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EFFECT OF FARM SIZE AND LEVEL OF VERTICAL INTEGRATION
ON RETURNS TO MANAGEMENT IN THE COMMERCIAL TURFGRASS INDUSTRY

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An important and viable agricultural crop which should receive more attention is turfgrass. This is particularly true in the Northeast where high population concentrations create a large demand for home and business beautification. The Northeast's average population density of three-hundred persons per square mile makes a crop with few offensive characterisitcs, maximum open-space amenities and high value per acre worthy of consideration by farmers, politicians and economists (U.S. Bureau of the Census).

The purpose of this paper is to present costs and returns for different size turfgrass farms and different levels of vertical integration that would be useful to farmers, researchers, extension personnel and others interested in agricultural production.[1] To this end, costs and returns are examined by farm size and methods of harvest and delivery. Numerous growers have integrated up the marketing chain because the harvested crop is in a form ready for retailing.

Costs and returns for 1976 are presented for four farm sizes (less than 100 acres, 100-150 acres, 151-300 acres, and more than 300 acres), three harvesting-handling methods and two delivery systems. The data are based on an enumeration of Maryland turfgrass growers and harvesters for the 1976 crop year. Comparisons are made with a similar study by Arnold and Lessley conducted in 1968-69.

### Production Costs and Returns for Unharvested Turfgrass

Production expenses per acre were separated into fixed and variable costs by farm size. Table 1 shows the two-year[2] average total cost to be $553 for all farms; the costs being highest on farms with less than 100 acres and lowest on farms with 151-300 acres.

Average fixed costs per acre attributed to machinery and equipment, permanent structures and interest on fixed capital decreased as farm size increased. The higher average fixed cost per acre associated with the more than 300 acre size category was due primarily to higher supervisory labor, since the opportunity cost of land (rental rate) was constant and real estate

taxes varied little across farm size groups. The higher average super-
visory cost is explained by increased travel time to more numerous fields,
more supervisory labor, indivisibilities in supervisory labor and negotia-
tions for larger volumes of sales.

Average variable costs declined from $348 per acre for the smallest
category to $301 on farms with 151-300 acres. These costs increased to $354
on farms with more than 300 acres. Expenditures for variable inputs appeared
to be more related to management decisions than farm size. The largest farms
were spending above or near average costs for nearly all the variable inputs,
probably to assure adequate growth, quality and uniformity in an attempt to
guarantee a market for large volumes of output. Some of the physical laobr
economies realized by the largest farms were offset by higher wages paid
because of a need for consistent labor quality and dependability.

Despite the advantage in average production costs per acre for farms
with 151-300 acres, farms with 100-150 acres received the highest per acre
returns to management (Table 1). This is explained by the higher gross re-
ceipts per acre for farms in the 100-150 acre size group. The variation in
gross receipts by farm size may be attributed to quality of product, physical
location, market power, market contact and volume of sales. It is reasonable
to conclude that the 100-150 acre size group was large enough to assure
quality and have some degree of market contact and power. However, because
the volume of sales was low (9 percent of total sales), they were not enticed
to accept lower prices in order to move extremely large volumes of grass.
Even though farms in the two largest size groups had a per acre return to
management lower than farms in the 100-150 acre size group, they marketed
more tufgrass and had higher total income. Farms in the two largest size
groups sold 28 and 45 percent of the turfgrass marketed, respectively.

Farms with less than 100 acres suffered from high production costs as
well as low gross receipts per acre. Relative to fixed costs, this size
group was not large enough to gain full economies of size. Too, variable
expenditures were slightly above the average of all farms. Gross receipts
per acre were lowest and may be explained by lack of market power, market
contact and custom harvesters not being as interested in purchasing and
harvesting small acreages of turfgrass.

In comparing 1976 (Tabe 1) to 1968 costs and returns (Table 2), average
total costs per acre for all farms increased by 102 percent while gross re-
ceipts per acre of unharvested turfgrass increased by 107 percent. Average
fixed cost increased 67 percent, with rental value of land representing the
largest absolute increase. Average variable cost for all farms increased by
132 percent, rising form $146 per acre in 1968 to $339 per acre in 1976.
Major components of this cost increase were fuel and oil, production labor,
top-dress fertilizer and seed. Relative cost efficiency by farm size remained
the same between 1968 and 1976, even though major shifts were observed in the
proportion that fixed costs were of average total costs. In 1968, fixed
costs accounted for 47 percent of average total cost for all farms, while
they accounted for only 39 percent in 1976. Consequently, increased manage-
ment education should focus on cost control of variable costs like seed,
fertilizer, top-dress fertilizer, fuel and oil and production labor.

