleration of machinery price increases. Unless these price increases are associated with considerably larger increases of expected value-product, the corresponding rise in level of farmer-investment required makes a further contribution toward lengthening the time required to break even or to realize machine-related profit. Particularly as this factor is associated with falling output prices, it clearly increases the difficulty of coming out ahead and the probability that farmers as a whole will lose economic ground with

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[10]"Rapidly changing technology makes obsolescence an increasingly important factor. . . . Machines may become technically obsolete before they wear out" (138).

respect to their use of machinery.[11]

Let it be supposed, for the purpose of further discussion, that over-rapid improvement of farm-machinery technology has in fact fostered overcommitment and consequent losses among farmers. How can such a tendency be reconciled with the fact that the largest quantities of new machinery are bought, and traded fairly regularly for newer models, by the same rather small group of affluent (and/or large-scale) farm operators? Under Johnson's fixed-asset theory, as previously discussed, overcommitment is attributed basically to errors made by individuals in the face of imperfect knowledge. Also, it is held that individuals who have overcommitted cannot shift their losses to others. But, surely the same individuals do not systematically repeat the same errors--and remain competitively on top.

A rational explanation of this seeming paradox can be attempted by taking an imaginary look at the problem through the eyes of the experienced, prosperous new-machinery user:[12]

. The list price of the new model is significantly higher than that of the one it supersedes, but

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[11]This is, of course, not to say that they necessarily would lose ground overall; gains on use of other improved inputs might outweigh (and thereby disguise) unfavorable net economic effects of machinery costs and benefits.

[12]Cf. (71; 86).

the expected value-product appears at least commensurately improved. Furthermore, a sizable, experienced customer may be able to negotiate a special deal (71; 43).

- Experience shows that the annual burden of market depreciation is much the heaviest in the first two or three years of service; and the plan is to dispose of the machine during or at the end of the third year (depending on market conditions).

- That burden, however, is reasonably predictable, and will not be unreasonably heavy if the machine is given the fullest possible employment over the three years. Significantly, a partial offset is provided by warranty coverage during a portion of that period--as well as by continuing solicitude toward a steady customer, on the part of manufacturer and dealer.

- Since the firm has adequate complementary resources at its disposal or within reach, there is no generally valid reason why value-in-service covering at least the full amount of normal market depreciation cannot be extracted from it in three years. (Allowance is made for some decline in output prices as other aggressive firms follow a similar course.)

- If downward pressure on farm prices elicits price-support measures nominally dedicated to small farmers, the contemplated machinery investment will prove highly profitable. In any case, the firm stands a good chance either of using other resources profitably with the aid of financial leverage, or of experiencing a very satisfactory capital gain.

- A major consideration is the need to avoid or minimize any costs of obsolescence. Obsolescence, far from being only a risk, seems virtually certain (based on thoughtful observation of recent trends) to be an important factor sooner or later. However, if the machine is resold after only three years' use there is a reasonably good chance that substantially all of that cost will be assumed by the second and any subsequent users, because usually up to that time no one knows when, how much, or with absolute certainty if, obsolescence

will be incurred before the machine wears out.[13]

- There is also the possibility that a trading advantage can be realized with respect to the difference between market depreciation and physical depreciation. Market depreciation is based mostly on average market-evaluations of physical depreciation and obsolescence on units of given make, model and age. If the unit is given much more than average use during the three years, it may be possible, in effect, to sell more years or hours of satisfactory service than remain in the machine's useful life.

If this representation of the new-machinery buyer's thinking is reasonably accurate, it appears to support the following generalizations:

- Overcommitment in machinery by farmers in the aggregate may result to a considerable extent from substantially error-free, repetitive individual economic decisions.

- These individual decisions appear to be based partly on considerations of economic efficiency and partly on opportunities to exploit competitive advantages that are inherent in a farmer's scale and method of operation.

- Although there is no apparent reason to suggest that one individual can shift to another losses which are already implicit in actual events, differing degrees of imperfection in knowledge or understanding with regard to the future may

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[13]Furthermore, there appears to be a sort of caste-system among farmers, with respect to the degree of obsolescence which they are willing or economically compelled to accept: "The farmer with a large operation and strong finances will tend to trade frequently and keep his equipment fairly new. The operator with a modest-size farm may run his equipment until it's nearly worn-out before he trades. An operator of a small farm may buy the used tractor and finish wearing it out, while the operator of a very small acreage will probably hire custom work done" (Noah Hadley, quoted in 86).

provide the basis for some individuals to shift future losses to others.

The last point merits special emphasis: the dynamics of the system of rapid technological change in farm machinery (and implicitly its commercial advantages) appear to be crucially dependent upon the ability of its beneficiaries to transfer to others the losses which it generates.

Discussion of the costs of rapid change should not be concluded without noting that there are consequences also in the broader, socio-economic dimension, to which Heady has called attention:

> . . . An important question is whether the rate of change in the farm firm should have been any more rapid over the last 15 years in major farming areas . . . especially in extensive farming areas with great spatial separation from concentrated population and industrial areas. The nation's relatively high unemployment rate could be given as one reason. . . . Change in the structure of individual firms has its impact on nonfarm families in rural communities through diminished demand for goods and services, a declining tax base at a time of need for increased investment in education and public services, and frequently a general deterioration of services in rural communities. Optimum is a common trade term in economics, but what is an optimum rate of change (72)?

V. THE REVERSE DYNAMICS OF UNDERCOMMITMENT

Farming under conditions of increasing returns to new machinery-technology is a situation that applies to a very large number of operators, generally including those with relatively small and unprofitable outputs. Not only are they at the lower end of the scale with respect to acquisition to new technology, but also many of them lag in the adoption and efficient use of prevailing technology. Undoubtedly, there are among them some who years ago greatly overcommitted themselves on equipment that now is obsolete. Warren saw this happening as long ago as 1916:

> The danger of overinvestment in machinery is even greater [than that of overinvestment in buildings], for there are skilled agents whose business it is to make sales. The average farm in Livingston County has an investment in machinery of $6 per acre of crops. Many a farm of an amateur has ten times this amount. The machinery on a general farm ought not to cost over $10 per acre of crops (166).

Increasing returns or undercommitment on inputs of modern machine services, as experienced by individual operators over extended time-periods, indicate the presence of one or more of the following handicaps:

- Inadequate managerial ability relative to the tasks of operating farms of viable size.
- Inadequate total financial resources for viable operation and business growth.
- Inefficient fixed-resource combinations attributable to the cumulative effects of past commitment-errors.
- Economic and cultural barriers to exit by operators who are not able to earn satisfactory returns from farming.

In a study which is concerned with problems of inefficiency, the inefficiency of undercommitment is not adequately explained in terms of differences in individual ability. The premise adopted here is that, while these differences certainly are important, it may prove more useful to examine the characteristics of the technological and economic framework within which undercommitted farmers operate.[1] The economic terms and conditions under which modern technology-bearing inputs are developed and

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[1]There exists a popular assumption that part-time farmers, who in 1964 operated perhaps one-third of the total number of Class VI farms, are for the most part in process of exit or barely managing to survive in farming. However, in a survey of farmers acquiring land in Thumb and South Central Michigan through purchase or rentals, between 1959 and 1963, it was found that nearly half of the part-time farmers but only one-third of the full-time farmers acquired land. In industrial Michigan, where part-time farming is becoming a common practice, a large proportion of part-time farmers have no intention of becoming full-time operators, but modern farm equipment allows them to handle increasingly larger-sized farms (31). In another study covering 74 Michigan farmers, no significant difference with respect to the adoption of approved agricultural practices was found between those who reported no off-farm work and those who spent one-half or more of their time in such work (78:17).

acquired constitute extremely dynamic features of that framework; and terms and conditions relating to the services of farm machinery appear particularly significant in their influence on the prevalence, magnitude, and persistence of undercommitment.

In the pursuant discussion some mention is made of various aspects of small-farming as such, because increasing returns are often (though not necessarily) associated with small-scale operations. Nevertheless, the central issue is that of identifying, understanding, and evaluating conditions that may tend to encourage or extend the incidence of increasing returns, or to reduce the magnitude of the problem in an inefficient manner.

Differences and Variability in Managerial Adequacy

The requirements imposed on a manager's ability in modern agriculture are large and increasing. An efficient total system of farm machinery services, it will be argued here, can and should promote the capability, and facilitate the tasks, of management as it relates to machine use.

Up to scale-limits substantially exceeding economically adequate sizes, it would appear, the relative importance of managerial ability to survival and

prosperity in the farming business has been inversely related to operating scale and financial ability.[2] An obvious corollary--putting aside the financial-ability factor for later discussion--is that the adequacy of a farm-manager's ability depends on (1) the level of his ability and (2) the level of difficulty associated with the task of managing an operation of viable size.

In a static framework, managerial ability is conceived of as a dimension which varies between individuals but is fixed for each individual. Similarly, the scale of viable operation and the difficulty of managing operations of viable scale are regarded as given quantities. It follows that the relative inability of some individuals to manage farms of viable size under prevailing conditions must be explainable in terms of their inherent inadequacy as managers. By attempted extrapolation, it might be thought that inducing such individuals to exit from farming is, per se, a contribution toward improved efficiency in agriculture.

If the exercise of managerial functions and the environmental conditions under which they exercised are conceived of as a dynamic system, however, a complex of

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[2]The bias of governmental policies and programs toward subsidization of large-scale operations, partly at the expense of smaller ones, provides much of the factual basis for this argument.

interacting variables can be identified. Practical managerial capacity in the individual operator varies as a function of experience, knowledge and acquired skills, hopes and expectations, apperceptions of what is both attainable and worth striving for, etc. These internal variables, in turn, are dynamically influenced by the presence or absence of (1) incentives and rewards, and (2) assistance toward managerial self-improvement and objective accomplishment. A farm operator tends to become more able to meet the requirements imposed on his managerial effort as the level, quality, and practical relevance of incentives and assistance are increased.

Whether the level of an operator's managerial ability is adequate is determined also by the qualitative and quantitative dimensions of the farm-management task. These dimensions are important variables. There is a persistent tendency for managerial tasks to become qualitatively more complex and quantitatively larger in scale. As the pace, direction, costs, and benefits of technological change are affected by private as well as public decisions, however, it is evident that the character and rate of change in complexity and scale are not autonomously determined. The qualitative requirements of complexity and the quantitative burdens of scale are strategic variables in the sense that they can be and are modified by strategic choices in the economic and political spheres.

It is to be expected that undercommitment will be more prevalent and persistent, involving greater impairment of overall economic efficiency in agriculture, to the extent that any or all of the following conditions result in excessive managerial burdens being carried by smaller operators:

- Unnecessarily rapid increase in minimum viable farm-size, reflecting the magnitude and major emphasis of R & D expenditure and related merchandising effort by the farm-machinery industry, and the prices of its products.

- Unjustifiably inferior assistance received by smaller as compared with larger operators, with respect to selection of equipment and modes of acquiring equipment-services, planning for efficient equipment use, prompt and efficient maintenance and repair service and information, etc.

- Inequitable new-machinery operating returns for smaller as compared with larger operators, reflecting (1) biased allocation of governmental incentives and rewards for efficient (or inefficient) operation, and (2) bias in farm-machinery price structures, and in terms for sale of machine services, favoring purchasers of larger equipment.

The first of these three general conditions has already been discussed in some detail, as has also the incidence of bias in the allocation of benefits from government programs. Reasons for believing the other hypothesized conditions also exist in reality will be advanced subsequently.

Illustrating the possibilities that exist for enhancing managerial adequacy, one method by which managerial capacity may be better matched with requirements has

been reported by Larson:

> One large vegetable-shipper in this country is operating 2,500 acres without owning a single piece of agricultural equipment. All his work is contracted and he sticks to administration only, since he believes this is the farm manager's real function (95:24).

In the immediate context it is relevant to consider, if such an arrangement is expedient and worthwhile for a large operator, whether it might not be even more advantageous for a great many smaller ones. There are obvious implications with respect to burdens, requirements, assistance, and, derivatively, even incentives. This idea merits careful exploration and will be examined more fully farther on in this section.

Financial Ability and Conditions of Firm Growth

Much of the difference between success and failure in farming operations can be accounted for by the relative adequacy or inadequacy of resources owned or controlled by the farm firm. Moreover, financial requirements have both static and dynamic dimensions. Resources which are sufficient today will not suffice for tomorrow's needs.

> Capital requirements per farm and per worker have increased to the extent that it is becoming increasingly difficuly for an individual, during his productive years, to accumulate a sufficient amount to finance

> an economically sized operating unit. This will be still more true in the decades ahead (21:383).

According to one prediction, by 1975 the "average level of investment per farm will skyrocket from the present $100,000 to $250,000" (15). Average assets per Michigan farm have been projected to increase from about $42,000 in 1959 to about $130,000 in 1980 (14:6). This prospect presents the two rather distinct problems of (1) how a would-be farmer can acquire control of sufficient resources to enter commercial farming on a viable scale, and (2) how an existing operation can be developed and expanded at a rate sufficient to maintain viability as costs rise and scale-requirements increase. The former problem is not germane to the purpose of this study, but the latter one is highly relevant. Dynamism in the pattern of farm ownership and organization implies the need for dynamism in the individual farming unit, and is importantly affected by the dynamics of technology and economics in the development and application of farm machinery.[3]

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[3]Results from a study of "what would have happened if a typical livestock feeder in the cornbelt had continued to farm (with exactly) the same (inputs)", between 1957 and 1967, indicated his costs would have risen 20 percent and his net income would have dropped 19 percent. The largest item of cost-increase was taxes, followed closely by machinery. Machinery costs, representing 17 percent of total costs excluding taxes in 1957, accounted for 39 percent of the increase in that total to 1967 (81).

Small farming operations are particularly handicapped by their relative inability to generate capital savings.

> A part-time farmer in a low-farm-income area often receives little or no cash in return for his investment. Commonly he settles for the rental value of his dwelling, the value of home-produced food, and increase in land value as returns for his considerable investment in land, labor and capital. . . . In seeking the best alternative uses for the farm resources employed (by such operators, ERS researchers in a northeast Texas study) found choice of enterprise more limited by capital than by land or labor (121).

The handicap is only less acute in farming on a scale large enough to generate cash that may be used alternatively for consumption or for farm inputs.

> In farming there is a strong interdependence between the business firm and the household, since the farm family is both a producing and a consuming unit. If income is insufficient to make farm investments and expenditures because of the necessity or the family's decision to make home and family expenditures, this will have an impact on future farm production and income. On the other hand, decisions to make major investments in the farm business may prevent the farm family from moving to higher levels of living in the short run (109:51).[4]

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[4]In a terminal survey assessing the results of a township-extension experiment conducted in Michigan, farmers in the experimental and control samples were asked if they could recall instances of having to choose between making an expenditure for the farm and one for the home during the last five years. Sixty percent of the total experimental sample and 43 percent of the total control sample cited such conflicts. Conflicts between purchases of farm machinery and various home items--usually basic home equipment such as ranges, refrigerators, and washing machines--were mentioned most frequently (109:51).

Bailey has listed the necessary conditions for growth of the farm business firm as follows (6):

- Minimum starting size
- Excess managerial capacity
- Profitableness of the business
- Some unused resources
- Added resources procurable.

An *a priori* case can be made for the proposition that patterns relating to the development and distribution of farm-machinery services may have an important bearing on each one of these necessary conditions. Their relevance to the conditions regarding minimum starting size and level of managerial capacity have been indicated, directly or indirectly, in previous discussion; and their relationship to the other three conditions can be conceived as follows:

- The condition of business profitableness has two significant aspects--

  (1) Of primary importance is the requirement of basic growth strategy, to minimize the short-run cost per unit of production services, one production period at a time (6:2). This means that *cash* receipts on the average must exceed cash disbursements. The rate of firm growth is slowed, to cite Bailey's example, if cash expenses for family living are $3,000 annually instead of $2,400. Similarly, if machine services cannot be purchased as they are used, and large additional amounts of cash must therefore be used, in effect, to buy *future* machine services, less cash will be available for expenditures

offering more favorable MVP's and greater growth potential.[5]

(2) Likewise fundamental is the requirement that MVP's on expenditures for different inputs should be as nearly as possible equalized, and in no case less than marginal cost. This condition is violated where losses through more-than-anticipated obsolescence or physical depreciation reduce farm-machinery MVP's below marginal costs. As discussed earlier, operators who buy used machinery are likely to suffer such losses under the prevailing pattern of rapid technological change and used-machine trading.

