ECONOMIES OF SIZE BY LEVEL OF MECHANIZATION IN DRY GROCERY
WAREHOUSES WITH IMPLICATIONS FOR MARKET PERFORMANCE

by

Gerald E. Grinnell, Terry L. Crawford, and Gerald Feaster
Economic Research Service
U.S. Department of Agriculture

Introduction

Wholesale and retail grocers have adopted relatively few major innovations during the past 50 years. However, several innovations are now available including universal product code, electronic checkstands, electronic funds transfers, super stores and hyper markets, modular packaging, and mechanized warehouses. This paper reviews developments relating to mechanized warehouses.

Research Findings

Case and Company, a management consulting firm, prepared a report for the Economic Research Service, on recent innovations for increased mechanization of dry grocery warehouses. Functional input-output relationships were developed using economic engineering techniques. These functions were extended by ERS to analyze returns on incremental investment of batch-pick-to-conveyor and vending type warehouses compared to conventional operations. In batch-pick-to-conveyor warehouses, cases are manually selected and moved by conveyors to staging areas at the docks. In vending warehouses case selection is fully automatic with items released onto conveyors which carry them to staging areas at the docks. The analysis included impacts of variations in output, number of items handled, and wage rates.

The following is a summary of the findings:

1. Conventional batch-pick-to-conveyor, and vending type warehouses each showed economies of size, although much greater savings were possible for the more mechanized types of warehouses.

2. Batch-pick and vending warehouses of the types studied, other things equal, were not feasible when weekly throughput was only 100,000 cases and wages were $12.00 per hour.

3. Other things equal, comparisons of returns on incremental investment (R.O.I.) between the more mechanized types of warehouses and conventional warehouses, handling 4,600 items, produced the following findings:

   a. At 200,000 cases per week and a $12.00 wage rate, the vending type warehouse showed a return of about 7 percent while batch-pick showed an 11 percent return on the incremental investment required over that of the conventional warehouse.

   b. At 500,000 cases per week, return on the incremental investment required for the vending warehouse ranged from 10 percent to 27 percent compared with conventional, as wage varied from $5.00 to $12.00 per hour. Under
the same conditions the batch-pick type warehouse gave returns on incremental investment ranging from 21 percent to 45 percent.

4. Other things equal, increases in the number of items handled from 4,600 to 7,000 increased return on incremental investment of vending type warehouses and decreased R.O.I. of batch-pick type operations compared to conventional.

5. The batch-pick warehouse produced greater returns on the required incremental investment over conventional than did vending warehouses for all combinations of wage rates and volume when the number of items handled was 4,600. Relative merits of vending operations improved as the number of items handled was increased.

In short, feasibility of more mechanized types of warehouses increases when wage rates and level of output are increased. The more mechanized equipment is expensive - equipment for batch-pick-to-conveyor adds about $2 million to the initial investment required for a conventional warehouse while the vending equipment raises this outlay by about $3.7 million.

Viability of Conventional Warehouses

The research findings have shown that conventional warehouses can benefit from economies of size but that higher output and wage rates increase the potential benefits of the more mechanized types of grocery warehouses. There is strong evidence that conventional warehouses may reduce significantly the comparative advantages of more mechanized operations by adopting partial automation and by reorganizing warehouses and operating practices.

First, by segregating slower moving items to the rear of the warehouse and halving the selection frequency of these items, total labor costs could be reduced by two percent. Second, by selecting four store orders simultaneously conventional warehouses could reduce selection time by about 10 percent and total direct labor by about five and one-half percent. Conveyerized warehouses were more efficient than conventional operations, in part, because the conveyerized facilities batch-picked store orders.

Third, conventional warehouses could increase labor productivity by using pick slot runners and flow racks to reduce replenishment and selection costs. Productivity of the conveyerized operation was higher than in the conventional, in part, because pick slot runners enabled selectors to pull reserve pallets forward manually making possible a one-third reduction in fork-lift replenishment. The vending type warehouse used slides to move cases forward in the picking slots.