Table 1

Production Costs, Gross Receipts and Return to Management per
Acre for Various Sizes of Turfgrass Farms, Maryland, 1976[a]

| Item | Farm Size | | | | |
| --- | --- | --- | --- | --- | --- |
| | Less Than 100 Acres | 100-150 Acres | 151-300 Acres | More Than 300 Acres | All Growers |
| | Dollars Per Acre, Two Year Production Period | | | | |
| Fixed Costs | | | | | |
| Machinery and Equipment | | | | | |
| Depreciation | 68.12 | 48.10 | 37.64 | 35.55 | 41.29 |
| Repairs | 34.06 | 24.05 | 18.82 | 17.78 | 20.65 |
| Insurance | 4.08 | 2.89 | 2.26 | 2.13 | 2.48 |
| Permanent Structures | | | | | |
| Depreciation | 19.26 | 14.56 | 10.78 | 10.18 | 14.70 |
| Repairs | 3.86 | 2.92 | 2.16 | 2.04 | 2.94 |
| Insurance | 3.86 | 2.92 | 2.16 | 2.04 | 2.94 |
| Supervisory Services | 7.21 | 6.70 | 15.14 | 26.05 | 13.65 |
| Interest on Fixed Capital | 52.50 | 38.26 | 30.44 | 29.78 | 35.52 |
| Land Rental Rate | 79.00 | 79.28 | 79.24 | 79.38 | 79.28 |
| Average Fixed Costs | 271.95 | 219.68 | 198.64 | 204.93 | 213.45 |
| Variable Costs | | | | | |
| Seed | 78.40 | 60.80 | 69.00 | 84.32 | 76.13 |
| Fertilizer | 32.96 | 33.40 | 29.12 | 37.06 | 33.54 |
| Top-dressing | 84.12 | 79.26 | 72.52 | 77.64 | 80.80 |
| Herbicides | 11.07 | 11.91 | 15.25 | 20.85 | 14.31 |
| Lime | 17.59 | 13.25 | 19.25 | 14.83 | 16.59 |
| Fuel and Oil | 32.27 | 30.36 | 26.77 | 31.55 | 31.11 |
| Production Labor | 63.65 | 60.39 | 45.44 | 59,58 | 59.61 |
| Interest on Variable Capital | 28.11 | 25.47 | 24.40 | 28.65 | 27.43 |
| Average Variable Cost | 348.17 | 314.84 | 301.75 | 354.48 | 339.52 |
| Average Total Cost | 620.12 | 534.52 | 500.39 | 559.39 | 552.91 |
| - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - | | | | | |
| Gross Receipts (Unharvested Basis) | 611.36 | 734.50 | 685.00 | 700.00 | 657.09 |
| Return to Management | - 8.76 | 199.98 | 184.61 | 140.59 | 104.12 |

[a] Data based on enumeration of farmers producing turfgrass in 1976. For
detailed characteristics, see Gilbert, J. Thomas and Billy V. Lessley,
Structure, Costs and Returns for the Maryland Turfgrass Industry, 1976,
Bul. No. 492, Maryland Agricultural Experiment Station, University of
Maryland, College Park, 1979.

Table 2

Production Costs, Gross Receipts and Return to Management per
Acre for Various Sizes of Turfgrass Farms, Maryland, 1968[a]