. The ownership or control of unused resources can contribute to growth-potential only (1) if these unused resources are liquid or in a form which lends itself to economically efficient use, and (2), provided they are liquid, if they are sufficient for acquiring additional inputs that are required for significant growth. It appears quite possible for a farmer to be overcommitted on obsolete machinery, in a resource-allocation sense, and at the same time to be in a position of potentially increasing returns with respect to new-machine inputs. In such a situation, unless liquidation of the obsolete equipment would enable him to acquire modern machine services, his resource-excess is of little if any value for growth purposes. To the extent that liquid resources are required for acquiring additional productive resources, this condition is linked with that regarding procurability of added resources.

. Added resources are procurable in a practical sense only if they are procurable in fully usable

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[5]"Farm operators with limited capital must consider the interest cost that could be earned by investing money in tile, fertilizer, lime, better breeding stock, labor-saving equipment, or for debt retirement. On many under-financed farms, capital invested in alternatives other than additional equipment capacity could yield 25 percent or more" (131).

form, at an immediate outlay which is within reach of the growth-seeking firm. Large, modern farm equipment is by far the most expensive category of resources used in farming (on a per-unit basis), with the exception of farmland operating acreages and, possibly, permanent structures. Furthermore, "the purchase of big equipment usually causes a chain reaction. The farmer who buys a big, self-propelled combine, for example, will usually require drying facilities or high-moisture storage facilities as a result" (5). The critical importance of being able to buy machine services as they are used is obvious, again, in this connection. Prospects for firm growth are significantly affected by the rate of increase in prices that must be paid to procure machine services;[6] and the immediate impact of these increases is much heavier if machine services must be purchased as machine units.

Availability of Hired-Machinery Services

Reference has been made to a need for greater availability of machine services on a leased, rental, custom, or contract basis. This problem will now be examined more directly.

Doane's Farm Management Guide (36:343) recommends three alternative approaches to reducing the costs and financial burdens of machine ownership:

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[6]Strickler points out that by 1965 the Bureau of Labor Statistics wholesale price index for farm machinery and equipment had risen 60.7 points above a 1953 base, compared with a 55.2-points rise for all machinery and automotive products (138:19). The ascent of prices has continued subsequently, notwithstanding highly vocal farmer complaints (54; 122) and moderately disappointing sales in 1967 (147). In February, 1968, it was predicted that further increases would follow the new labor contracts, as soon as dealers could work down inventories (49:11).

- Consider group ownership of some seasonal equipment with neighbors.
- Buy a good used machine to save on interest and depreciation costs.
- Hire or rent machinery which is needed but which is unprofitable to own.

The first two of these approaches undoubtedly afford distinct advantages, as compared with sole ownership of new equipment, to many operators (137). Nevertheless, they represent distinctly sub-optimum solutions to problems of obsolescence[7], managerial burdens, and reliability or timeliness of operation, in relation to which machine-hire or rental arrangements appear to be potentially more satisfactory.

Machine-hire and -exchange practices are most common, and apparently becoming more prevalent, in harvesting operations (4).

> Of the 153 million acres of all crops harvested by the combine in 1964, 28 percent . . . was harvested with custom or exchange machines. Machine rental or leasing, on the other hand, is still relatively unimportant, but farmers, machinery dealers, and others in the industry are becoming increasingly interested in these methods. The four machines most often rented or leased were tractors, trucks, fertilizer distributors, and sprayers (3).

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[7] In comments on a judicially-decided requirement that the United Shoe Machinery Corporation offer sale of its machines as an alternative to the lease terms which alone had been offered previously, some shoe manufacturers reportedly voiced concern, observing that "when shoe factories own their own machines, there is a possibility that they may be less rather than more interested in replacing them with better ones" (171:144).

If, as postulated here, rental, leasing or contract arrangements could fulfill farmers' needs more adequately than custom or exchange work, relatively greater prevalence of the latter practices indicates a less-than-satisfactory situation from an aggregate-efficiency standpoint. Conditions observed in Michigan are illustrative. Although complete custom hiring has been increasing in some Michigan areas, single or joint ownership and ownership with selected custom harvesting are the two methods most commonly used. "Renting or leasing of expensive harvesting equipment is presently not possible in many areas of Michigan. A recent survey of Michigan farm equipment dealers indicated that very few dealers presently have rental or leasing programs" (28).[8]

Presumably, the availability and utilization of rental, leasing, or contract services would become much more widespread and popular if strongly backed by farm-equipment manufacturers, and merchandised with their active participation.[9] Some of them, it has been

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[8]Similarly, but in a broader geographic context, Vermeer and Black report that "In many communities rental machines are not available" (162:345).

[9]During 1955, the first year during which the United Shoe Machinery Corporation was required to offer its machines for sale (on terms not substantially less advantageous to a shoe factory than its lease terms), "almost no newly built machines were purchased . . . Shoe factories do apparently prefer to lease. This was the

reported, do provide leasing arrangements (138:20), and Allis-Chalmers is said to have established a wholly-owned subsidiary for this purpose (45). It would appear, however, that the major manufacturers are basically reluctant to enter the field with vigor, if they are willing to enter it at all (114:1180-81), and that the plans so far instituted have rather limited applicability to the broad problem of promoting efficient machine use throughout American agriculture.

The Ford Motor Company, for example, in 1962 reportedly had under consideration a proposed plan for leases covering a 1- or 2-year period on a fixed or predetermined-charge basis. This plan (concerning the eventual disposition of which there appears to be no published report) was appropriately described by the information source as designed to offer "a very practical solution for larger farm operations to obtain their equipment requirements" (112). Larger operations, implicitly, could utilize equipment rather fully over a 1- or 2-year period, whereas smaller ones would be less able to do so.

Much better adapted to the needs of many undercommitted, smaller-scale operators (and particularly to

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sentiment of 'virtually all' of the 15 manufacturers who testified at the trial and the 45 who answered a questionnaire sent out by the court" (171:133, citing 110 F. Supp., at 349).

those of part-time and semi-retired farmers) would be provisions for furnishing services on a contractual basis. Services could be rendered against payment covering actual work accomplishment as measured in relation to stipulated volume requirements and specified standards of care, effectiveness, and timeliness. (An analogy with highway or building contracting is both obvious and apt.) Such provisions, where properly drawn and priced, would reasonably relate farmers' costs of services purchased to their fair market value, and would tend to maximize their enjoyment of the following customer-benefits which have been ascribed to leasing arrangements (114:1180; 112; 117; 160):

- Tax savings.
- Conserving capital for growth and profit-promoting purposes.
- Protection against financial risks of obsolescence.
- Elimination of maintenance, service, and administrative (i.e., trading and record-keeping) problems.
- Obtaining needed equipment when other financing is not available.
- Regular use of efficient, up-to-date equipment.
- Flexibility for changing to enterprises or methods of operation that require different equipment.
- Flexibility for either expanding or contracting operations.
- Avoidance of storage problems.

Contractual arrangements, of course, are likely to have narrower appeal to full-time farm operators, since they need to obtain labor-returns on their own services. If they are efficient as managers and machine-operators, however, short-term rental or leasing arrangements--provided that such are available--may enable them to enjoy most of the above-listed benefits even more fully than can the farmers buying contract services.

In summary, it appears that making adequate, flexible pay-as-you-go machinery plans generally available would contribute importantly toward overcoming the inefficiencies of undercommitment or increasing returns on modern machine services.

Biased Tendencies in Machinery and Parts Pricing

There is evidence which appears to indicate a significant bias, favoring users or larger or newer machinery at the expense of those who use smaller or older equipment, in the pricing behavior of machinery manufacturers as well as in that of dealers.

Some support for such an inference is found in the following comparisons of the percentages by which average retail prices on smaller and larger tractor and combine models increased from 1957-59 average levels up to 1965:

Table 8.--Percentage increases in average retail prices of selected farm machines and machine sizes, 1957-59 to 1965

Machines and Sizes		Larger Models	Smaller Models
Tractors:	Wheel, 60-69 belt hp.	13.1%	
	Wheel, 30-39 belt hp.		19.9%
	Crawler, 35-49.9 db. hp.	13.5	
	Crawler, under 25 db. hp.		24.1
Combines:	Self-propelled, 12-ft.	20.1	
	P.T.O. 5-6-ft.		33.9

Source: Agricultural Statistics, 1966, p. 480.

An obvious argument opposing the inference of pricing bias might be based on the fact that certain costs--notably in the assembly, handling, and merchandising categories--are more a function of unit volume than of material costs or quantities. This argument, however, rests on an implicit cost-plus pricing premise, and possibly overlooks the fact that allocations of other important costs, of a distinctly overhead nature, are somewhere between largely and entirely arbitrary.

If, employing a more market-oriented philosophy, it is assumed that price changes should be related to changes in MVP of the equipment-unit to the average

customer, it might be reasonable to expect that prices of larger units should have advanced more rapidly than those of smaller ones. This rests on the suppositions that (1) more money is expended, per unit, for product-improvement on larger than on smaller models, and (2) increasing scale economies in farming operations tend to enhance MVP's of larger relative to those of smaller models.[10]

Regardless of whether more-rapid price increases on smaller models seem economically justifiable from the manufacturer's standpoint, however, a pattern of this nature would appear to have significant implications regarding purchase-incentives as these relate to changes in agricultural efficiency. With some oversimplification, it can be broadly asserted that the purchase of larger equipment is more frequently associated with overcommitment (at least in the collective-efficiency context), whereas the purchase of smaller equipment is more commonly associated with movement from an undercommitted toward

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[10]Under a different type of market-oriented philosophy, however, the pattern of relative price trends would resemble that which appears actually to have developed. If smaller equipment is thought of as being bought for replacement, by a diminishing class of customers, then its sales may be regarded as captive business in a declining market-segment. These considerations might underlie decisions to price smaller models less competitively than larger ones. The latter may be thought of as being bought for expansion; and their sales may be regarded as "plus" business, in a growth-market-segment wherein each competitor is anxious to maintain or if possible improve his share.

a more optimally committed position. To the extent that this generalization has basis in fact, if prices rise faster on small machines than on larger ones the incentives for correcting undercommitted conditions are thereby made less favorable in comparison with the incentives for further overcommitment.

Any adverse influence of new-machinery pricing trends on the persistence of undercommitted conditions is, of course, additional to that of other factors discussed in this section. Under the influence of all these factors, farmers who are long on used equipment and short on financial resources tend to continue such equipment in use over long periods of time and, eventually, to replace it with equipment that is newer but likely also has received heavy use.[11] Since repair-requirements are positively related to time-in-service and accumulated use, these operators, who are not customers for new machinery, are steady customers for repair parts and service labor. In this respect they are, to a large extent, captive customers, signifying that their demand for repair parts and labor has relatively little negative price-elasticity.

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[11]"In recent years, according to a study conducted in South Dakota, there is some indication that used machinery sales are gaining in importance as prices of new machinery increase" (33:35).

Manufacturers' profit margins on farm machinery parts and repairs business, according to Standard & Poor's, are higher than on original equipment (135:M-10). Cromarty reports, on the other hand, that manufacturers assert the relatively high prices of repair parts are due rather to the costs of handling small orders, of maintaining patterns to produce parts, and of storing parts for several years. They suggest, furthermore, that provisions to cover these special costs may be included in parts prices, or some portion may have to be recovered in the prices of new machinery (33:34-5).

At the dealer level, heavy reliance on repair parts and service labor as a profit source is indisputable. Analysis of composite-average 1966 operating statistics for all farm-equipment dealers discloses that the combined gross margin on parts and labor accounted for 43.8 percent of the total operating margin, whereas repair-parts cost represented only 13.2 percent of total cost of sales (29:6). As at the manufacturer-level, it might be contended that much of the return on parts sales went to cover the costs of handling, storage, and investment in parts inventory; but the gross profit obtained on parts sales alone was equivalent to 71.1 percent of the value of 1966 year-end parts inventory (29:6, 12).

Conceivably, an attempt at defense of the dealers' high margins on parts and service might be made on the

grounds that (1) average dealer net returns are, after all, rather modest,[12] and (2), unless narrow margins on other lines are amply compensated through parts and labor, many dealers will fail. This argument appears to reflect a lack of concern about efficiency, however, to the extent that it rests on assumptions that (1) prices of new machines must be kept low enough to maintain high selling rates, and (2) the existing number of dealerships (including the least efficient among them) must be maintained.

Finally, putting to one side any question of excessive profit margins, it might be claimed that high parts prices are necessary in any case because the special service-parts-availability costs increase with length of storage period (33:34), and many rather old units have to be serviced. But, if the farm-machinery industry had to bear all costs of maintaining older equipment in service and had the power to retire units that could no longer be used efficiently, it seems very doubtful that such high costs would be incurred. If not, then, to the extent the actual costs exceed those that a totally responsible industry would tolerate, the existing system

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[12] 7.54 percent return on total assets, in the highly successful 1966 sales year (29:14).

involves avoidance of responsibility, and shifting of penalties, for undercommitment.

There is yet another field of economic contact, between the machinery industry and its undercommitted customers, wherein it might be found that the industry has a pecuniary interest in the persistence of undercommitment. Phillips quotes one large company, on the subject of its motives for setting up a credit company, as declaring "We have been driven to this decision, rather than to seek it out as a money-making venture" (115:351). Abrahamsen, however, observes that

> . . . there are many who would disagree (with the proposition that manufacturers gladly would relinquish the credit arrangements they have developed). This is because the granting of credit has become a profitable activity for those manufacturers who provide it (1:1184).

As noted by Phillips, "the lending policies of most banks have proved to be not readily adaptable to the particular needs of large-scale farm machinery credit, leaving the industry little practical alternative to assuming the credit load itself" (115:350). In practice, it seems not unlikely, this often means that customers whose credit ratings do not command access to bank credit (at bank rates) can find no better alternative than financing by a manufacturer's credit subsidiary (at considerably higher cost)--because the services of new machines can be obtained only by buying the machines. Assuming

that large, adequately capitalized farmers usually pay out of accumulated cash or borrow from banks, in this light the manufacturers' retail financing activities might be seen as profitable ventures to which they are driven by their reluctance to sell machine services as such.

Direction of Technological Change

If technological development of farm machinery is oriented toward expanding the scale of farming operations, with relatively little consideration of the efficiency-needs of smaller units, then the direction of that development tends to contribute toward maintaining or even increasing conditions of undercommitment.

The needs of smaller operators are importantly concerned with both costs and design considerations. Vermeer and Black, among others, have called attention to the significance of cost factors:

> One way to reduce costs of machinery is to develop cheaper machines that will perform the same volume of work as the machines now in use. Perhaps too little emphasis has been given to this aspect of machine design. In order to reduce fixed costs, or the costs of owning them, the new models would need to be sold for less money than their predecessors (162:341).

Scoville, who also recognizes that costs must be supportable, points to a need for machinery that is

designed to fit the requirements of smaller farmers, referring especially to part-time operators:

> The peculiar equipment needs of part-time farmers should be taken into account. Their places usually are small; equipment therefore should be adapted to small acreages. But they tend to value their time at off-farm wage rates; equipment capacity therefore should be high. Since the total amount of work done in a year is low, investment in machinery and structures must be kept down. These contradictory needs suggest that special study should be made of kinds of equipment and buildings that would come nearest to meeting requirements of part-time farmers. There are about one half-million part-time farmers, and improvement in their facilities should be worth-while (129:395).

Notice may be taken of a caveat entered by Ruttan, concerning cost-reduction as a major orientation of technological development:

> It is difficult to conceive of an innovation that successfully lowers costs which does not also expand output (and hence lower prices) under free market conditions (123).

This objection is undoubtedly valid as against a dominant emphasis on cost-reduction throughout the field of farm-machinery research and development--at least while farmers' economic behavior continues atomistic. What is suggested by Scoville, however, is not a generally dominant emphasis on lowering costs, but cost-reduction as one special yet essential feature of a movement toward better serving the technological needs of smaller farmers, and thereby redressing the balance of effort that long has weighed heavily against them. Granted that lower costs would help smaller operators to expand their

outputs, the resulting incremental effect would surely be minor by comparison with overproduction on the part of overcommitted firms. Vigorous survival and productive participation on the part of formerly-languishing small farm businesses might well exert a modest salutary braking influence against further overcommitment tendencies in the industry as a whole.[13]

The Rational Conditions for Equipment Replacement

A large share of aggregate machinery-undercommitment, in the sense employed in this study, is accounted for by farmers who own considerable rather old machinery. One way of gaining an overall perspective on their problem is to review the necessary conditions for a rational decision to dispose of an old machine in exchange for a new one.[14]

The following proposed list of necessary conditions for a rational replacement decision constitutes a

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[13]There is, of course, also a broader question of whether sound public policy is well served by relying, in effect, on undisciplined self-interest within the farm-machinery oligopoly for the regulation of farmers' machinery costs or of any other factor bearing significantly on their efficiency.

