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# Research and Development of Food Processing Firms

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Many new food products and methods of production are due to research and development (R&D) which cost food industries $428 million in 1978, according to the National Science Foundation. The R&D intensity of the food industries—R&D expenditures in food divided by food sales—was 0.4 percent in 1978, which was the lowest for all manufacturing industries.

Despite the low R&D intensity in food manufacturing, the rate of technological change in food, as measured by increasing labor productivity, is about average for all manufacturing industries. The explanation of this paradox is that technological change in the food sector is due not only to research in the food industries, but also to research in chemicals, machinery, and many other industries.

Technological changes in food industries occur through the development of new products and new production processes. For example, the introduction of frozen juice concentrates and instant hot cereals gave consumers new food products. The development of a new production process to freeze dry coffee is an example of a process invention.

Additional examples of process inventions are the development of a new conveyor belt and the substitution of plastic for glass bottles.

Technological change in food manufacturing is also affected by changes in technology outside the food industry. The use by food firms of small computers to help control the food production process is an example of how new nonfood technologies can lead to technological change in the food industries.

### Explaining Food Firms' R&D Expenditures

The resources devoted to R&D activities vary widely among U.S. food processing firms. A look at the R&D expenditures of 10 large food processing firms shows expenditures ranging from $800,000 for the Pabst Brewing Company to almost 100 times that amount, $79.1 million, for General Foods Corporation.

Why do firms' R&D expenditures differ so widely? Research and development expenditures of firms represent a form of investment by those firms. Since firms benefit from reduced production costs or increased sales from new or improved products over a period of years. But, investment in R&D is an optional investment. While meat packing firms, for example, must periodically invest in factories and machinery if they are to continue packing meat, they need not invest in R&D.

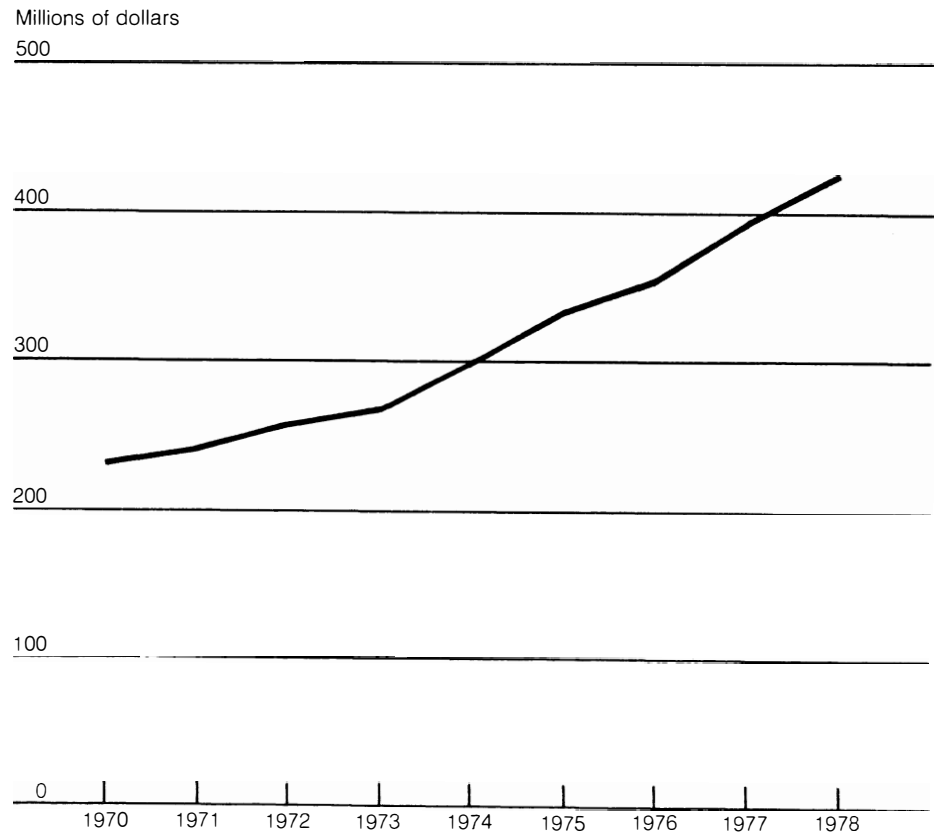
Firm size, the percentage of total industry sales enjoyed by the leading four firms, and the degree of diversification are hypothesized by economists to affect the amount of money a firm spends on R&D activity. A mathematical model was developed to determine the relative importance of these three characteristics in explaining differences in R&D expenditures for American food processing firms.

### Firm Size

There are two reasons why a firm's R&D expenditures might increase more than proportionately with its size. First, economies of scale in research and development may—up to some point—diminish the unit costs of research as the R&D laboratories increase in size. This occurs if R&D laboratories use expensive, specialized equipment and specialized personnel. Then, for unit costs of R&D to be at a minimum, labor and equipment must be fully employed.