| Item | Farm Size | | | | |
|---|---|---|---|---|---|
| | Less Than 100 Acres | 100-150 Acres | 151-300 Acres | More Than 300 Acres | All Growers |
| | Dollars Per Acre, Two Year Production Period | | | | |
| Fixed Costs | | | | | |
| Machinery and | | | | | |
| Equipment | 36.16 | 24.48 | 20.10 | 13.58 | 25.24 |
| Depreciation | 20.88 | 14.16 | 11.62 | 7.86 | 14.60 |
| Insurance | 3.76 | 3.54 | 2.10 | 1.42 | 2.62 |
| Permanent Structures | | | | | |
| Depreciation | 8.12 | 7.56 | 7.36 | 5.66 | 7.08 |
| Repairs | 2.66 | 2.48 | 2.42 | 1.86 | 2.32 |
| Insurance | 2.40 | 2.24 | 2.18 | 1.68 | 2.10 |
| Supervisory Services | 3.42 | 7.31 | 9.09 | 28.56 | 10.04 |
| Interest on Fixed | | | | | |
| Capital | 27.36 | 21.58 | 19.48 | 17.10 | 21.78 |
| Land Rental Rate | 42.31 | 41.95 | 42.98 | 42.70 | 42.17 |
| Average Fixed Costs | 147.07 | 124.30 | 117.33 | 120.42 | 127.95 |
| Variable Costs | | | | | |
| Seed | 29.00 | 22.40 | 22.10 | 29.00 | 26.69 |
| Fertilizer | 18.45 | 16.71 | 19.11 | 18.51 | 17.76 |
| Top-dressing | 24.08 | 25.37 | 25.90 | 32.81 | 26.73 |
| Herbicides | 6.36 | 8.56 | 6.49 | 10.69 | 7.32 |
| Lime | 10.64 | 10.33 | 9.76 | 8.42 | 9.76 |
| Fuel and Oil | 7.03 | 7.74 | 5.09 | 7.97 | 6.81 |
| Production Labor | 34.02 | 35.62 | 32.66 | 31.36 | 33.47 |
| Interest on Variable | | | | | |
| Capital | 17.68 | 17.18 | 16.56 | 18.86 | 17.60 |
| Average Variable Cost | 147.26 | 143.91 | 137.67 | 157.62 | 146.14 |
| Average Total Cost | 294.33 | 268.21 | 255.00 | 278.04 | 274.09 |
| Gross Receipts | | | | | |
| (Unharvested Basis) | 304.16 | 333.33 | 311.60 | 340.25 | 316.77 |
| Return to Management | 9.83 | 65.12 | 56.63 | 62.21 | 42.68 |

[a] Data based on enumeration of farmers producing turfgrass in 1968. For
detailed characteristics, see Arnold and Lessley.

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Average gross receipts for all farms increased from $317 per acre in 1968 (Table 2) to $657 per acre in 1976 (Table 1). This caused per acre returns to management for all farms to increase from $43 in 1968 to $104 in 1976, an increase of 142 percent. There was only a slight change in the relative profitability among the farm sizes.

## Methods and Costs-Returns for Harvesting and Delivery

### Methods of Harvest and Delivery

The three methods of harvest observed in 1976 -- Hand Directed, Hand Rolled; Tractor Powered, Hand Rolled; and Palletizer, Palletized Handling -- varied widely in the degree of mechanization and, therefore, labor intensity.

The first method, used mostly by small-scale harvesters, involved using a hand-directed machine which cuts the turfgrass into segments 15 inches wide and three to four feet long. The turfgrass was then rolled and hand loaded onto trucks. The second method involved using a tractor-powered turfgrass cutter to lift the turfgrass. The turfgrass was then rolled and hand loaded onto trucks. The final method, observed on turfgrass farms where larger acreages were harvested, was characterized by the use of a palletizer mounted on a tractor. The palletizer lifted the turfgrass and transferred it up a conveyor belt while rolling it. into a ball. At the end of the conveyor, and stationed on the back of the tractor, were one or two men who received the rolled turfgrass and loaded it on a pallet. Full pallets were forklifted onto waiting trucks.

Two methods of delivery were commonly used for transporting turfgrass. Method I was the use of a flatbed truck capable of transporting 350-400 square yards of trufgrass. Method II involved a larger truck capable of hauling 650-700 square yards of turfgrass. Most palletized turfgrass was transported by Method II, but each method could transport either rolled or palletized turf-grass. Method II was equipped with a stationary boom to facilitate unloading.

### Cost-Returns for Harvest and Delivery

To comply with industry terminology, costs and returns for harvested and/or delivered turfgrass are expressed on a square yard basis. They are based on a 95 percent harvest rate, or 4600 square yards per acre. Although harvesters reported yields up to 98 percent, turfgrass experts and the majority of harvesters agreed that 95 percent was a realistic and attainable yield.