[14]Cf. P. B. Jones (86); Faris (42); The Ford 1968 Almanac (140:162); Larson (95:79-89); and sources cited by Larson.

synthesis of some prescriptions offered by other writers, with the addition of some constraints:

- Present value of anticipated net revenue from the new machine must exceed present value of alternatively anticipated net revenue from the old machine.
- Present value of incremental net returns on incremental investment required to obtain and use the new machine must not be less than present value of anticipated returns from alternative uses of the same capital.[15]
- The incremental net-return effect must not be compromised by eventualities such as inability to obtain suitable complements, or losses on complementary resources already owned.
- That portion of the price not coverable by trade-in allowance must not exceed the firm's total cash and credit resources as reduced by requirements for higher-priority uses and after allowing for any required complementary inputs.

Admittedly, this set of rules is rather complex. Even so, the full measure of complexity in the decision-making problem is implicit rather than explicit.[16] Thus, the economic desirability of trading an older machine for a newer one is closely hedged about with conditions--conditions which in general have increasingly negative

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[15]Larson estimates that it is normally more economical to trade for a second-hand-tractor--up to and including one six years old, with a three-year-old tractor showing the lowest average cost--than for a new one (95:82-3).

[16]Also, there is the possibility that a trading decision may be forced, even though uneconomic in terms of these criteria, because of problems of reliability, labor availability, etc., affecting the existing machine.

effects with increasing differences between the respective machines as to age, price, size, and technological factors. Modestly capitalized owners of older, smaller machines would seem to have hardly any incentive for obtaining the services of modern equipment through acquiring ownership of it. To the extent that they do become owners of expensive modern equipment, moreover, the probability appears high that their purchase decisions are economically irrational.[17] These decisions are difficult; the customer needs expert, responsible advice and assistance; but it would appear that the professional advice received may in too many instances be incompetent or irresponsible.

Barriers to Exit

All previous discussion in this section has been concerned with barriers to upward adjustment from the condition of undercommitment. It is, however, not those barriers but barriers to exit that are relevant to the situations of many operators who--for reasons of age, disability, or other limitations or personal reasons--are incapable of or indifferent toward upward adjustment.

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[17]A decision to dispose of the old machine outright and substitute leased or contracted machine services, if such services were available on sound and attractive terms, would exemplify a simultaneously rational and efficient decision.

Barriers to exit, moreover, are important not only to those who would like to leave agriculture, but also to those who wish to remain.

> Farm operators are cognizant of the need to increase the scale of their operation and to become more efficient. . . . But the demand for land for individual farm expansion will need to be satisfied primarily by farmers going out of agriculture. . . . Retirements and transfers out of agriculture probably will not be rapid enough to avoid upward pressure on land prices (31).

Inadequate employment-qualifications among farm people, as related to declining or inelastic demand for relatively unskilled labor--outside as well as inside of agriculture--have been identified by Hathaway and Perkins as major factors in the overall farm-nonfarm mobility problem (70). For the purpose of this study, however, the most relevant question is how off-farm migration decisions by owners and operators may be affected by the status of their investment in the farming business as such.[18]

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[18]Boyne has suggested that, during inflationary periods, farmers who are net debtors vis-a-vis the nonfarm sector receive important real-wealth gains (12). (Real-wealth gains are capital gains adjusted for the purchasing power of money (12:6).) In general, however, it appears unlikely that smaller farmers being pressed to leave agriculture can realize capital gains that would go far toward compensating the opportunity costs they have accumulated, as determined by inferior operating returns. If they own land, the fact that their holdings are small or low in value indicates either that they had little capital when they began farming or that their earnings have been poor over the years. In either case they have not been able to command much credit; and, excepting

> The farm price and cost relationships in the future will be important factors in the rate of retirement and the number of people who completely move out of agriculture (31).

If current price and cost relationships constitute a situation that would seem to encourage withdrawal from farming operations, it should be remembered that the present situation bears a legacy from the past. Over the years, four observable tendencies, all identified in earlier discussion, appear to complement each other in making liquidation of machinery investment in small-farm businesses economically difficult:

- Historically, the hiring of machine services has involved considerable difficulty, risk, or inconvenience, to avoid which most farmers invest--in many cases to excess--in expensive machines.
- Machinery prices tend to rise faster than the labor returns which their owners are able to earn either inside or outside of agriculture.
- Rapid technological change tends to accelerate used-machine obsolescence, as well as depreciation of labor-returns associated with the use of older machinery.
- The first three factors tend to produce the combined effect of "trapping" capital investment in machinery, and therewith the associated owner-labor (127; 84:19-20).

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those who may have succeeded in obtaining government-subsidized loans, it is improbable that they could have incurred large debts except at relatively high interest rates. Furthermore, in an empirical investigation of investment returns on farm and non-farm equities, Kost has found that the stock market has been a better place in which to speculate than the land market (93).

VI. COSTS AND HANDICAPS OF OLIGOPOLISTIC DUPLICATION

It will be argued, in the section following this, that the economic behavior of members of the full-line farm-machinery oligopoly follows naturally from the fact that they are compelled to persist in competing against each other, with mergers precluded.

Preliminary to taking up that argument, the present section is devoted to consideration of the most obvious major consequence of the compulsion to compete. This is the necessity for each firm to provide itself with a complete, competitively adequate set of all of the kinds of facilities, product designs, personnel, business systems and arrangements, operating schedules and routines, financial resources, services, inventories, and elements of administrative and executive superstructure that would be required by a firm exercising monopolistic control. Significant implications of this requirement are that, as compared with operations controlled by a single firm,

- Many variable costs are likely to be higher, even if optimally controlled within the limits imposed by scale disadvantages;
- Many fixed costs will be multiplied;

- Losses through waste will tend to be multiplied because of scale disadvantages, lack of industry-wide coordination in planning and control, and mutual cancellation of the intended benefits of competitive effort;

- Fixed costs, investment, and waste-losses will tend to be further inflated by overcommitment resulting from individual efforts to maintain or improve competitive positions, particularly during cyclical periods of strong demand;

- Aggregate profit-targets will likely be higher because of greater investment in resources;

- Pressure to increase sales--regardless of probably unfavorable effects on farmers' efficiency--will be higher because of resource-overcommitment in the industry;

- Probably more product-offerings will be poorly-designed, under-designed, or over-designed relative to the requirements of agricultural efficiency;

- There will be needless proliferation of product designs, adding to the customer's already difficult problems of rational, well-informed choice; and

- Service to customers in the forms of product-information, technical advice and assistance, and product-repair and -maintenance will tend to be less adequate, efficient, and uniform, because of divided responsibility and conflicts between the goals of adequate, responsible service and reasonably-related cost.

Engineering, Design, and Tooling Costs

Agricultural economists many years ago pointed out that important savings on machinery could be achieved through standardization of designs, based on engineering determinations of what is required, rather than on farmers'

whims and geographic preferences (136). The costs from which such savings could be made have increased tremendously over the years.[1] Although new-model tooling costs are doubtless considerably less significant for farm machines than for passenger cars, an indirect indication of their growing importance may be seen in the reported fact that the cost of new-model tooling for automobiles advanced 200 percent between the immediate postwar years and 1955, as compared with an advance of only 35 percent in production-workers' wages (170:475).

Manufacturing Costs

"Costs of production are an important structural element bearing upon market conduct, since these condition price policy and in turn affect the nature of competition. In the farm machinery industry, the so-called overhead costs are particularly significant" (115:332). A striking historical illustration of the relationship between unit

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[1]The Ford Motor Company, which as of 1963 was one of the world's two largest manufacturers of wheel-type tractors for farm and industrial use (58), acted to realize some of these savings in 1964 and 1965 by eliminating duplication of engineering and design in the tractors it produces in the United States, England, and Belgium (60). Obviously, if worthwhile savings can be achieved in this way by one manufacturer, much greater savings could be realized by eliminating the duplication involved in parallel efforts of all full-line companies.

Table 9.--Manufacturing overhead costs, selected farm machines, 1932 and 1937

Representative Equipment Models	Average Factory Overhead Cost per Unit	
	1932	1937 (or 1936)
Row-crop tractor	$486.00	$ 91.59
Eight-foot binder	53.30	31.62
Thresher	343.16	193.22 (1936)

Source: Report on the Manufacture and Distribution of Farm Implements, Federal Trade Commission, Washington, 1948. (Cited in Phillips, 115:333).

sales volume and overhead cost per unit is implicit in the above comparison drawn from a report of the Federal Trade Commission (see Table 9).

High overhead costs are generally indicative of underutilized capacity. "The leading power machinery and implement firms were among the first in this country to embark on a policy of diversification in order to assure continuing full use of their resources" (22:370). Obviously, the phrase "continuing full use" is employed here in a relative (and perhaps optimistic) sense.[2]

[2]Cromarty quotes a 1957 report that "makers of tractors, combines, and harrows have taken to turning out such varied products as baby buggies, fertilizer, and boat motors" (33:53, footnote). To the extent that production of added lines requires conversion from normal

Scale requirements for low unit-cost have increased greatly in recent years with the introduction of automated manufacturing processes, which contribute to fuller plant-utilization and savings in labor cost but impose heavy additions to fixed investment, as well as reductions in flexibility of operations and model changes (41:158). Automation has been more widely employed in the production of passenger-car components than in farm-machinery manufacture, presumably because of wide differences in production volumes. In the farm-machinery field, it appears the most important economically feasible application is in producing engines. High fixed costs related to engine manufacture have contributed to development of the family concept of engine design, i.e., a high degree of interchangeability of parts between several models and between gasoline and diesel engine types (97).[3]

All available economizing expedients notwithstanding, high volume-requirements evidently continue to

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operations, it would appear that extraordinary cost penalties associated with the learning curve--reflecting gradual normalization of high start-up costs--must be borne.

[3]Some compromise of efficient design in particular assembled products may result: "Some parts may be overdesigned, but the idea cuts down on the manufacturer's tooling requirements, reduces parts inventory, and reduces the service-stock requirements" (97).

represent an obstacle to farm-machinery applications of some highly promising technology. It is expected, for example, that "the gas turbine will . . . be commercially available as an optimal power plant for tractors (but) this will depend to some extent on development of additional vehicular markets for the engine, with attendant economies of mass production" (80). Patently, the obstacle of high volume-requirements could most effectively be overcome if one company commanded the entire market-volume now shared among several firms.

Dealer Organization

A fundamental characteristic distinguishing the full-line from the short-line manufacturer is that of distribution through dealers, often served through branch houses, in all localities where farmers buy implements, instead of through higher-cost channels. This kind of arrangement depends on the ability to command a dealer's full efforts for the company's products by making it unnecessary for him to carry those of any other maker (172: 238, 240). The farm-machinery market, as Phillips points out, is made up of a tremendous number of relatively small enterprises scattered over a vast rural expanse. This characteristic, together with diverse requirements of soil and terrain and unpredictable geographic variations

in farm income trends, explains the "urgency, from the producer's point of view, of being represented in every segment of the market, and the consequent building up, in the early decades of this century, of a large and unwieldy organization for retail distribution" (114:1172).

During the last several years considerable criticism has been voiced to the effect that, although dealers' numbers have been declining fairly steadily[4], there is still substantial over-representation in view of (1) increasing dealer-financial requirements, and the attendant need for larger sales-potentials, (2) declining customer-numbers, associated with diminishing geographic density, (3) slower growth or actual decline in demand for some important types of machines, with larger but fewer units sold, and (4) improved roads and better communications (115:347; 172:246; 111; 114:1173-5; 1:1183-4).

"Manufacturers reportedly agree there are too many dealers in the market and most are said to be thinking in terms of fewer, stronger outlets" (111). This attitude presumably reflects their understandable concern

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[4]Dealers handling mainly farm machinery reportedly totaled 16,362 at the end of 1963, compared with 19,008 only 5 years earlier. According to subsequent counts (possibly employing a slightly different definition), there were 16,297 dealers in 1965 and 15,165 in 1967 (138:20).

with problems of business operating efficiency.[5] It may be doubted, nevertheless, whether their individual competitive interests in maintaining strong, separately aligned, and sufficiently well-dispersed local representation can be reconciled with the interest of farmers in being served adequately and at minimum economically justifiable cost.[6]

Obviously, a farmer who owns a machine is in a position to benefit satisfactorily only from the service that can and will be provided him by a dealer who represents the machine's manufacturer. The service received

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[5]Such concern was manifested in the Ford Motor Company's program, completed in 1964, aimed at streamlining the firm's distribution system by marketing its products directly to Ford tractor dealers rather than through distributors. The program consolidated 28 warehouses and distribution points into 7 district offices and 10 depots (59).

[6]"A Canadian parliamentary committee (in 1937) reported that 'unless some outside agency or competition forces them to do so, it is unlikely that the companies will initiate a more economical policy, as each fears the loss of identity of its own organization'" (114:173). Abrahamsen has noted an "inclination of manufacturers to 'hang on' to dealers in the hope that future volume will justify their existence . . . (Moreover) the strong credit ties between manufacturer and dealer place the latter in what some people describe as a 'captive' position" (1: 1183). "Since 1948, dealers' need for help in financing inventories and sales has increasingly been met by manufacturers, some of whom also provide leasing arrangements" (111). Dealers have complained about the system of annual contract orders (111); and the practice of "full-line forcing" (insistence that a dealer carry the manufacturer's full line) has drawn complaints not only from many dealers but also from several short-line competitors (172: 241).

from such a dealer will likely prove inadequate to the extent that, because he must share local business with (and compete for it against) dealers selling other makes, he is (1) financially too weak to be effective, (2) geographically too remote to give prompt, economical service, or (3) competitively motivated to attend to the needs of larger or more densely clustered farm operators while neglecting those of smaller or more dispersed ones.

From this reasoning it seems to follow that, except for losing the questionable benefit of being able to choose among brands and local dealers, the farmer would be better served if his dealer were the sole local representative of the only manufacturer of the only national full-line machinery brand. Such a dealer would, in all likelihood, be (1) financially stronger and at the same time less burdened with inventory[7], (2) located closer to the average farmer, (3) relatively free of incentive to discriminate among classes of customers, and (4) unencumbered by a need to engage in expensive, economically unproductive competitive effort. He would, consequently, be better able to concentrate upon providing efficient, equitably-allocated service effort, and responsible,

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[7]Aggregate dealer-inventory requirements, as compared with those relating to the present market structure, would be reduced both by (1) the economizing effect of centralization, and (2) progressive elimination of problems of parts interchangeability.

objective economic and technical advice on the acquisition and use of machinery services, at substantially lower cost.

Planning and the Flow of Information

If every indicator of private (individual or firm) economic advantage or disadvantage were removed from the equation, the economic inefficiency herein identified with the development and application of farm-machinery technology would appear simply as a result of incredibly poor planning. Certainly such poor planning would not be tolerated if these processes were operated under an integrated system.[8] Good planning is vitally dependent upon good and timely information; and giant enterprise now has at its disposal previously-undreamed-of capabilities for swiftly gathering, digesting, and interpreting information required for effective planning.[9]

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[8]As Galbraith has observed, "The market is superseded by what is commonly called vertical integration," and "industrial planning is in unabashed alliance with size" (64:27, 31). Elsewhere, it has been remarked that "technological change makes long-range planning riskier--and more necessary. The new stress on long-range brainstorming is changing the role of top management 'from administrator to anticipator'" (165).

[9]"A behind-the-scenes partner in the engineering, manufacturing, and selling of trucks is an elaborate information network which has its headquarters at International Harvester's Electronic Processing Data Center . . .

Planning, however, and the information upon which it depends, can be no better than the objectives they are designed to serve. These objectives, within the farm-machinery industry as now constituted, are not (1) to improve farmers' efficiency, consistent with reasonable profits on the operation of an efficient system for developing and supplying machine services, but (2) to trade on the development of potential agricultural efficiency-improvements, within a framework of oligopolistic market-rivalry. Certain kinds of informational problems that would seem highly relevant to the former purpose might well appear completely irrelevant to the latter. The following hypothetical examples, though crudely stated, may serve to illustrate:

- How does next year's projected new-tractor demand at this year's prices compare with a sales volume that would maintain farm power-supply at an efficient level (or adjust toward it); and what price changes would serve to moderate or stimulate demand for efficient adjustment?

- What shifts within the internal balance of the existing price-structure are needed to compensate for exogenous forces that tend to stimulate overcommitment or hamper correction of undercommitment?

Customer orders from the districts, material requirements, vendor schedules, engineering changes and specifications . . . all these and other end uses are the day-to-day work load for these computers. Within a 24-hour period, International Harvester can locate any truck within the United States, determine what changes have been made to it since its initial manufacture, and what warranty charges have been applied against it" (82).