A second reason is because large firms receive larger benefits than small firms from the development of new products and new production processes. When a firm introduces a production process innovation, the extent of cost savings depends on the

**Research and Development Expenditures in Food Processing Industries**



scale of production and costs. If one firm's sales and costs are twice those of another's, identical percentage costs savings will result in total cost savings that are twice as great for the larger firm.

Larger firms generally have the financial resources to better promote new products. For example, General Mills recently spent over $10 million to introduce its new Crispy Wheats 'n Raisins Cereal.

On the other hand, some economists argue that smaller firms have an advantage over larger firms in the process of deciding to engage in particular research projects. They argue that since a large firm is likely to have more decision-making stages than a smaller firm, the managers of a large firm have more chances to decide against investing in any specific R&D project.

In the model, firm size was measured by the total assets of food processing firms. Firm R&D expenditures increased more than proportionately with firm size up to a firm size of about $150 million in assets (1967 dollars)—about one-sixth the size of the largest firm studied—and increased at a diminishing rate for larger firms.

### Market Power and Diversification

Market power and firm diversification also help to explain inter-firm differences in R&D expenditures. Market power exists in an industry when one or a few firms produce a large percentage of an industry's total sales. In this situation, price competition may be lessened because each firm realizes that others will probably meet any price cuts. As a result, firms in industries where there is market power usually earn greater profits than firms in competitive industries. These larger profits may increase firms' R&D by providing the financial resources necessary for investing in R&D. However, since price competition is lessened, the need to engage in R&D to reduce costs may be lessened.

In the model, firm R&D expenditures increased as the leading four firms' share of industry sales increased from 0 to about 60 percent. When the leading four firms' share increased beyond 60—a level which represents high market power—firm R&D expenditures declined.

Diversified firms—those that manufacture more than one product—are likely to invest more heavily in R&D than specialized (one-product) firms. If diversified firms engage in R&D projects in several of their product lines, the risk of R&D investment is reduced since projects that fail may be offset by those that succeed. Results of the model confirm that R&D expenditures increase with increasing firm diversification.

### The Larger Picture

These results demonstrate that the characteristics of U.S. food processing firms and of the markets in which they sell their products play an important role in determining their R&D expenditures. However, much of the research on food technology may actually be performed by individuals, firms, and other institutions outside the food processing industries.

Analyses of a group of patents awarded for mechanical inventions suggests that R&D by U.S. food firms may not be the most important determinant of changes in food technology. Except for the starch industry, where 67 percent of the patents granted to U.S. corporations were assigned to starch companies, U.S. food processing companies accounted for less than 30 percent of the patents granted to U.S. corporations. And, when patents from all sources are considered only 9 percent were traceable to U.S. food firms. Technological changes in food processing appear to be heavily influenced by research performed by organizations outside the U.S. food processing industries. ■

### References

Working Paper No. 47 (1980) of the North Central Research Project NC-117 presents a more detailed discussion of the economic hypotheses and the statistical tests. This paper is available from the Food Systems Research Group, Department of Agricultural Economics, University of Wisconsin, Madison, Wisconsin 53706.

**Research and Development Expenditures of Ten Large U.S. Food Processing Firms, 1979**

| Firm name | Firm's R&D Expenditures |
|---|---|
| | Million Dollars |
| Standard Brands Inc. | 8.7 |
| Oscar Mayer & Co. | 4.9 |
| CPC International Inc. | 33.9 |
| Campbell Soup Co. | 18.8 |
| General Foods Corp. | 79.1 |
| Kellogg Co. | 11.4 |
| Nabisco Inc. | 11.1 |
| Carnation Co. | 10.5 |
| Hershey Foods Corp. | 3.6 |
| Pabst Brewing Co. | .8 |

Source: Standard and Poor's Compustat Services, Inc.

**Orgins of a Group of Patents for Six Food Manufacturing Industries, 1969-1977**

| Industry | U.S. Food Firms Within the Industry Share of: Patents Assigned to U.S. Corporations | Total Patents |
|---|---|---|
| | Percent | |
| Beer | 28 | 7 |
| Meat | 18 | 11 |
| Dairy | 22 | 8 |
| Sugar | 22 | 6 |
| Poultry | 21 | 13 |
| Starch | 67 | 29 |
| Six Industries' Averages[1] | 24 | 9 |

[1]Weighted by industry shipments.

Source: Culbertson, John D. and Willard F. Mueller. *The Influence of Market Structure on Technological Performance in the Food Manufacturing Industries.* Working Paper 47 of North Central Regional Research Project NC 117. October, 1980. p. 17.