Total harvest cost per yard in 1976 was least, 12.4 cents per square yard, for the palletizer method (Table 3). Individuals who used the hand-directed system had the highest total harvest cost of 13.3 cents per square yard, while the tractor-powered method had total harvest costs of 12.8 cents per square yard. The major cost component of the hand-directed system was labor. Total labor cost for the hand-directed method was 6.3 cents per yard, 17 percent greater than the tractor method and 86 percent greater than the palletized method. The labor-cost savings of the more capital intensive methods[3]/ were sufficient to more than offset the increased fixed and variable costs associated with the increased capital.

Individuals who perform harvest and delivery of turfgrass must secure

and maintain an adequate market for their product and services. Sales and administrative costs of performing this responsibility in the form of advertising, secretarial and bookkeeping services, office and utility expenses were 4.5 cents per square yard of harvested turfgrass. These expenses did not vary with harvest method.

Average total cost for the two methods of delivery was 10.8 cents per square yard for Method I and 9.3 cents per square yard for Method II (Table 3).

A summary of average total cost by farm size for each combination of production, harvest and transportation methods (including the option to purchase by the acre) is shown in Table 4. Average total costs in this table were constructed by "stacking" harvest and delivery costs onto calculated base production costs (f.o.b. farm) for each farm size. Although all possible combinations are reported, some combinations of farm size and harvest technique are unlikely. For example, costs reported for the smaller farms employing highly mechanized harvest techniques may be understated and may lead to inflated estimates of the return to management. Machinery costs for the various harvest practices were based on harvested acreages (18.5, 42.5, 70.6 acres in 1976 for hand, tractor and palletizer harvest, respectively) that might not be attained each year by the smaller producers. However, some could reach the required size through custom harvest for other farmers.

Return to management for various farm sizes, methods of harvest, methods of transportation, as well as the option to purchase turfgrass by the acre for later harvest and delivery, is presented in Table 5. Returns to management for growers ranged from a low of 28.5 cents per square yard (7.9 cents in 1969) on farms with less than 100 acres selling turfgrass f.o.b. at the farm using hand-directed harvest to a high of 38.2 cents per square yard on farms with 151-300 acres where the palletizer was used to harvest and Method II was used to deliver turfgrass. It should be noted that 1976 returns to management for producers, relative to 1969 returns, were in excess of three to one. Even with an adjustment for inflation, 1976 producers were better off relative to 1969 producers. Too, returns per square yard increased as more mechanization was introduced into harvesting and as larger, more efficient trucks were used to transport the turfgrass. In short, Table 5 shows that returns per square yard increase with added levels of vertical integration as well as substitution of power and equipment for labor.

## Conclusions

Farm size and the level of vertical integration were found to be factors influencing return to management in the trufgrass industry. Average total costs of production per acre decreased up to the 151-300 acre size, although unharvested returns per acre were greatest for the next smallest farm size (100-150 acres). Pressures to assure product quality and large volumes of sales appeared to force larger farms to make decisions that offset some of their advantages of size. Return to management increased with the level of vertical integration. The increased returns were necessary because management assumed additional responsibilities for harvest and delivery.

While there is an economic incentive for vertical integration, rapid conversion of the entire industry is not expected soon. Changes in the industry's present structure should be gradual and will partially depend upon

several critical factors. First is the time element involved in the transition from production to an integrated production, harvest and marketing system. Many growers lack market contact beyond their encounters with harvesters which, in many cases, consists of only one or a few individuals. In order to sell turfgrass on a harvested basis, growers will be forced to familiarize themselves with the market and analyze and anticipate market needs. In some cases, they will be forced to forego other agricultural endeavors or sources of outside income and concentrate efforts on production, harvest and sale of trufgrass. This transition not only requires desire on the part of the individual, but also a great deal of time and planning. Fluctuations in the construction industry also introduce considerable risk into the decision. Second, the transition will require changes by non-growers who presently harvest, transport and install turfgrass. Growers can expect little progress toward integrating operations until these people forego their customary pruchase patterns (purchase unharvested by the acre) and express a desire to purchase harvested turfgrass by the square yard. Finally, the entry into the integrated market requires a substantial amount of capital investment. Many producers do not and will not possess the resources needed for partial or full vertical integration.