- What advance order-commitments would prospective new-machine purchasers be able and willing to make, and against what incentive discounts, for cooperating toward the common objective of better production-planning as a means of reducing costs?[10]

- What are the projected costs of obsolescence next year on machines now in use? and how can the owners most efficiently be idemnified and the costs most efficiently be recovered in the pricing of new machines and machine services?

- What average annual rate of R & D expenditure can be efficiently absorbed by the agricultural system during the next five years?--i.e., what economic-efficiency limits are imposed by the magnitude of potential losses from obsolescence on serviceable equipment?

- What should be the balance of R & D expenditure, over the next five-year period, as among programs oriented toward labor-saving, soil- or water-conservation or yield-improvement, machinery-cost reduction, and greater safety or convenience?[11]

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[10]One executive is quoted as saying the industry does not produce to fill signed orders but "for orders we estimate we will receive just shortly before field use." (Statement by W. A. Scholl, Executive Vice-President, Allis-Chalmers Corp., reported in Implement & Tractor, Oct. 1, 1961. Cited in 111.) Results of a survey reported in 1964 indicate that (1) the strength of a farmer's intent to buy is stronger as the time of planned purchase approaches, and (2) likelihood of actual purchase is positively related to the strength of intent to buy (178).

[11]Questions such as this, of course, have implications with regard to political choice as well as economic efficiency. In the system as it now exists, relevant decisions are made which should reflect consideration of such questions; but the questions (if directly considered at all) tend to be considered within a framework of corporate competitive strategy (including public relations) rather than of public policy.

The competitive structure of the industry appears to rule out not only questions such as those just listed, but also questions designed to reduce the magnitude of business errors (hence of waste and overcommitment of resources) attributable to imperfect knowledge, insofar as the answers might have any bearing on competitive activity as such.[12] Thus, the efficiency-promoting potential of information-gathering and planning activities, already circumscribed by the limitations of competitive business-purpose as such, is further restricted by the rules of the competitive game.

Transportation Costs and Decentralization of Production

The full-line farm-machinery companies found it necessary to centralize their operations in order to realize maximum economies of scale in production; and all of them established themselves in the North Central States because the economic center of gravity of the

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[12]At least one short-line manufacturer has complained that the Farm Equipment Institute's preoccupation with avoiding any suspicion of antitrust-law infringement "hampers it from performing or improving certain constructive services (such as) acting as a clearing house for its members price lists and collecting operating statistics direct from members rather than merely circulating Census data" (172:244).

nation's agriculture is in that region. "There has been a limited amount of decentralization, though the Midwest is still the center of (the industry's) production" (172: 250).

It seems highly probable that large savings in transportation cost could be realized if manufacturing operations for some or all types of widely-employed product types were dispersed regionally. The aggregate amount of any such savings, however, would surely be far exceeded by attendant increases in manufacturing costs, if decentralization were effected by subdividing the operations of individual companies. Another hypothetical alternative, regional division of the national market among the different full-line firms, not only doubtless would be opposed by the Antitrust Division, but appears unattractive from the companies' own viewpoint, because of higher risks related to weather conditions and other factors affecting variations in farmers' incomes.

The economies of decentralization, evidently, could best be realized by a monopolistically-organized industry.

Inventories

In discussing dealer-organization, it has already been pointed out that the aggregate inventory-burden could

be much smaller if there were only one full-line brand, sold through only one dealer network. The same principle, of course, carries all the way back through the manufacturers' finished-goods inventories (equipment and parts) to raw-materials stocks.

A further substantial opportunity for inventory cost-savings is implicit in the difficulties which individual manufacturers encounter, and the errors they make, in trying--with imperfect knowledge of the actions of other manufacturers and their dealers--to maintain adequate yet economical stocks on hand.

> The only known information covering inventories is the estimated change in inventories at the manufacturers' level. This estimate is the difference between the published data on the value of production and manufacturers' shipments. As such, it ignores the buildup of inventories at the dealer and wholesaler levels. If manufacturer and dealer inventories moved in opposite directions, this could represent a serious error.[13] In any case, it treats the dealer as a passive element in the market or, at best, assumes that his market actions follow a pattern similar to those of the farmer. . . . Shipments of machinery by manufacturers become known only as the year progresses since planned shipments may not be realized if the market demand weakens, or it may be an underestimate of actual shipments if demand is underestimated (33:37).

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[13]An industry spokesman was quoted as observing that "retail U.S. sales advanced 43 percent while factory sales advanced only 34 percent in 1966. Inventories were leaned sharply by that kind of imbalance. Most manufacturers moved into 1967 determined not to repeat the error of 1966, when inventories . . . were cleaned out" (10).

In order to minimize the risk of losing sales because of inadequate supply, manufacturers tend to carry stocks large enough to allow for considerable error; and carrying costs are consequently greater than they would be if requirements could be determined more accurately.[14]

Logically, it could be expected that a monopolistic producer, possessing more nearly perfect knowledge concerning demand and inventory situations at both plant and dealer levels, would be able to achieve significant cost savings based on better inventory control.

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[14]It should be noted also that, when substantial inventory-imbalance occurs because of cumulative estimating errors, production-cost penalties result from the changes in output-rate that are required for inventory adjustment. This is because labor-cost per unit tends to rise when extra shifts, overtime labor, or temporary additional workers are utilized, or when workers are laid off. Such penalties may in part account for the fact that Deere & Company's 1967 earnings were some 26 percent lower than those of 1966, on a 1.2 percent gain in sales (147). If, however, an industry under single management proved itself better able to moderate fluctuation in production rates, this ability might well provide a basis for additional savings based on more peaceful labor relations. On the one hand, a guaranteed-annual-wage arrangement might not appear unacceptable, as the price of labor peace, to a company which maintains a fairly stable labor force in any case. Alternatively, a profit-sharing arrangement--which would tend to be less costly to the employer than an annual-wage guarantee, except in years in which higher labor costs could most easily be supported (119)--might be more attractive to a union if offered by a company which also provides a relatively high degree of employment-security based on effective planning.

VII. THE OLIGOPOLY TRAP AND THE SPONSORSHIP OF INEFFICIENCY

In sections IV and V, major causes of agricultural inefficiency were examined, with particular attention to the dynamic influences of farm-machinery technology and economics. This section is addressed to the problem of why those influences seem to be oriented more toward increasing inefficiency than toward improving efficiency. The problem is visualized as being centered upon the oligopolistic market-structure of full-line farm-machinery manufacturing.

In orthodox academic treatment of oligopoly problems, the breaking-up of large firms into smaller ones ordinarily is conceived of as the only possible constructive alternative.[1] It is generally presumed that continuance of an existing oligopoly would be socially and economically less inefficient than its replacement by a monopoly. In this study, by contrast, it is assumed to be largely self-evident, or implicit in the argument presented, that breaking up the full-line farm-equipment

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[1]Cf., for example, Lanzilotti (94).

oligopoly would lead to even greater impairment of efficiency among farmers and in the overall national economy. The question for which an answer is sought is that of whether objectives of efficiency-improvement might be better served by the industry under a monopolistic (or analogously coordinated) market structure than within the established oligopolistic framework.

The Frustrated Impulse toward Monopoly

There are persuasive reasons for supposing that, absent governmental interference, a monopoly would fairly soon develop in the manufacture of those farm-equipment lines in which the full-line companies are dominant. Foremost among these reasons is the relationship between trends with respect to efficient operating-scale requirements and the size of the market.

> The traditional explanation of concentration change emphasizes market size and minimum efficient scale; that is, the scale of operation needed to obtain the minimum cost per unit. . . . If the scale required for efficient operations grows faster than the market, we would expect concentration to increase (151:733, testimony of Leonard W. Weiss).

> Farm machinery companies have many of the same problems that the automobile companies have--national distribution, maintenance of supply parts and service, and so on. But unlike automobile manufacturers, they

> do not have as large a mass market[2], and they are dealing with a shrinking, rather than an expanding, number of customers. They are also burdened with a greater variety of supporting machines and with a large overlay of used equipment. Much farm equipment has longer life than automobiles, and obsolescence may be a more difficult problem (153:iv).

As in the automobile industry, because of the importance of overhead, differences in cost levels among farm-machinery makers are often related to differences in production volume (115:335).[3] Conant reports that the largest plants in the industry have consistently recorded the lowest average costs per unit of output (115:335; 27:31). Among experts cited by Edwards, the concensus is that 200,000 units per year is the absolute minimum volume requirement for low unit cost in passenger-car production (41:155-64).[4] Granted that an analogous standard for tractor, combine, or corn-picker manufacture might be much lower, it appears to be an open question whether

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[2]Total 1960 domestic wheel-tractor output of 146,500 units was equivalent to only 7.8 percent of the number of Chevrolet automobiles produced in the same year (Phillips, 115:334, Table 13.4).

[3]Referring to 1967 operating results: " . . . blessed with economies of truly volume production in its basic tractor lines, Deere has easily outpaced Massey-Ferguson not only in Return on Capital but in Growth as well" (147).

[4]Whitney observes that "it is on the whole the economy of size, rather than the process of merger, which has reduced the number of passenger-car assemblers to five (as of 1958). In fact, the need for enlarging the capital base to make production more efficient has been behind every merger" (170:472).

any of the farm-machinery producers commands sufficient volume for reasonably full realization of scale economies in manufacturing alone. The range of volume bringing additional scale economies in R & D, advertising, marketing, inventory management, transportation, financing, and general administration, of course, reaches much higher.[5]

Consideration of these economic factors--along with those of barriers to entry, which Bain found "very high" in the case of tractors, and "substantial" for other large, complex machines (7:170)--leads to the question of why there has been no further reduction in the number of full-line companies since the White Motor Company's acquisitions between 1960 and 1963.[6] Although confirmatory evidence is somewhat circumstantial, it would appear that the most important explanation is to be found in the obstacles and discouragements presented by the

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[5]One indication of the relative burdens of overhead in the respective industries is found in the percentage relationships of non-production employees' payroll to production-workers' aggregate wages. In 1966, these were 42.2 percent for farm machinery and equipment manufacturers and 27.3 percent for manufacturers of motor vehicles and equipment (155).

[6]Oliver Corporation and Minneapolis-Moline, Inc., are separate full-line subsidiaries of White Motor Company. The J. I. Case Company suffered low returns in the late 1950's and large losses in the early 1960's, pursuant to which it was acquired by the Kern County Land Company (1964) and has since led a hopeful yet precarious business existence, with a particularly sharp downturn of earnings in 1967 (111; 147).

antitrust laws and related enforcement policies and investigative activities.[7]

> As an oligopolistic supplier of capital goods exclusively to agriculture, the industry attracts the attention of sincere reformers and political opportunists alike. Especially prior to 1940, public inquiries were made into virtually every aspect of the industry's operation by governments in the United States and Canada. These have been directed both at individual firms and at the industry as a whole (115: 339-40).

"To some extent," in Phillips' view, a slow, steady decline in International Harvester's market share, and its eventual replacement by Deere and Company as the largest domestic seller, might be attributed to "the company's protracted antitrust experience (which) may have caused it consciously to retrench" (115:352).[8] Both Whitney and Phillips have remarked on the great care which is taken by the Farm Equipment Institute, the

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[7]Whitney asserts that "the influence of the antitrust laws on this industry has been relatively slight," but the context of this remark indicates that it refers to such influence as would affect the general competitive behavior and economic performance of established participants (172:256).

[8]"After 1945, according to one 'highly placed official' of the (International Harvester) company, its entry into refrigeration and power equipment was partly motivated by reluctance to strengthen its position in the implement market and possibly draw antitrust attention" (172:235, citing 130:309-10). "It is notable that neither of the two top companies acquired any of the small ones which came up for sale after 1950. Thus the reduction of competition was less than it might have been" (115:354).

industry's trade association, "not to give even the appearance of violating the antitrust laws" (172:244; 115:329).

It seems evident that merger is ruled out as an approach toward monopoly or duopoly in the industry, at least for the foreseeable future.[9] The other conceivable approach, that of Darwinian competitive struggle to the death, seems equally unlikely, for two general reasons:

- None of the smaller full-line firms possesses resources sufficient to justify any hope of achieving success by an attempt to force competitors to abandon the business.

- Every full-line firm, on the other hand, has such a heavy commitment (overcommitment, probably) of fixed resources, more or less specialized in the farm-machinery business, that it can be expected to resist strenuously any attempt to force its liquidation or conversion. Because each company has so much to lose, that is, it cannot afford to give up. Therefore, an attempt to expel other companies by competitive means would be too costly, even for such a leader as Deere & Company (which has done well enough, ordinarily, without making such an effort).

The following significant inferences may be drawn at this point:

- The full-line farm-machinery industry is, practically speaking, prevented from (1) reorganizing

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[9]Markham wrote in 1963 that "antitrust policy has been greatly strengthened in recent years, especially antimerger policy" (102). Bringing the situation up to date, Attorney General Ramsey Clark reported in August, 1968, that a record number of suits challenging business mergers were filed by the Justice Department in fiscal 1968 (20).

itself into a single-management structure, or (2) otherwise establishing a high degree of industry-wide managerial coordination.

. This being the case, each company in the industry is compelled to compete as best it can in an oligopolistic milieu, which is shaped by governmental policy, consonant competitor-behavior, and the economic characteristics of the market.

Affirmative Implications of Oligopolistic Market Power

If the farm-machinery industry is obliged to function within an oligopolistic framework, it is quite natural for its participants to take full advantage of the market power conferred upon them by that framework. The nature and degree of market power may be said to consist in a set of relationships between the situation and characteristics of a supplier group and those of a buyer group. Based on this definition, it is ventured here that probably no other American industry supplying durable producers' goods possesses market power comparable with that of the full-line farm-equipment makers.[10]

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[10]As Lanzilotti has observed, "The structural features of agriculture, i.e., the size distribution of farms, level of managerial skill, exit barriers, demand-supply elasticities, etc., are conducive to an inferior bargaining position for farmers vis-a-vis both buyers and suppliers. This structural inferiority means that under short-run price fluctuations during the crop year the farmer is not in a position to engage in the well-ordered marketing . . . typical of large manufacturers

The essence of market power, as conceived of in this study, is the ability to control as "decision variables" (33:36) factors which are essentially "market variables" in a more purely competitive environment. To an extraordinary degree, for an industry that supplies producers' goods, the farm-machinery makers appear to be in a position to treat as decision variables the following factors:

- The rate, direction, and cost of change in product technology.
- Product-differentiation (115:328-30, 331, 345; 172:251).
- Price- and service-discrimination, based on market separation.[11]

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and processors. Also, much as farmers would like to, they are unable to escalate cost increases forward in the administrative fashion of manufacturing industries. A price universe with such a cleavage inevitably produces inequities, with the flexible price sector bearing the brunt of the price disparity . . . The structural superiority and market power of food processors and agricultural supply firms constitute an aggravating influence to adjustments in prices and incomes in agriculture (94).

[11]Exercise of this capability has been discussed under the heading, "Biased tendencies in machinery and parts pricing" (Sec. V). Theoretically, it is a capability attributed to monopolistic power, and is conditioned on (1) the ability to keep two or more markets separate from each other, and (2) differences in demand elasticities among the different markets (96:197-8). Both conditions appear to be satisfied in this case (the former condition by differences in product-specifications). It would appear that oligopolists can exercise the equivalent of monopolistic power in any matter in which they can arrive at agreement based on common interest, and can devise or develop practical means of cooperating to implement such agreement.

. Price adjustment, as related to demand-fluctuation and to prices of competitors' products (115: 339-46; 172:252; 33:30-36).

Significantly, the industry's market power weighs much more oppressively on the weaker, generally smaller and undercommitted, than on the stronger, in many cases overcommitted, farm operators. In turn, it seems not unlikely that a study of differences in the industry's conduct in the farm-machinery market, as compared with its behavior in the industrial-equipment market also served by it, would disclose that users of the industrial products are in a less unfavorable market position than most of the stronger farm operators.[12] If such is the case, it lends some support to the view that farmers are more vulnerable to exploitation than any other class of

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[12]The following reported remarks by an International Harvester official, to the 1967 National Farm & Power Equipment Dealers Association convention, may be indicative: "There are distinct differences between the customers in industrial and agricultural markets. The industrial salesman must be the type of person who can call on purchasing agents in large manufacturing companies. He needs to have intimate knowledge of contractors' problems and should be a member of their associations in the community. He needs to keep track of the going labor rate in your area and the productivity cost (sic) of your equipment in replacing hand labor, if he is to serve the real needs of his customers." Dealers were urged not to overlook the opportunities in rental and leasing of tractors and equipment for the industrial market. The further observation was made that in some areas 50 percent of the larger equipment is rented, and that this is an increasing trend (74).

durable-goods users.[13]

It is not asserted here that the market power exercised under the industry's existing structure is greater than that which an unrestrained monopoly would possess. A hypothetical judgment on that issue would be somewhat beside the point, in any case. If the alternative were conceived to be one of unrestrained monopoly, it would be relevant to consider whether its exercise of market power would be more exploitative, or less so, than that of the present oligopoly. The fact that a monopoly would not have to engage in competitive struggle for desired market and profit shares, or for economic survival, suggests that it would be under much less compulsion to behave exploitatively with respect to its market, hence that much of its power might go unused.