Fourth, adoption of the mechanized order selection equipment forces firms to increase managerial and organizational discipline which in itself increases productivity. Although innovating firms claim the improved productivity can only be achieved with the mechanized equipment, we feel the issue is not settled. Well managed and disciplined conventional warehouses, performing above average, can be quite efficient compared to the more mechanized operations.

Fifth, equipment manufacturers are introducing new equipment designed for relatively small warehouses. One manufacturer, for example, has introduced vending type order selection equipment that is about one-quarter as large as the previous vending machine and sells for about $850,000 compared to $3.7 million for the larger machine. Although designed for use in small facilities, it may be more feasible for partial automation of larger conventional operations.
Future Developments

Assuming annual wage increases of 7 percent, in 1986 firms will face wage rates, including fringe benefits, of $15 to $23. By buying mechanized equipment now, operators can lock in today's equipment prices as a hedge against future wage increases. A shift to a high degree of mechanization could have a significant impact on market structure. Once the initial investment is made the relatively low variable costs combined with a need to spread the large fixed costs may result in a margin and cost squeeze on small non-mechanized operations. Relatively small profit margins and rather high financial leverage of many grocery distributors may make them vulnerable to failure and liquidation or merger when competitive conditions tighten, even for relatively short periods.

On the basis of current economic conditions, it appears unlikely that more than 50 dry grocery warehouses could justify adoption of high volume, highly mechanized equipment. Very recent developments concerning mechanization of grocery warehouses may enable small operations to gain some of the advantages of advanced mechanization without requiring the large initial capital outlay. If the advances in mechanization of small warehouses prove viable another 150 warehouses might be added to the list. This still would account for only one-third of the 600 grocery distribution centers now in existence.

Conclusion

Much information is now available to analyze productivity of dry grocery warehouses varying in level of output, technology used, number of items handled, operating procedures employed, etc. Additional information appears to be accessible to complete most production economic analyses of modern dry grocery warehouses. Further research is needed to:

1. Survey actual and potential productivity of existing warehouses;

2. Expand analyses of mechanization to include perishables departments;

3. Assess the long-term survival prospects of small warehouses and wholesalers in the at-home branch of the food distribution system; and

4. Assess impacts of innovations outside the warehouse on warehouse operations. This would include: backhauls, modular and standardized packaging, shipment of items by manufacturers in bins and other bulk display containers, increased store size, product damage, sanitation, union restrictions, etc.

One of the largest voids in economic research in grocery wholesaling and retailing continues to be in the area of market structure, conduct, and performance. Findings of cost studies conducted thus far will be very valuable in this effort when combined with information from other sources. Still, a great deal of information is needed on operating practices, pricing policies, margins, functions performed, services rendered, etc. to complete analyses of industrial structure and its implications for market performance which is of great importance to farmers and consumers as well as market participants. Equally important are findings which can serve as a sound information base for decisions in this area by public policymakers.

Footnote

1 Terry Crawford and Gerald Grinnell reported the findings of this study, "Performance Comparisons of Conventional,
**Cost and Innovations in Distribution Trucking**

by

Terry L. Crawford, Gerald Feaster, and Gerald Grinnell

Economic Research Service

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**Introduction**

Transportation costs are a significant portion of the total cost of marketing food products. For-hire charges for intercity transportation account for 5 cents of the consumer's food dollar. Additional trucking costs are incurred by grocery distribution firms operating their own fleets. Higher energy prices and other transportation cost increases require prudent evaluation of truck fleet operations, including operating practices, routing, and possible adoption of recent innovations applicable to truck operations.

The Economic Research Service has maintained research in the area of marketing cost for food products including transportation for some time. ERS commissioned a study by Case and Company, a management consulting firm, to evaluate distribution trucking costs as part of a systems analysis of various distribution functions such as warehousing, trucking, and store operations. A key element in this study is the measurement of potential improvements in the food distribution system through development of basic production functions for direct delivery and delivery via food...