## FOOTNOTES

[1] This study does not include installation because of limited farmer participation and since many installation operations are only a part of larger landscaping, nursery, etc. business.

[2] The majority of producers reported a production period of two years.

[3] Table 3 shows that the average variable cost of harvest labor decreased between 1969 and 1976, a result of an increase in efficiency of labor since wages increased during the period.

## REFERENCES

Arnold, F.T. and Billy V. Lessley. The Commercial Turfgrass Industry in Maryland: Structure, Costs and Returns. Maryland Agricultural Experiment Station Bulletin 488, May 1972.

U.S. Department of Commerce, Bureau of the Census. Statistical Abstract of the U.S.: 1977, (98th Edition). Washington, 1977.

Table 3

Average Cost of Harvest and Delivery
by Various Methods, 1969 and 1976

| | Method of Harvest | | | | | |
| | Hand-Directed Hand Rolled | | Tractor-Powered Hand Rolled | | Palletizer, Palletized Handling | |
| Item | 1969 | 1976 | 1969 | 1976 | 1969[a] | 1976 |
| | ---------------- Cents Per Square Yard ---------------- | | | | | |
| **Harvest** | | | | | | |
| Average Fixed Costs | .79 | 1.79 | .91 | 1.77 | --- | 2.18 |
| Ave. Variable Costs of Machinery | .57 | .73 | .60 | 1.15 | --- | 2.40 |
| Average Variable Cost of Labor | 7.26 | 6.26 | 5.56 | 5.37 | --- | 3.36 |
| Sales and Administrative Costs | 2.22 | 4.50 | 2.22 | 4.50 | --- | 4.50 |
| Average Total Harvest Costs | 10.84 | 13.28 | 9.29 | 12.79 | --- | 12.44 |
| **Delivery** | | | | | | |
| Method I | | | | | | |
| Ave. Fixed Costs | 2.99 | 5.46 | 2.99 | 5.46 | --- | 5.46 |
| Ave. Variable Cost | 3.64 | 5.31 | 3.64 | 5.31 | --- | 5.31 |
| Ave. Total Delivery Costs | 6.63 | 10.77 | 6.63 | 10.77 | --- | 10.77 |
| Method II | | | | | | |
| Ave. Fixed Costs | 3.13 | 5.97 | 3.13 | 5.97 | --- | 5.97 |
| Ave. Variable Costs | 2.00 | 3.33 | 2.00 | 3.33 | --- | 3.33 |
| Ave. Total Delivery Costs | 5.12 | 9.30 | 5.12 | 9/30 | --- | 9.30 |
| **Average Total Costs of Harvest and Delivery** | | | | | | |
| Method I | 17.47 | 24.05 | 15.92 | 23.56 | --- | 23.21 |
| Method II | 15.96 | 22.58 | 14.41 | 22.09 | --- | 21.74 |

[a] The palletizer was not generally used in 1969.