This proposition would seem rather persuasive even if it were assumed a monopolized industry would operate under no public restraint. Such an assumption,

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[13]According to E. B. Weiss, "Consumer exploitation has been replacing labor exploitation as the real problem of our times. We would not permit the things to be done to people as workers that we allow to be done to them as shoppers!"(167). In significant respects, farm-machine services appear to be developed and merchandised as luxury goods for a consumer market rather than as productive inputs for an industry (Cf. 101). The Kennedy Administration's initiatives in consumerism awakened a broad public concern about the consumer's plight, but few people seem to have noticed the fact that the user of farm equipment may have his economic independence at stake.

however, seems altogether unrealistic. The nature of a recommended alternative assumption will be made clear in the discussion that follows.

Limitations on Market Power--Exemption from Responsibility

In projecting the wider social and economic consequences of oligopolistic market structure in an industry, it is useful to keep in mind the familiar saying, "When everyone is responsible, no one is responsible." Contrariwise, whether or not the point is enforced in any practical way, there is probably quite general awareness, when a monopoly misbehaves, that it is the monopolist who is responsible. Responsibility is a personal attribute; and the legal concept of corporate personality helps to maintain this element of order in the world of economic affairs. An industry, however, while it does have structure, does not have personality; and a company which is only a part of that structure cannot be responsible for the consequences of that structure as a whole.

It is proposed to assume a quite flexible model of the monopolistic enterprise which conceivably could supplant the full-line farm-equipment oligopoly. One characteristic of this model, however, is regarded as both indispensable and inevitable: the monopolist is not

unrestrained. This should follow logically from the fact that the monopoly will be regarded as responsible for consequences of the actions it takes--and even, with not too long a jump in reasoning, for some of those it fails to take. (The dividing line is necessarily somewhat arbitrary.) Responsibility for negligence implies that restraints may be coupled with constraints--positive obligations to do certain socially necessary or desirable things because ample power to do them is present, and because power carries with it socially definable responsibilities.

The minimum restraint which can reasonably be assumed is that of the force of public opinion. Obviously, if this is not matched by sufficient practical awareness of the monopoly's responsibilities, in the minds of those who wield its power, public opinion is likely to become more articulate and forceful as it is given voice by individuals such as plaintiffs, reporters, economists, judges, bureaucrats, and senatorial investigators. Eventually, if a well-behaved monopoly such as the United Shoe Machinery Corporation[14] ceases behaving acceptably, it

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[14]The economic relationship between the United Shoe Machinery Corporation and its customers, and the manner in which the customers' needs are served (reportedly to their virtually unanimous satisfaction) afford a number of instructive parallels suggestive of directions which efficiency-oriented change in the farm-machinery industry might take. Cf. Whitney (171).

may well become a more-or-less thoroughly regulated business (the equivalent of a public utility), may be broken up[15], or may be replaced by a publicly-owned enterprise.[16] Possibilities such as these are a part of the everyday consciousness of executives in monopolistic firms, and presumably are taken fully into account in their decision-making processes.

The behavior of a company which forms part of an oligopoly, on the other hand, is unlikely to be subjected to any comparable restraint--much less constraint--because the oligopolist's power is assumed to be much more limited. The limitations to which this assumption generally refers are those concerning the degree of control

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[15]Galbraith quotes Kaysen and Turner's statement that "the primary goal of antitrust policy (is) the limitation of undue economic power to the extent consistent with maintaining desirable levels of economic performance" (88:44-5). Commenting, Galbraith points out that "this, of course, implies that higher levels of market power are associated with higher levels of economic performance. Market power, in other words, is socially efficient" (64:185, footnote).

[16]In Donald Dewey's view, "Without the discipline of antitrust, we can safely predict that many large corporations will grow even larger, and that they will come to look like monopolies, however much their power over price is actually limited by the existence of substitute products, imports from abroad, and the ambitions of troublesome small rivals. The history of American politics provides every assurance that legislation will sooner or later convert such giants into regulated public utilities. The experience of other countries indicates that the step from regulated public utility to public ownership is a short and obvious one" (35).

exercised over output, prices, and profits; and, for an industry in which control over changes in technology is of major importance, there may be a general readiness to agree on considering the oligopolist's power more limited in this regard also.

A value-judgment, however, that an oligopolist's behavior in a particular industry will likely be more acceptable than that of a monopolist, can hardly be justified on the foregoing premise alone. Some effort, at least should be made (1) to identify and evaluate any additional respects in which an oligopolist may possess less power than a monopolist, (2) to determine whether the presumed advantages of certain power-limitations may be qualified or even outweighed by probable disadvantages, and (3) to weigh the foreseeable advantages against the foreseeable disadvantages.

In the broadest view, the superiority of the monopolist's market power, as compared with the power of an oligopolist, consists in the ability to integrate an industry horizontally. From this power, which confers a high degree of ability to coordinate a market vertically, all of the other superior market-advantages of the monopolist are eventually derived.

Antecedent to the monopolist's superior power over output, prices, and profits, are superior capabilities for (1) controlling costs, i.e. minimizing costs

within the entire industry, for given outputs, and (2) planning and executing business strategies. Of these two categories of capability--which are of course highly complementary--the first has already been treated at some length, as it might apply to the farm-machinery industry.[17] Here it is apposite that, since profits are a function of costs, prices, and output (or sales, which correspond fairly closely with output in a highly concentrated industry), direct comparisons of profit levels or profitability rates are likely to tell little if anything about whether monopoly or oligopoly is socially more efficient.[18]

If the possible influence of public opinion is disregarded, prices and output--under either monopoly or oligopoly--may be said to reflect decisions of business strategy as fundamentally oriented toward profit-maximization and as conditioned by the market. But, since the market is much more highly coordinated under a monopoly, the monopolist's control over prices and output is much greater--much less conditioned by the external market environment--than that of the oligopolist. The prevailing

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[17]Refer to Section VI.

[18]Referring to the monopolistic United Shoe Machinery Corporation, Whitney declares "Certainly United's operating cost is more important to its customers than its profit margin, since the latter has recently been only one-fifth of the former" (171:143).

academic inference is that, ceteris paribus, output will be lower and prices and profits higher under a monopoly than under an oligopoly.

The ceteris paribus assumption, although admirably adapted to the method of comparative statics, is unacceptably unrealistic where the problem addressed is that of how the dynamics of efficiency and growth in one industry are affected by the dynamics of market power in another. Alternatives cannot be meaningfully compared if their most significant differences are assumed away. Differences with regard to powers of horizontal and vertical coordination beget not only differences as to the degree but also differences as to the purposes of control actually exercised over output, prices, and other decision variables. It is arguable that these differences as to purpose may be more significant than differences as to degree of control.

The purposes of an oligopolistic firm are, in general, constrained to serve a strategy that is oriented toward economic survival or growth through competitive rivalry with other oligopolists in the exploitation of market opportunities. Such a strategy, by definition, tends to be more short-range, opportunistic, and exploitative, as compared with the strategy of a rational monopolist. The monopolist can maximize profits in the long run by foregoing some short-run exploitative opportunities

and by investing time and money in the cultivation of all segments of his market. The oligopolist cannot afford to wait and accept the risk that any abstention from potential short-range self-aggrandizement on his part will be exploited to the advantage of his rivals.

A priori, it does seem highly probable that farm-machinery output (on an average annual basis, but not necessarily in every year) would be lower if the industry were a monopoly than if it remained an oligopoly. In line with the argument sketched in the preceding paragraph, however, this probably would reflect more-efficient rather than less-efficient use of resources. Relevant premises are that (1) farmers in the aggregate tend to overcommit; (2) overcommitment impairs aggregate agricultural profitability and hence the capacity of agriculture for balanced economic growth; and (3) restraints on and imbalance in agricultural business growth inhibit the optimal development of steady future demand for evolving farm-machine technology. On these premises it would seem consistent both with efficient resource-use and with sound long-range business planning for an integrated farm-machinery industry to restrict output to levels required to maintain an adequate but qualitatively improving machine-service capability. In an oligopolistic industry, on the other hand, imperatives of the struggle over relative market positions virtually compel each firm to increase

its sales (output) by all available and generally-accepted means--i.e., as far as possible to prevail on farmers to take long forward positions on fixed investment in machinery.

Similar considerations afford a basis for suggesting that a monopolistic farm-equipment industry seems more likely than an oligopolistic one to administer prices in such a way as to encourage economic efficiency and broadly-based growth in the market for machine services.[19] A coordinated pricing strategy committed to long-range

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[19]In his decision in the United Shoe Machinery Corporation case, Judge Wyzanski observed that "Under the system, entry into shoe manufacture has been easy. The rates charged for all customers have been uniform. . . . United has, without charge, promptly and efficiently supplied repair service and many other kinds of service. The cost to the average shoe manufacturer of its machines and services supplied to him has been less than 2 percent of the wholesale price of his shoes" (180 F. Supp. at 340, quoted 171:139). Whitney explains that ease of entry resulted from the facts that no large cash outlay to buy machines is needed, and the royalty per shoe produced is no higher for a small than for a large manufacturer. But, "had there been competition in shoe machinery, discounts would probably have been offered to the larger customers, who would thus have obtained an advantage over smaller competitors" (171:139-40). Further, "The gross income of United may be compared with the factory value of all shoes produced in the United States. In the first years for which both series are available, 1934-38, United's gross income was 9 or 10 percent of factory value; for the next 6 years it was 6 or 7 percent; and since 1945 it has been only 4 or 5 percent . . . During the 25 years period 1925-49, United's average return of 10 percent on invested capital was approximately equal to the return of 72 other producers of durable equipment" (110 F. Supp. at 325, quoted 171:140).

profit maximization might be reflected in a balance between discouragement of overcommitment and encouragement of adjustments to correct undercommitment. The monopolist's capability of pursuing such a strategy, without unacceptable heavy sacrifice of short-range profitability, would be indirectly but importantly enhanced to the extent that cost-reductions could be achieved through integration and improved coordination.

By contrast, the oligopolist appears competitively driven toward either or both of (1) short-range profit-maximization, supported by product-differentiation as a partial defense against the varying pressures of price competition, and (2) conditional pricing-restraint as an adjunct to the tactical pursuit or defense of market-share objectives. The role of pricing strategy, however, may be overshadowed by that of costs. In an oligopolistically-organized industry in which the prospective benefits of crushing one member seem smaller than the probable cost, the price at which the least efficient firm can survive may in effect constitute a floor, supporting the profitability of other members at higher rates dependent upon their different levels of cost-efficiency and product- and service-differentiation.

Regardless of any evaluation of the consequences of limitation on the oligopolist's market power, however, the fact remains as stated before, that relatively little

social restraint is imposed upon the exercise of the power he has. Since he lacks the power required to control behavior of the industry in the aggregate, obviously he cannot be considered responsible for it. Moreover, since his conduct is presumed by and large to reflect the pursuit of legitimate self-interest within a competitive environment, he is substantially exempted from responsibility for the effects of his own contribution to the industry's total performance. Competitive behavior is cloaked in a mantle of presumed virtue--and limitations on the power to perform well become, in effect, the basis of an unrestricted license to perform poorly.

Motivation for Alliance with Inefficiency

In order to explain why the oligopolist uses his limited but socially unrestrained and non-accountable market power in the way he does, it is possible to interpret his motivational structure in terms of rational imperatives underlying a tolerable adjustment between his limited-power status and the threats and opportunities of his environment. Following is a comparative catalog of motivational characteristics which, it is proposed, distinguish the oligopolist from the monopolist (see page 136).

THE OLIGOPOLIST	THE MONOPOLIST
Leads from weakness	Leads from strength
Has some power <u>in</u> the market	Has power <u>over</u> the market
. must think in terms of market opportunity	. can think in terms of market development
Power constantly challenged by rivals	Power unchallenged
. must compete with them for support by the strongest economic allies to be found within the market (Allies' aims become his, so also their values, victims, vested interests)	. needs make no deals, curry no favor, cater to no special interest
Long-range future lies over the horizon, if anywhere	Long-range future grows out of the present
. present action dictated by present needs, threats, opportunities	. present action consistent with long-range needs, dangers, opportunities
Technology: a tool for contriving, cultivating and exploiting short-range opportunities; a selling point; a sales accelerator	Technology: a tool for building from the present toward the future; a source of important economies if properly managed
Farmer: a man who is able and willing to invest in machinery	Farmer: a man who uses machine services in agriculture
Small Farmer: a market for second-hand machinery; an inefficient loser	Small Farmer: another user of machine services

Implicitly, the oligopolist's motivational structure has a strong bias toward overcommitment; and the

only way to escape the penalties of overcommitment is to acquire a larger market for the company's products. As all firms in the industry share this bias, and because it is cumulative in tendency, pressure builds up on all sides to move products into the market at a faster rate. The farm market as a whole, however, appears already substantially overcommitted in farm machinery.

The machinery-manufacturer--oligopolist or monopolist--may be presumed to be aware that the market has both overcommitted and undercommitted segments, and that these two segments display significantly inter-related tendencies toward disequilibrium. Further overcommitment in the overcommitted segment is facilitated and encouraged by deeper undercommitment in the undercommitted segment; and the latter tendency is exacerbated by the former.

This farm-market situation, of course, is largely if not entirely explainable in terms of market imperfections--imperfect knowledge, product differentiation, resource-lumpiness and -fixity, biased influence of governmental and corporate policies, differences in resource-endowment and market power, etc.

The manufacturer is confronted with three major alternatives:

. To pursue a strategy of promoting efficiency by reducing market imperfections and otherwise opposing the dual tendencies toward overcommitment and undercommitment.

- To follow a neutral or passive course as between opposing and encouraging inefficiency.
- To align the firm's strategy with the inefficiency-promoting forces of disequilibrium and seek to exploit them for competitive advantage by cultivating market-imperfections that give rise to them.

Whether or not there is validity in the earlier suggestion that a monopolist might be naturally disposed to choose the first of these alternatives, it is significant that he would be in a far better position to consider it--i.e., would have far more to gain and less to lose by it, as well as far greater power to execute it successfully--than would the oligopolist. Realistically speaking, it seems the oligopolistic concern must opt for the third alternative, the dynamics of which are in harmony with the firm's power-limitations, economic necessities, and time-frame.

One way of verifying whether the full-line companies are significantly motivated along the lines postulated here is to examine their public attitudes and their overt behavior. Pertinent observations contained in the following paragraphs are supplemental to others, scattered among earlier portions of the study, which have a bearing on this question but will not be reiterated.

Various sources have noted that the trend toward larger farms is associated with increasing sales potential for farm machinery (135:M-9; 46:19). Faris reports

that sellers of farm supplies (including farm machinery) concentrate their efforts, and their price concessions, on the larger operators; and he foresees a growing trend in that direction (43).

Published writings about Deere & Company, and by its spokesmen, suggest that the firm follows a deliberate policy of market-segmentation, concentrating its efforts and resources intensively on the wants of relatively large farming customers (124:118; 53). One spokesman has advocated a pattern of farm-firm growth at a "rapid pace" and by "violent changes" (89:1549).

Some agricultural economists have called for measures to relieve the distress or to promote satisfactory adjustment of farmers who are disadvantaged by the rate and direction of technological change (127; 98). A Deere & Company representative takes issue with one such recommendation, characterizing it as a proposal "by legislating subsidies and special advantages to certain farm groups, which would be most difficult to distinguish, to forsake more of the market economy in order to save some questionable traditional forms" (90).

Although the following quotation is not from an industry source, it appears possible that it reflects an industry point of view.

> Smaller farms, including many part-time farms, provide a market for some new equipment, especially in small sizes. More importantly, these farms provide

> an outlet for used machinery. Since the number of small farms is shrinking rapidly, there is some concern about the future market for used machines" (138: 14).[20]

Agricultural economists have suggested also, in view of farmers' inability to agree on effective collective action, that the entry of resources into agriculture needs to be restricted by some external agency or authority (83:23-4, 27-9; 125; 143). Johnson declares, however, that "suppliers are unlikely to perform this function well as they simply do not have incentives to control the overcommitment unless they become owners of the agricultural producing firms" (83:28). The following words of a full-line company official[21] appear implicitly to lend some support to this view:

> (Machinery marketers) must accelerate the pace of acceptance by farmers. In face of the onrushing tide of population, the customary lag of 3 to 5 years from "early adopter" to general use must be cut to a year or two, at most (116).[22]

Many farm leaders are said to agree that farmers need increasing amounts of educational and service help (109:81-2); and research results indicate such help brings

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[20]Abrahamsen, however--presumably with the dynamics of the farm-enlargement process clearly in mind--envisions "a new set of marginal farmers appearing as soon as the present ones disappear" (1:1183).

[21]W. L. Pringle, Vice-President-Marketing, Minneapolis-Moline, Inc.

[22]Refer also to quoted statement by a Massey-Ferguson official, p. 10.

impressive improvement of managerial effectiveness (109: 8-14, Appendix Table 1; 110:25-36). Insofar as such help relates to selection and use of commercial products, it should be possible for suppliers to provide it efficiently as a marketing service, involving special requirements of objectivity, precision, expertise, and impartiality (40; 117).[23] Farm-machinery industry leaders have voiced strong support for this principle[24]; but it would appear to receive somewhat limited application in the farm-machinery business. "Competitors point out that particular farm implements are too highly differentiated as among sellers to permit exact comparisons of prices" (172:251)--

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[23]Producers of agricultural chemicals, feeds, and seeds have developed marketing programs along the lines of W. R. Grace & Company's "full service selling concept," under which the crop-growing program embraces advice and assistance commencing with soil tests and ending with storing and marketing the crop (66).

[24]Merrit Hill (then Vice-President, Ford Motor Company) in 1961 suggested an analogy between the farmer's position and that of his own company when purchasing equipment for its manufacturing operations: ". . . We have little use for the . . . salesman who merely claims his equipment is as good as or better than anyone else's, and who then quotes us a price or offers us a 'deal'. The men we respect are those who analyze our operations, recommend to us the equipment we need to solve our problems, prove to us that such equipment will perform the way they claim it will, and finally convince us that we can make more money through the ownership of that equipment than we could do without it" (77). J. G. Staiger (Group Vice-President, Farm Machinery, Massey-Ferguson Ltd.)., referring to the marketing role of farm-machinery suppliers in developing countries, said, "We must reverse the traditional adage and apply the principle of caveat vendor" (133).

or, implicitly, of values. Also, as suggested previously[25], the farmer's inferior market-power status apparently commands less educational and service effort than is required for selling in the industrial equipment market.

A 1965 study of commercial farmers' machinery-buying habits identified brand of equipment as the leading determinant of place of purchase (11). Tendencies found with respect to brand preference in an earlier study (92) appear to have rather limited relationship with rational, objectively and fully informed product-selection.[26] These patterns of farmer-behavior evidently reflect the influence of manufacturers' product- and service-differentiation efforts. According to Phillips, cooperation toward standardization of certain common components and design features[27] since World War II

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[25]Footnote 12, page 124, is again apposite.

[26]These tendencies were as follows: (1) As income of a farmer having low brand-preference increased, his brand-preference tended to rise; (2) younger and less-experienced farmers tended to have greater brand-preference than older and more experienced ones; (3) as a farmer's exposure to radio, television, and printed publications rose, his brand preferences tended to increase; and (4) farmers who placed higher estimates on the differences among available dealers tended to have higher brand preferences.

[27]Impetus toward standardization efforts, nowadays promoted by the American Society of Agricultural Engineers and the Farm Equipment Institute, is said to have been given by "the spread in the use of the power-take-off after 1924, the gradually increasing level of technical sophistication among buyers, and the pressure of official investigation by such public bodies as the FTC in the 1930's" (115:329).

> has been accompanied by a resurgence of competition in those aspects of product design not affected by the standardization measures. Complaints, in fact, have frequently been heard that the process of differentiation has been carried to excess and has the effect of simply impeding price competition rather than contributing genuinely to farm productivity (115: 329).[28]

Referring again to overcommitment of purchased farm inputs, Johnson suggests that "one would expect overuse to be curtailed mainly by structural changes that would make contractors and vertical integrators financially responsible for the losses associated with overuse" (83:24). The introduction of comprehensive, flexible plans for leasing or contract services of farm machines owned by manufacturers is a possible form of vertical integration that could make the manufacturers financially responsible for losses attributable both to overcommitment and to obsolescence.[29] As of 1958, however, according to Phillips, leading manufacturers were generally opposed to the rental idea.[30]

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[28]Phillips hedges this observation to some extent by adding that "while doubtless many of the so-called improvements are of the 'frill' variety (and thus expendable), the complaint has only a restricted validity" (115:329).

[29]Cf. Abrahamsen (1:1184).

[30]The National Retail Farm Equipment Association in 1958 supported the principle of renting by dealers, but took the position that from the dealer's standpoint it should be limited to used and reconditioned rather than new equipment (114:1180).

> All have made provision for adapting their agreements currently used in renting industrial machinery to farm equipment, and stand ready to do so if competitive conditions make it necessary. . . . But each of the leading companies claims that it will not be the first one to make such a move. . . . While company-supported renting by dealers is by no means imminent . . . in any tight market situation . . . a temptation will be present for companies to move extra machines into the hands of dealers for rental purposes under some form of accelerated payment plan.[31] . . . The competitive aspects of such a possibility are interesting, since this is a situation where the gains, though probably short-lived, would accrue to the company which made the move first (114:1180-81).[32]

The Forbidden Competitive Motive

The foregoing discussion of oligopolistic motivation would doubtless be grossly inaccurate if it referred to oligopolists free to engage in any economically rational and efficient form of competitive behavior. When oligopolists are forbidden to merge, the prospect regarding possible gains from competitive conduct is modified so fundamentally as to transform their very concept of competition, hence, the major outlines of their competitive behavior.

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[31]Abrahamsen concurs: "Indications are that interest in rentals will closely reflect the extent of machinery sales and economic conditions in the industry" (1:1185).

[32]The situation as it appears to exist as of this writing is discussed under "Availability of Hired-Machinery Services," Section V.

> There is an interaction between structure and behavior which . . . has two characteristics (that) seem to be almost totally unperceived and unanalyzed:
>
> . The interaction is continuous. Thus, behavior alters structure, the altered structure affects behavior, the changed behavior in the altered structure in turn realters structure, and so on indefinitely . . .
>
> . Structural changes are a form of competitive behavior. It is customary to think of structure in a given industry in static terms, and thus as different from ordinary market decisions. But in terms of internal, economic motivation . . . they are quite similar. Structural moves are products of competitive forces just as clearly as, say, price changes or product improvements.
>
> . . . Whenever competitive behavior inducing structural change is artificially restrained, all other competitive behavior in the industry is adversely affected (104).

If it be accepted that competitive behavior basically consists in the vigorous exploitation of economic opportunities within the firm's practical reach, the farm-machinery manufacturer's behavior may be explained as the result of his having rationally eliminated all but the last of the following alternative major lines of strategy:

. If competitors are weak, force them out.

. "If you can't lick 'em, join 'em."

. If you can't lick them or join them, don't really fight with them. If you can't afford to fight your competitors, effect a mildly competitive collaboration with them in exploiting situations of short-range opportunity in the market-place--i.e., if horizontal struggle would bring only pain, concentrate on using the vertical market power you have.

Exploitation of opportunities in the farm-machinery market, this study concludes, has consisted in making economic alliances with tendencies toward inefficiency. Considering, however, that the oligopolist does not remain an oligopolist by choice--and that he is only one of a group of competing oligopolists, whatever that may mean in practice--it would be wrong to indict him for sponsoring inefficiency. That responsibility resides in the public policy which asserts that competitive structure *per se* is more important than economic efficiency.

The adverse consequences of that policy, like those which result in air and stream pollution, are of course unintended.

VIII. INHERENT LIMITATIONS OF OVERCOMMITMENT STRATEGY

In Section VII the farm-machinery industry's oligopolistic structure was discussed in terms which might seem to suggest that--because merger is forbidden, and other deliberate forms of competitive elimination are too costly--the structure is immutable. Such an inference, however, cannot be seriously entertained unless companies operating within the oligopolistic framework can maintain viable adjustment to their changing economic environment

The key to satisfactory adjustment is strategic adaptation. This section and that which follows will discuss some reasons for anticipating that sooner or later the prevailing market strategy will prove non-viable, and, because adaptive capability appears to be limited by the oligopolistically competitive situation, that some firms will be eliminated. In the long run, legal sanctions cannot assure the preservation of a structure which is not economically viable.

The individual farm-machinery-maker has little power to influence the long-range consequences of

industry-wide strategy. It is therefore rational for him to try to protect or enhance his competitive position, upon which will depend his relative ability to deal with any long-range eventualities. Hence, long-range strategy tends to consist of short-range strategy projected indefinitely into the future. If there is a fundamental inconsistency between the industry's consequent behavior and the requirements for long-range viability of its present structure, none of the companies is in a position to do much about it.

The strategy of promoting farmer-overcommitment has certain inherent limitations which suggest that eventually it will prove self-defeating if pursued long and single-mindedly enough:

- Slow growth of food demand.
- Diminishing returns on the results of labor-substituting technology.
- Developments in competing technologies.
- Countervailing power of major agricultural enterprises.
- Potential increase of efficiency in the use of existing machinery.

Slow Growth of Food Demand

The uncertainty of relationships between long-range worldwide food needs and long-range export demand

for U.S. food output has been discussed in the first section. There is much less uncertainty with respect to domestic trends and prospects in food demand. Here the outlook may be summarized as follows:

- The growth of food demand is more closely related to population growth than to the significantly faster growth of national income. As personal incomes increase, a diminishing share of the total is spent for food products in the aggregate.

- As incomes rise, the allocation of total expenditures for food favors livestock products, fruits and perishable vegetables. Demand growth is slowest for those products--food grains and other vegetable staples--the cultivation of which requires the mass-produced kinds of machinery that full-line companies have found it most advantageous to manufacture.

There are basically three sources of demand for new machinery--growth of demand for products for which machinery is required, need for replacement of worn-out machinery, and desire to exploit the economic (and other) advantages of improved equipment. Obviously, if food demand were to grow rapidly, the effects upon machinery demand would be registered not only through farmers who wish to add to their stock of equipment but also through those whose equipment has significantly deteriorated, as well as those who are prepared to capitalize on the latest technological improvements. If, on the other hand, growth in food demand is slow, technological improvement constitutes the only available basis for a relatively strong rate of increase in machinery demand.

Where, however, the main thrust of technological development is oriented toward increasing the individual farmer's productive capacity--as it has been to a very large extent--it appears possible that negative effects on the MVP's of new-machinery expenditures eventually will predominate. If enough farmers buy the new equipment to make its development and production profitable to the manufacturers, farm output is likely to grow faster than farm-product demand (which as already discussed is inelastic). This would precipitate a drop in aggregate gross farm income (except to the extent that prices may be supported) and a much sharper decline in net farming income. Whether the individual farmer's MVP of new-machinery expenditure also declines will depend on whether the revenue-reducing effects of lower product prices, and the incremental fixed costs of substituting more-expensive new equipment for less-expensive older equipment, are sufficiently offset by the increase of output capacity and the potential savings in variable cost.

Here it is relevant to consider what general characteristics might reasonably be attributed to those farm operators, as a group, who consistently constitute the principal market for larger and more expensive new machines--i.e., the growth-market for farm machinery:

. They have relatively heavy investment in machinery and other fixed assets--implying that a

considerable share of any accounted profit is required to cover returns on investment.

- They are more dependent upon relatively well-paid hired labor than other farmers, and therefore can less readily absorb lower returns to labor.

- The used machines which they would consider trading for new ones are in general more up-to-date and of higher capacity than those owned by other farmers. This implies that at any given point of time the average farmer in this group stands to gain less from a trade, in terms of improved variable-cost efficiency and increased capacity, than would the average farmer outside the group, upon acquisition of identical new machines.[1]

- Many of these farmers are more or less habitually overcommitted to expensive fixed inputs, their profitability depending more upon high-volume market leverage than upon economic efficiency as such. These operators are susceptible to especially adverse effects from product-price declines.

Insofar as these generalizations are valid, the industry's efforts to maintain an upward sales trend, at profitable selling prices, may be considered exceptionally vulnerable to a general recession of farm prices. Therefore, to the extent that a rising trend of machinery sales depends upon increasing farmers' productive capacity faster than the growth of farm-product demand, it evidently cannot be maintained indefinitely.

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[1]It has been argued in Section IV that farmers who trade early and often are intent upon avoiding costs of future obsolescence and physical depreciation.

Diminishing Returns on the Results of Labor-Substituting Technology

A major aspect of technological change, as it impinges upon agriculture, is the manner in which it modifies productive resources, production relationships, and production organization.

The major emphasis of farm-machinery technology upon labor substitution has contributed very materially to the continuing trends toward larger equipment, faster and more powerful tractors, larger and more specialized farms. The discussion which follows is addressed to the problem of diminishing returns relative to these developments.

There are a number of reasons for expecting that, sooner or later, labor-substitution will prove to have exhausted its usefulness as a profitable basis for technological change in American agriculture. The ultimate reason, of course, would be that the substitution process had exhausted its supply of expendable raw material, i.e. replaceable farm labor (33:26). Eventually some minimum force of workers will have to be retained in farming operations, even if they are exclusively managers, mechanics, and technicians. Doubtless this is still a remote prospect; and it is probably more realistic to expect that the labor-displacement effort will be largely

abandoned substantially short of that extreme, essentially because it will no longer pay for itself.

It is perhaps not premature to question whether the farm-machinery industry will find it economically feasible to participate in the latter stages of the labor-replacement era. As implied in subsequent discussion with reference to machinery-substituting technology, it is possible to foresee increasingly keen inter-industry competition based on technological rivalry for dominance in the market for farm inputs. Should this condition arise, enormous pressures doubtless would build up in the farm-machinery industry, directed toward achieving all possible efficiencies in its internal organization and operations and toward maximizing the value of its services to as many farm operators as possible.

At such a time, if indeed not sooner, the industry would no doubt conduct a vigorous reappraisal of the giant-tractor concept as the cutting edge of its strategy for claiming a growing share of the farmer's income (61; 80). Some of the problems pointing toward future diminishing returns on the technology of increasing machine-sizes are not hard to identify.[2]

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[2]It is not asserted that diminishing returns are already in evidence. Nevertheless, there is some evidence that the sales trend toward larger tractor sizes may have begun to lose momentum. In 1967, against the background of a 5.5 percent drop in total wheeled-tractor

- As equipment is made larger there are increasing problems of soil compaction associated with heavier weight (144).

- Increasing weight, furthermore, reduces efficiency by using up engine power needed for doing work (149).

- Conversely, as draft-loads become heavier, there is a need for increased weight as an aid in overcoming growing problems of efficiency-loss through slippage (140:95, 167).

- The objective of increasing tractor-sizes is to increase power. This necessitates further improvement of power controls (80).

- Use of greater power is associated with combining operations formerly executed separately, and performing them at higher rates of speed. These factors necessitate the elaboration of numerous complex mechanisms to aid the operator in properly controlling those operations themselves (80).

- "A larger machine may reasonably be expected to have a greater effective capacity, but it will have a lower field efficiency than a smaller machine" (8:349; 140:166; 159:6).

- Decline in field efficiency, together with increased capital investment and larger work-requirements per unit as machine-size increases, "will create a financial pressure for a guaranteed performance in work capacity and reliability" (174; 149; 105).

- Assuming that a rapid rate of technical progress will continue to affect the economic operating life of farm machines, this too will strengthen owners' demands for higher reliability (174).

- Projecting another trend: "Capital limitations will encourage the expansion of rent and leasing plans for farm machinery; and this in turn will

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retail-unit sales, sales of 70-79 horsepower units increased 52 percent, "due to the introduction of many new models" (146) compared to a 28 percent gain on units of 100 horsepower and over, and declines in the intermediate size groups.

develop new pressures for machine reliability," accentuated by lack of direct ownership, which in turn will encourage harder use (174).

- Hence, even though there is no reason to doubt that technically optimum solutions always are feasible, it seems logical to expect in general that, as horsepower ceilings are raised, the favorable margin between rising effective capacity and rising cost will diminish and ultimately disappear. Solutions that are feasible technically may not be feasible economically (103).

- Further, increasing machine-size is associated with increasing farm-unit land requirements (83: 10). "Greater demand for land has led to higher prices of land. This is an indirect cost of owning larger machines" (162:341).