## Table 4
## Average Total Cost by Size of Farm and Level of Integration, Maryland, 1969[a] and 1976

| Production Option | No Harvest 1969 | No Harvest 1976 | Hand Directed Hand Rolled 1969 | Hand Directed Hand Rolled 1976 | Tractor-Powered Hand Rolled 1969 | Tractor-Powered Hand Rolled 1976 | Palletizer, Palletized Handling 1969 | Palletizer, Palletized Handling 1976 | Transportation Option |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Cents Per Square Yard | | | | | |
| Purchase by the Acre[b] | --- | --- | 18.23 | 27.56 | 16.68 | 27.07 | --- | 26.72 | f.o.b. farm |
| | | | 24.86 | 38.33 | 23.31 | 37.84 | --- | 37.49 | Method I |
| | | | 23.35 | 36.86 | 21.80 | 36.37 | --- | 36.02 | Method II |
| Produce Less Than 100 Acres | 6.72 | 13.48 | 17.56 | 26.76 | 16.01 | 26.27 | --- | 25.92 | f.o.b. farm |
| | | | 24.19 | 37.53 | 22.64 | 37.04 | --- | 36.69 | Method I |
| | | | 22.68 | 36.06 | 21.13 | 35.57 | --- | 35.22 | Method II |
| Produce 100-150 Acres | 6.12 | 11.62 | 16.96 | 24.90 | 15.41 | 24.41 | --- | 24.06 | f.o.b. farm |
| | | | 23.59 | 35.67 | 22.04 | 35.18 | --- | 34.83 | Method I |
| | | | 22.08 | 34.20 | 20.53 | 33.71 | --- | 33.36 | Method II |
| Produce 151-300 Acres | 5.82 | 10.88 | 16.66 | 24.16 | 15.11 | 23.67 | --- | 23.32 | f.o.b. farm |
| | | | 23.29 | 34.93 | 21.74 | 34.44 | --- | 34.09 | Method I |
| | | | 21.78 | 33.46 | 20.23 | 32.97 | --- | 32.62 | Method II |
| Produce More Than 300 Acres | 6.35 | 12.16 | 17.19 | 25.44 | 15.64 | 24.95 | --- | 24.60 | f.o.b. farm |
| | | | 23.82 | 36.21 | 22.27 | 35.72 | --- | 35.37 | Method I |
| | | | 22.31 | 34.74 | 20.76 | 34.25 | --- | 33.90 | Method II |

[a] To get 1968 production costs on a comparable basis with 1969 harvest and delivery costs, they (Table 2) were adjusted for the 5 percent increase in the index of prices paid by farmers.

[b] In lieu of production costs for those not producing turfgrass, the average price of $657.09 per acre (14.28 cents per square yard) for unharvested turfgrass was used in the cost calculation for 1976 and $339.90 (7.39 cents per square yard) for 1969.

# Table 5

Return to Management from the Sale and Transportation of Harvested Turfgrass by Farm Size, Methods of Harvest and Transportation, Maryland, 1969 and 1976[a]

| | Hand-Directed Hand Rolled | | Tractor-Powered Hand Rolled | | Palletizer, Palletized Handling | | Transportation Option |
|---|---|---|---|---|---|---|---|
| | 1969 | 1976 | 1969 | 1976 | 1969 | 1976 | |
| Purchase by the Acre | 7.27 | 27.74 | 8.52 | 28.23 | --- | 28.61 | f.o.b. farm |
| | 7.64 | 32.47 | 9.19 | 32.96 | --- | 33.31 | Method I |
| | 9.15 | 33.94 | 10.70 | 34.43 | --- | 34.78 | Method II |
| Produce Less Than 100 Acres | 7.94 | 28.54 | 9.49 | 29.03 | --- | 29.38 | f.o.b. farm |
| | 8.31 | 33.27 | 9.86 | 33.76 | --- | 34.11 | Method I |
| | 9.82 | 34.73 | 11.37 | 35.23 | --- | 35.58 | Method II |
| Produce 100-150 Acres | 8.54 | 30.40 | 10.09 | 30.89 | --- | 31.24 | f.o.b. farm |
| | 8.91 | 35.13 | 10.46 | 35.62 | --- | 35.97 | Method I |
| | 10.42 | 36.60 | 11.97 | 37.09 | --- | 37.44 | Method II |
| Produce 151-300 Acres | 8.84 | 31.14 | 10.39 | 31.63 | --- | 31.98 | f.o.b. farm |
| | 9.21 | 35.87 | 10.76 | 36.36 | --- | 36.71 | Method I |
| | 10.72 | 37.34 | 12.27 | 37.83 | --- | 38.18 | Method II |
| Produce More Than 300 Acres | 8.31 | 29.86 | 9.86 | 30.35 | --- | 30.70 | f.o.b. farm |
| | 8.68 | 34.59 | 10.23 | 35.08 | --- | 35.43 | Method I |
| | 10.19 | 36.06 | 11.74 | 36.55 | --- | 36.90 | Method II |

Column group header: Method of Harvest (spanning Hand-Directed Hand Rolled, Tractor-Powered Hand Rolled, Palletizer, Palletized Handling)

[a] In determining the return to management, gross receipts f.o.b. at the farm were based on a harvest of 4,600 square yards per acre and a harvest price of 55.3 cents per square yard (25.5 cents in 1969). The price for delivered turfgrass was 70.8 cents per square yard (32.5 cents in 1969).