- To the extent that the increase of machine-sizes becomes associated also with employment of hired operators rather than family labor, it is to be expected that upward pressure on labor costs per man-hour will increase markedly (75). "Increased social and economic pressures to increase wages to hired workers are expected, and wages are expected to rise a full 75 percent (5 percent a year) or more by 1980" (141:13).

- Yet another penalty attached to investment in ever-larger and more expensive equipment is progressive loss of the flexibility farmers need for adjusting to changing economic conditions without incurring heavy depreciation and obsolescence costs (129:395).

Another trend which has arisen in response to the need for extracting maximum service from the costly instruments of labor-saving technology is that toward enterprise specialization. "One of the disadvantages of specialization is that work may not be provided for all seasons and periods of the year if there are only a few enterprises" (73:321). A further disadvantage is the attendant reduction of flexibility, with consequently

greater vulnerability to market fluctuations and weather variations, and increased exposure to problems of asset-fixity. One approach toward overcoming these disadvantages is through the acquisition of more land, so that specialized enterprises on different large tracts can be synchronized within a broader pattern of diversification (71). Thus, the move toward specialization may be viewed as an aspect of the trend toward enlargement of the farm firm. It is worth noting that, to the extent different portions of the total farmed area are physically separated, costly machine- and man-hours must be expended in moving between them. The advantages, of course, may substantially more than compensate for these costs.

Future prospects regarding the farm-enlargement trend constitute a complex and somewhat controversial subject-field which cannot be treated fully within the limits of this study. There is relevance, however, in the fact that this trend thus far has been noticeably more pronounced in animal husbandry than in crop-raising.[3] It may, furthermore, be asserted with some confidence that technological developments have not as yet invalidated the proposition that larger-than-family-size farm

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[3]Cf. 44:49, 51.

firms have no clear advantage over adequate family farms[4], insofar as economic efficiency is concerned (100; 17). Trelogan foresees that such advantages will gradually accrue as techniques of cybernation are brought to bear upon the communication and control limitations of farm operations (148). Within the horizon of ordinary business planning, however, it appears to remain true that legitimate scale economies in farming, while not necessarily decreasing, cease to increase after family-farm size limits are attained, except in highly specialized farming enterprises.[5] "The drive toward larger farm size is motivated by possibilities of greater profit, not by lower average cost" (154).

In the present context, it is significant that reasons relating more to inefficiency than to efficiency, in a macro-economic sense, may well have inspired the growth of numerous very large farming firms (107). Where such is the case, there is probably a high degree of vulnerability to adverse effects from termination of the

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[4]The "adequate family farm" is defined as a farm business with sufficient resources and productivity to yield enough farm income for (1) family living; (2) farm expenses, including depreciation, maintenance of the livestock herd, equipment, land and buildings, and interest on borrowed capital; and (3) enough capital growth for new farm investments required to keep in step with technological advance and rising levels of living (100:8, footnote).

[5]See, for example, a description of Green Giant Company operations (71).

conditions (such as governmental subsidies) upon which profitability or viability depends.

Developments in Competing Technologies

The history of man's material progress is filled with illustrations of the principle that, when the notion that "there must be a cheaper (or easier) way" occupies the minds of resourceful individuals, cheaper (or easier) ways usually are found to serve human purposes. An obvious corollary, which applies to the development of farm machinery as well as to any other technology, is that a given technology is likely to be exposed to competition from rival technologies.

One conceivable kind of technological change that would be beneficial to the public at large would be the development of attractive, cheap ways of growing food with relatively little or no dependence on the world's limited supply of arable land. (Some of the directions already foreseen in which such change might develop include intensive cultivation of marine food sources, petroleum-fed algae culture, hydroponic development, etc.) (15). If such developments were to materialize while soil-grown food products were in plentiful supply relative to economic demand, it is obvious that the MVP's of

farm machinery, and of other resources used in growing traditional crops, would be adversely affected.

Within the field of agriculture, a distinction has often been made between technology which is primarily labor-saving (i.e. labor-substituting) and that which is predominantly land-saving in its effects. The principle upon which a logical choice of either orientation has been based is that of economizing in the use of the most scarce, (that is, in general, the most expensive) resource. Thus, farm-machinery technology largely has been directed toward economizing labor, and fertilizer technology toward economizing land. It seems possible that in the future a new orientation may develop, toward economizing in the use of machinery or perhaps machinery and labor. The reason for such a development, if it occurs, would be clearly economic in nature, based on identification of machinery (or the machinery-labor combination) as the most expensive, economically least efficient input.

Conditions which would ultimately favor a trend in this direction might include continuing steady machinery-price increases, diminishing returns on efforts to maintain the pace of labor-substitution, and technological implications of ongoing research in such fields as genetics, agricultural chemicals, radiology, electronics, ecology, agronomy, agrology, and hydrology. At the

present time there are some innovations in various stages of development or application which might be interpreted as pointing toward a gathering emphasis on machinery-economization--e.g., minimum tillage, improved herbicides, multipurpose machinery-design concepts (150)[6], broadcast-seeding of traditional row-crops, and the use of airplanes in chemical dusting or spraying. Undoubtedly, such developments, where practical, are supported also by other considerations. The possible adverse implication with respect to farm-machinery MVP's is, in any case, unmistakable.

Countervailing Power of Major Agricultural Enterprises

Unquestionably, valid reasons of economic efficiency support the replacement of a substantial number of small farms by fewer and larger units. Economic reasoning also suggests, on the other hand, that efficiency considerations place desirable limits on the extent to which this process should be carried.[7] Nevertheless, if

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[6]The citation refers to a report concerning a design-concept--proposed not by a farm-machinery company but by the United States Steel Corporation--for "a single tractor, Vantage, which executes the farm tasks presently performed by a number of units" (150).

[7]A Minneapolis-Moline official, taking note that "a 5,000 or 10,000-acre farm is not necessarily more

the farm-enlargement process is systematically stimulated and encouraged by the farm-machinery industry as well as by the federal government, it seems unlikely to stop where efficiency criteria are satisfied. A plausible hypothesis is that the trend might continue until that market strategy is bankrupted by its own effects upon market-power relationships.

Factual and logical grounds for anticipating such a course of events are contained in developments described by Faris:

> In many areas quantity discounts are available for farm inputs such as fertilizer, insecticides, farm machinery, fuel, etc. This may be looked upon as a reflection of economies of selling. In addition, manufacturers or wholesalers may give quantity discounts to local suppliers. Also, they sometimes make special discounts to local dealers in areas where the price competition is particularly severe (43:1242).
>
> It has long been recognized that some operators of larger farms purchase a sufficient quantity of some inputs to obtain them at a price lower than the price paid by operators of average-size farms . . . As (average) farm size increases, a larger share of the factor purchases will be made by these farm operators (43:1240).
>
> (Thus) there is a concentration of purchasing power in a relatively small number of buyers. It is these buyers that the sellers concentrate upon to obtain as customers. In the future, it appears that suppliers will cater more and more to the large farm operators (43:1243).

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efficient than a 500 or 1,000-acre farm," has expressed the view that "the number of farm units will most likely stabilize at the point where the farmer makes a good living through use of technology on what should be characterized as a large family farm" (116).

> A few of the larger farm operators are undertaking some of the functions of suppliers through acquiring small dealerships for some farm supplies.[8] Also, there is some bypassing of local retail outlets and purchasing direct from the wholesale outlet or manufacturer.[9] Although these are not common practices, the implicit possibility of larger farm firms taking over the function or bypassing local sellers should improve the bargaining power of larger buyers (43: 1244).

Projecting these developments into the indefinite future, it is possible to foresee (1) progressive thinning of the ranks of dealers devoted primarily to the farm or farm and industrial equipment business, and (2) increasing pressure on manufacturers to extend deeper discounts benefiting a larger proportion of a diminishing total number of customers.

The possibility, consistent with profitable operations, of granting economically meaningful discounts to one class of customers depends upon the ability to offset much of the related cost through charging full price to other customers. Therefore, if the market-segment represented by those other, less-powerful customers becomes too small relative to the discount-demanding segment, an adequately broad program of meaningful discounts will not be feasible. The situation obviously would be further

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[8]The Green Giant Company, for example, acquired farm-implement dealerships, making its policy of early trade-ins more economical (71).

[9]In the car-and-truck business, sales to such customers are known as fleet sales.

exacerbated insofar as dealership-status might be held by large machinery-users who are not particularly interested in performing all of the functions normal to that role.

A basic challenge would be presented to the industry, if matters long continued to evolve in this way, in the form of confrontation by a more-or-less solid array of customers armed with fairly impressive countervailing power. With relatively few weaker customers remaining as potential targets for diversion of that power, the farm-machinery oligopoly might be compelled to relieve the resulting pressures through changes, however painful, in its own structure and strategy.

Potential Efficiency-Increase in the Use of Existing Machinery

In much of the previous discussion concerning the generation of increased output within agriculture, there are tacit assumptions that (1) the contribution made to output by equipment already present on farms is not variable, and (2) that costs associated with its ownership and operation cannot, or will not, be reduced. These assumptions are useful for studying numerous aspects of variation in new-machine investment, but additional light can be shed on the problem at this point if they are relaxed.

Major possibilities are in fact apparent, in principle at least, for more economically efficient ownership and use of a given stock of machinery. As the consequences of the farm-machinery industry's postulated market strategy progressively unfold, such possibilities may conceivably become a significant factor tending to inhibit continued pursuit of that strategy. The reasoning which appears to support this speculation may be outlined as follows:

- Overcommitment has a fundamental connotation of overinvestment in a given resource or enterprise, relative to the opportunity-cost yardstick. This is, of course, inefficient per se but even greater inefficiency is involved, from the individual firm's standpoint, if the resource is fixed in production but underutilized relative to its capacity.

- A market strategy of inducing overcommitment to machinery in farming tends to place more farmers in the more-or-less overcommitted category while at the same time gradually eliminating those in the undercommitted category.

- As undercommitted operators diminish in number, their obsolescence-absorbing role might be filled to a considerable extent by a different set of marginally viable farmers characterized by underutilization of more-than-adequate used-machine capacity.

- The viability of these capacity-underutilizing farmers would, in general, be considerably less marginal than that of undercommitted farmers. Instead of succumbing to the cost-price squeeze, many of them probably would compete actively against full-capacity new-machine users for acquisition or control of any farmland coming on the purchase- or rental market. Thus, (1) increased pressure on land prices and rentals would make farm-enlargement less attractive to new-machine users, (2) capacity-underutilizers could more

advantageously expand operations for fuller machine-utilization, and, implicitly, (3) an increased proportion of the land which changes hands would become associated with more efficient use of existing machines rather than with introduction of newly-purchased equipment into the farming economy.

IX. PORTENTS OF CHANGE IN THE MARKET FOR MACHINE SERVICES

The foregoing section was concerned with a review of factors which appear likely to impose eventual limits on the workability of the farm-machinery industry's present strategy, as interpreted herein, and on the viability of its existing structure. Discussion of the industry's future prospects continues in the present section, but with a nearer-range and somewhat less speculative, more objectively-based outlook.

In effect the question is raised whether, in view of developments already observable, the industry may encounter increasing difficulties in the course of the next several years--say the coming decade.

The Diminishing Market for Used Equipment

As the number of relatively prosperous, heavy-users of machinery increases, there is correspondingly increased output of used machines into the secondhand

market.[1] Paradoxically, although it has often been suggested that faster exit of smaller, disadvantaged operators would facilitate adjustments including more-rapid equipment-modernization in agriculture, there are grounds for anticipating an opposite effect where the economics of new-machinery purchases are concerned:

- A smaller market for used equipment implies that it will command lower prices; this reinforces the effect of more used items being offered on the market.
- As anticipations of resale value decline, MVP's of expenditures on new machines decline--tending to result either in reduced sales, lower new-product prices, or both.

To the extent that events might develop in this manner, the effects on the machinery industry would be more or less severe. The impact of a long-term decline

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[1]The annual turnover of nationwide average dealer used-equipment inventory reportedly declined from 5.38 times in 1956 to 3.63 times in 1966 (Source: Cost of Doing Business Studies, National Farm and Power Equipment Dealers Association, reported in 158). This trend, however, may not adequately reflect the actual increase in volume of used machinery accepted by dealers as trade-ins, because (1) inventory valuations tend to reflect changing estimates of resale values in the market, and (2) as market conditions change, varying proportions of the used machinery acquired by dealers are offered for resale, dismantled for parts, or junked. Cromarty reports that, in a 1936 survey of dealer practices in disposing of used equipment, two-thirds of those respondents accepting trade-ins indicated that they dismantled from 1 to 25 percent of the trade-ins, and a similar proportion indicated that they junked from 1 to 25 percent. "In general the rate at which used machines are reconditioned and sold is related to the price received . . . for new and used machinery, and the cost of the necessary repairs . . ." (33:35).

in demand would compel deep cuts to be made in productive capacity, as well as costs of distribution and administration. Overhead would have to be distributed over a smaller sales volume without increasing prices, or perhaps even while reducing them.

Realistically, such sweeping changes are not to be expected except under extreme economic pressure (short of a structural realignment within the industry). Therefore, even if the secondhand market should fall off continuously, it seems likely that new-machine prices will yield only very slowly to downward pressure, so the economic effects would be rather fully reflected in depreciation of MVP's on farmers' new-machine expenditures, hence in diminished purchases.

Agricultural Policies and Programs

As discussed in Section IV, agricultural policies and programs during the last generation or more have contributed toward enhancing the MVP of expenditures on machinery and its complements, for the individuals who made these expenditures. At the same time, since macro-consequences have not been faced realistically, MVP's of the resultant expenditure-increases have been substantially negative for agriculture and for the larger society.

Now, however, evidence is gathering that the tide has turned:

> Present farm programs have had it . . . A major threat to farm programs is an urban-minded Congress . . . Less than 1/3 of House Agriculture Committee members will be from farm districts. Rules Committee, that decides which bills come to a vote, may have only 1 or 2 members with a farm interest . . . The hostile attitude of Congress toward farm programs is even more significant. . . . It shows up in refusal to enact LBJ's omnibus farm bill, in the near-majority vote for a limit on payments per farm, and in dozens of speeches. Newspapers and TV networks add to the sentiment with blasts at 'huge farm subsidies.'
>
> Money is the basic problem . . .
>
> First step is going to be to cut back--and then end--big, multi-billion-dollar programs that pay for idling cropland . . . And there'll be less money for conservation cost-sharing, subsidies to electric coops, and cut-rate loans by Farmers Home Administration. Even farm research may be nicked. PL480 export program will survive--but only at its scaled-down level.
>
> Urgent need now is for a new approach to the 'farm problem', one that an urban Congress wil go along with.
>
> First big change in farm program thinking to reflect the new Washington attitude is to handle farm poverty as mainly a poverty problem--not a farm problem. Farm programs haven't helped the very-low-income farmer. While agriculture as a whole suffers from too much production capacity, he suffers from not enough. Payments to produce less hardly solve his income problem. He'd fare better under poverty programs than under farm programs (142:9).[2]

The major implication of the indicated new Congressional approach to agricultural problems appears to be that government inducements toward increasing output

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[2]See also (52:9).

will be substantially reduced or withdrawn. Thus, the MVP's of individual operators' expenditures on new machines will be reduced, particularly for those farmers already overcommitted relative to unsubsidized demand levels. In due course, however, as aggregate capacity is worked downward toward a level commensurate with market needs, MVP's should become better than before for farmers who are not overcommitted, since their competitive position within agriculture would be relatively improved.

In effect, the prospect is that Congress and the public will progressively be less disposed to subsidize overt actions which give rise to inefficiency in agriculture.[3]

Increasing Returns to Expenditures on Substitute Inputs or Under-Utilized Complements

"The most profitable quantities and combinations of variable resources are being used to produce a product

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[3]Coincidentally, John Fisher in Harper's Magazine reports that the approaching retirement of Senator Carl Hayden, long-time chairman of the Appropriations Committee, may enable the President who enters office in January, 1968, to close down the Interior Department's Reclamation Bureau. The Bureau spends billions of dollars to bring land into expensively-irrigated production while the USDA spends over a billion a year to keep other land out of production (57).

when their respective marginal value products are all exactly equal to the cost of acquiring another unit of each resource" (164:73).

Substitution between machinery and labor has been discussed previously. Aside from labor,

> The remaining inputs used in conjunction with machinery . . . are the livestock, buildings, fertilizer, seed, acreage harvested, etc., necessary in the production process. For the most part these items are mildly complementary with machinery, but compete for dollar expenditures on the basis of their marginal dollar returns. One measure of their adoption is the index of prices paid by farmers for items used in production . . . (33:26-27).

The MVP of expenditure on a resource is a function of the price and the marginal value-product per technical unit of the resource. The competitive aspect of the relationship between machinery and fertilizer inputs is accentuated by conditions in which indicated continuing high technical productivity of fertilizer applications (145)[4] are associated with declining fertilizer prices (44:16-18). Use of anhydrous ammonia, for example, which averaged 572,000 tons yearly during the 1957-9 period, amounted to 1,960,000 tons in 1966. The quantitative increase was 243 percent, the increase of retail value only 174 percent (44:16).

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[4]But, see report of a different view, in the discussion on complementary inputs, p. 174.

Doane's Service apparently places machinery and equipment fairly low on its list of usually-recommended priorities:

> Assuming that you already own farm land, another place to invest added capital is in further development of the farm . . . We believe that soil improvements including drainage, liming to correct soil acidity, and adequate fertilizer should be given number one priority. We would recommend this order, drainage, liming, and fertilizer. Fertilizer needs a properly limed soil to give full returns; and both limestone and fertilizer need a properly drained soil to give best returns. I think that soil improvements should be given priority over building improvements. The soil produces income to support the buildings, not the other way around . . . An investment in farming machinery and equipment should also be made with the purpose of saving labor and increasing the efficiency of operation (67).

Decreasing Returns to Expenditures on Complementary Inputs

Problems related to complementary inputs are in a way inversely analogous to those associated with substitutes. As noted earlier, the distinction between complementarity and substitution is somewhat arbitrary, albeit a useful one. In the final analysis, all inputs which are in at least some degree essential for a productive resource-combination are complements. Assuming that they are combined in optimum proportions, none of them is used profitably if their combined value product does not exceed their combined cost.

An apposite example of decreasing returns on complementary resource combinations is provided by the results of the Master Corn Growers Contest conducted in 1967 in Washington County, Iowa (169). Among the 25 contestants, yields averaged 144 bushels of shelled corn per acre; and their costs averaged $111.90 per acre, or 77.6¢ per bushel. The average per-acre cost was composed thus:

Seed	$ 5.90
Insecticides	1.92
Herbicides	5.08
Fertilizer	22.16
Lime (pro-rated)	1.44
Tractor & Machinery	17.89
Drying	5.88
Crop or Hail Insurance	1.27
Misc. Overhead	4.50
Land Charge ($540 @ 7%)	37.80
Labor (@ $2 per hr.)	8.06
	$111.90

It is pertinent to consider the implications of these cost data in the light of the trend of real estate prices in Iowa (See Table 10).

Table 10.--Real estate price indices, Iowa, 1962-1966 (1957-59 = 100)

Year	Index
1962	106
1963	108
1964	112
1965	117
1966	131

Source: Agricultural Statistics, 1966, p. 439.

Discounting the fact that the index-rise accelerated continuously, it seems a reasonable assumption that its rise will continue at no less than the 5.5 percent average annual rate for 1962-66--barring a major agricultural recession. If so--and provided no other cost increases occur--assuming the price of corn were to hold steady at $1.00 per bushel, ex-farm, within less than a dozen years the average among those 25 Master Corn Growers would be able to show no gross profit at all, unless

- further gains in crop-yield were obtained, and their value not cancelled out by cost increases, or
- significant cost-savings could be effected.

Some doubt, however, has been cast recently on the view that further sizable increases in fertilizer application to corn, above currently recommended levels, will prove profitable. Pending the development of more fertilizer-responsive varieties (not now in evidence) of major crops such as corn and soybeans, some spokesmen in the fertilizer industry reportedly foresee an early peak in fertilizer consumption, followed by a gradual downward trend (37).

On the cost side, it seems rather wishful to expect much help from further fertilizer price-reductions. The impressive reductions effected in recent years have reflected a combination of production-cost savings and over-capacity in the industry (44:16). Neither of these

influences seems likely to persist unabated in the future.

Furthermore, it should not be overlooked that progressive yield-improvement based on fertilization, etc., has had an important land-substituting function; and, if this function is performed less effectively in the future, the rising trend of land prices may be further accelerated (83:22).

Another significant approach to land substitution is that of irrigation. Here, too, it is often found that very high yields are accompanied by very high costs; and large fixed-capital expenditure increases vulnerability to unfavorable price-movements and other vicissitudes (63:1256-59; 30).[5]

Finally, there is, of course, little realism in the assumption of no increases in costs other than that of land. The strong upward trend of taxes and the possibility of further rises in interest rates must also be considered. The direction and rate of change in the combined cost of machinery and labor, of course,

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[5]Among these vicissitudes, in some areas, is the possibility that the source of water supply will prove inadequate relative to an overwhelming surge of demand. Toward the end of a recent, almost lyrical report on a "Boom in the Great Plains" appears the following cryptic observation: "It all started with irrigation, and nobody's sure where irrigation will end. Part of the huge Ogallala formation and other reservoirs recharge, some don't" (9).

constitute a central problem to which this study is addressed.

Changing Farmer Expectations

Obviously, new prospects with regard to public policies and programs are going to have an important impact on farmers' economic hopes and expectations. What farmers expect is continually subject to modification by the interacting influence of many factors. Some of the other important developments that recently have affected expectations in agriculture include the following:

- Bumper crop prospects for 1968, implying probable intensification of the cost-price squeeze (55).
- Dimming of the prospect that growth of export demand promises near-term relief of the American farm-surplus problem. At a recent farm forum, Agriculture Secretary Freeman declared, "We face an overproduction problem in the U.S. for the next 10 years, even if we use the Food for Peace program" (50:12).
- Higher interest rates and tighter credit (56; 51: 15; 49:11; 52:13).

The effect of change in expectations concerning relevant market conditions is change in anticipations of future benefits from expenditures of effort and resources. Significantly, these anticipations have large subjective elements, related to uncertainty and imperfect knowledge. The manner in which farmers will respond to information on changing conditions is, therefore, exceedingly difficult

to foresee. Nevertheless,

> It appears that the cost-price squeeze many buyers now find themselves in will play an important part in how price and service conscious they become. Farmers may look more and more at the factor market as a means of increasing net revenue (decreasing costs) as their opportunities to influence prices through legislative action decrease (43:1245).

The presence of uncertainty and imperfect knowledge implies that major errors potentially exist in the subjective anticipation of future value-products relative to present expenditures. A large element of anticipation appears to be reflected, for example, in the present structure of prices paid for farmland (125). In a study of Minnesota land-transfers effected during 1966-67, it was found that those who acquired land to initiate farming paid an average of $200 an acre, investment buyers paid $214, and expansionist buyers, $228 (106). If prospective buyers of farmland should revise downward the future-value assumptions upon which existing values are based, the possibility of large losses in market value would have to be faced by many landowners who now contemplate large as-yet-unrealized gains. Conceivably, as has happened in the past, actions taken to avoid or minimize anticipated losses could precipitate a land-market collapse. Such a collapse would no doubt be associated with a general agricultural recession.

Growing concern about the possibility of an agricultural depression, as well as continuing frustration of

most farmers' efforts to achieve parity returns, undoubtedly have contributed to their growing interest in the development and use of collective action and bargaining power. Results of surveys conducted among Michigan farmers in 1965 and among Farm Journal subscribers in 1968 may be interpreted as indicative of increasing readiness to consider action based on majority decisions to control output (69:25-27; 65). A strong movement directed toward this objective would probably tend to make the system of agricultural production more efficient in the aggregate; and at the same time it would substantially reduce the MVP's of expenditures that imply resource overcommitment in the industry.

X. CONCLUSIONS AND SIGN-POSTS

Farm-equipment manufacturers are like other farm-input producers in that they offer something needed by farmers and that they profit from selling as much of it as possible. They are unique in the degree of power they possess--derived from their control over development of and access to lumpy, durable, expensive packages of an exceedingly complex and dynamic technology--to boost sales by means of product- and service-differentiation, promotional effort, market segmentation, price- and service-discrimination, and technological acceleration. Unique power to increase sales on these terms implies unique power to influence economic efficiency among farmers. To recognize this fact is to raise the broad question whether or under what conditions such power is or can be exercised constructively rather than exploitatively.

What farmers, like any other goods-producers, basically require from suppliers is not their products but their services--the services of their products, and the related services that make for efficient use of those product-services. Essentially, the farmer's economic efficiency in the use of machine services depends on his

being treated like other users of producers' durables. This means that products and services should be developed, designed, produced, merchandised, and priced to fulfill his objectively-determined economic needs, rather than to capture his imagination, cultivate his whim, or exploit his ignorance.

Statistical indications are that changes in the use and cost of farm machinery have had a negative effect upon aggregate agricultural efficiency in recent years. In agriculture there is an inherent tendency toward resource-overcommitment, which has been further encouraged by a variety of governmental programs. The farm-machinery industry has in effect been taking advantage of this situation by cultivating the patronage of farm-operators who, under prevailing conditions, find it profitable to overcommit and overproduce relative to demand levels that would obtain, absent subsidies. A corollary is that undercommitted farmers, whose disadvantages reflect advantages for operators prone to overcommit, find it difficult or impossible to obtain up-to-date machine services at prices or on terms that are economically attractive. They find themselves relegated, partly for this reason, to roles such as those of obsolescence-loss absorbers, high-profit repairs customers, and, eventually, suppliers of land to the farm-enlargement market.

Product-proliferation and -differentiation among the full-line firms reflect a market atmosphere of "live and let live," rather than one of strenuous competition. Market conduct in all important respects appears to be shaped by opportunities for selective application of market power. Such conduct is explainable not in terms of rapacity, but rather as the result of what is herein referred to as an oligopoly trap. Merger is prohibited, vigorous price-competition is mutually unprofitable, so co-existence is accepted. The trapped oligopolist's market power is quite sufficient to support short-range, exploitative strategy within the market, but wholly inadequate for undertaking any long-range measures to coordinate and develop the market as a whole. Competitive considerations, moreover, compel him to conform his strategy to his power-potential.

The logical alternative to full-line oligopoly would be monopoly. The monopolist's much greater market power would convey opportunity, incentive, and responsibility for dealing constructively with the farm-machinery market as a whole, in terms of its efficient present coordination and sound future development. He would, as compared with the oligopolist, be more answerable for the consequences of exercising his greater power.

The farm-machinery industry makes a business of transforming its agricultural market-environment. This

fact underlies an urgent need of the ability to manage strategy in such a way that its consequences will be manageable. The trapped oligopolist, however, has comparatively little latitude in strategy matters; and, projecting future consequences of the prevailing strategy of overcommitment, it is foreseeable that some of the full-line companies eventually will fall as victims of their inability to develop viable alternatives. Thus--antitrust laws or no antitrust laws--eventual further concentration of market power in the industry may be expected.

If, in the long run, an unlimited competitive struggle for survival is inevitable, it is relevant to consider how eventual acceptance of that premise may affect the strategy and conduct of farm-machinery producers. Strategic behavior, predictably, will no longer be governed by the conditions of the oligopoly trap, once it is recognized as potentially a death-trap, rather than a device for protective custody and mutual security.

Companies enjoying the strongest market positions obviously would have commanding advantages in any all-out contest based on escalation of overcommitment-strategy. A firm not in that category would have virtually no chance of winning a battle on these terms, unless it were financially strong enough and resolved to try to "buy the

market".[1] The premise that overcommitment strategy is not viable, however, would suggest that a company which places ultimate reliance upon that strategy can be defeated by one which stakes its future on constructive service to the farm market.

It is proposed that the manufacturer who moves soon enough, and with massive efficiency, into a comprehensive program of leasing and contract services, will be the manufacturer who survives. From this as a beginning, other essential features of a strategy oriented toward agricultural efficiency-improvement may be expected to follow naturally.

As of now, however, there is no apparent disposition in the industry to regard a conclusive struggle as inevitable. Thus, although the problem examined in this paper is seen as tending ultimately to resolve itself, significant progress may come about only after much additional damage to the farming economy, as well as needless losses to people whose energies are committed to serving companies that finally will succumb.

An earlier, less costly, and therefore better solution probably would result if the legal obstacle to merger were removed. A number of economists now agree

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[1]The J. I. Case Company's experience in the late 1950's indicates that such an effort might prove prohibitively costly (115:355).

that the antitrust laws are anachronistic[2]; and Galbraith, for one, foresees that in due time they will be reformed to conform with the reality of effective-planning requirements in the modern industrial system (64:197). It is to be hoped that business leaders, agricultural economists, and other public-spirited citizens will lend support toward bringing this about.

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[2]Cf. Galbraith (64:187-88, 196-97), Merkel (104), and Dewey (35). Donald Turner, the Assistant Attorney General in charge of antitrust enforcement, was a member of a committee which, after a study of the international telecommunications industry, recently recommended "that the Congress now . . . enact appropriate permissive merger legislation" (Merkel, 104:57, citing the Intragovernmental Committee on International Telecommunications, Report to the Senate and House Commerce Committees, Apr. 29, 1966).

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APPENDIX

Table 11.--Farmers' imputed costs for hired and family labor and for interest on machinery and equipment investment, 1957-1965

Year	Labor Man-Hours[a] (Millions)	Average Hourly Wage for Hired Labor[a]	Imputed Labor Cost (Millions)	Farm Machinery and Motor Vehicle Net Assets[b] (Billions)	Fed. Land Bank Avg. Rate on New Loans[c] (Percent)	Imputed Interest Cost (Millions)
1957	11,059	$.73	$8,073	$20.2	5.17	$1,044
1958	10,548	.76	8,016	20.2	5.24	1,058
1959	10,301	.80	8,241	22.1	5.51	1,218
1960	9,825	.82	8,057	22.3	6.00	1,338
1961	9,473	.83	7,863	22.0	5.64	1,241
1962	9,060	.86	7,792	22.5	5.60	1,260
1963	8,820	.88	7,762	22.7	5.60	1,271
1964	8,441	.90	7,597	24.1	5.60	1,350
1965	7,904	.95	7,508	25.7	5.60	1,439

[a]The Farm Cost Situation, 1968 Outlook Issue (FCS-39), Nov. 22, 1967, p. 11.

[b]Agricultural Statistics, 1965, p. 439; 1966, p. 442.

[c]Agricultural Statistics, 1966, p. 501.

Table 12.--Farmers' total imputed machinery and labor expense, 1957-1965

Year	Machinery Expense			Imputed Labor Cost[c]	Total Machinery and Labor
	Repairs and Operation[a]	Depreciation and Consumption[b]	Imputed Interest[c]		
	$(Million)	$(Million)	$(Million)	$(Million)	$(Million)
1957	$3,163	$2,825	$1,044	$8,073	$15,105
1958	3,197	2,928	1,058	8,016	15,199
1959	3,327	3,093	1,218	8,241	15,879
1960	3,256	3,086	1,338	8,057	15,737
1961	3,158	3,049	1,241	7,863	15,311
1962	3,249	3,098	1,260	7,792	15,399
1963	3,264	3,117	1,271	7,762	15,414
1964	3,275	3,245	1,350	7,597	15,467
1965	3,410	3,444	1,439	7,508	15,801

[a]From Farm Income Situation (FIS-207), July 28, 1967, p. 60.

[b]From Farm Income Situation (FIS-207), July 28, 1967, p. 63, Valued in terms of current replacement cost, not original cost.

[c]From Table 11.

Table 13.--Computation: indices of output per dollar of machinery and labor expense, 1957-1965

Year	(Column 1) Machinery and Labor Expense: Total Amount[a] $(Millions)	(Column 2) Machinery and Labor Expense: Percent of 1957-9 Avg. Output Value[b] (Percent)	(Column 3) Indices of Actual Output[c] (1957-9=100)	(Column 4) Ratio of Output Quantity Index to Machinery and Labor Exp. Percentage[d]	Indices of Output per Dollar of Machinery and Labor Exp.[e] (1957-9=100)
1957	$15,105	44.3%	95	2.145	96.4
1958	15,199	44.5	102	2.318	104.0
1959	15,879	46.5	103	2.218	99.6
1960	15,737	46.2	106	2.298	103.1
1961	15,311	44.9	107	2.387	107.1
1962	15,399	45.1	108	2.397	107.8
1963	15,414	45.2	112	2.480	111.4
1964	15,467	45.3	112	2.475	111.1
1965	15,801	46.3	115[f]	2.486[f]	111.6[f]

[a]From Table 12.

[b]Column 1 values as percentages of 1957-59 average market value of farm output (farm marketings, home consmmption, and change in inventory) from Agricultural Statistics, 1966, p. 482.

[c]Agricultural Statistics, 1966, p. 459.

[d]Column 3 indices divided by Column 2 percentages.

[e]Derived from Column 4. [f]Preliminary.