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THE ECONOMIC ANALYSIS OF CONGLOMERATE FIRM GROWTH USING
CONSTANT DOLLAR MEASURES

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**THE ECONOMIC ANALYSIS OF CONGLOMERATE FIRM GROWTH
USING CONSTANT DOLLAR MEASURES**

by

WAI WONG

**A dissertation submitted to the Graduate Faculty in
Economics in partial fulfillment of the requirements
for the degree of Doctor of Philosophy, The City
University of New York.**

1981

This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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CHAPTER I

INTRODUCTION AND SUMMARY OF FINDINGS

The Growing Importance of Large Conglomerate Firms

The conglomerate merger wave of the late 1960's and the resulting increase in the number of giant conglomerate firms has raised a number of questions about the effects these firms might have on our competitive market system. The movement toward increasing numbers of large conglomerate mergers reflects a shift in the direction of merger activity away from predominantly horizontal mergers. This shift dates back to the passage in 1950 of the Celler-Kefauver Act and its strict interpretation by the courts. With horizontal mergers effectively foreclosed, corporate growth-by merger in the 1960's and 1970's has been increasingly accomplished by diversified and conglomerate mergers.

Legislators and others have noted with concern that the share of manufacturing assets owned by the 200 largest corporations rose from 46 percent in 1947 to 61 percent in 1972, and that a significant part of the increase was the result of conglomerate mergers. Some economists, most notably Professor Corwin Edwards, have claimed that conglomerate firms possess and employ anticompetitive powers by virtue of their large absolute size and the many markets in which they operate.

Central to this issue is the argument put forth by O. E. Williamson, W. J. Baumol, R. L. Marris and others on the modern large corporation. Because of this separation, they argue, managers, in cases in which the two objectives conflict, are more likely to choose to maximize the growth of the firm than maximize profits. One principal method of achieving more rapid firm growth is through mergers and acquisitions, and this method, in combination with the strict

prohibition of horizontal mergers, may explain the rise of the conglomerate firm. Once the conglomerate has been built, it is argued, its managers can, at the expense of short-run profits, maximize sales through such anticompetitive practices as cross-product subsidization, reciprocity, and full-line selling. In sum, bigness and a greater degree of diversification have increasingly come to be characteristic of the business corporation and it is this combination that concerns antitrust authorities.

Sources of Detailed Data on Conglomerate Large Companies

Numerous studies have attempted to describe and analyze the characteristics of conglomerate firms. They have been frustrated, however, by the lack of detailed product and industry data for these companies. To accurately describe the conglomerate firm, data on individual product operations are necessary. Companies are in general not required to report such information however, and are understandably very careful in making it available. Although detailed data of this nature are required in reports to the Census Bureau, they are reported under strict guarantees of confidentiality.

To meet the growth need for more up-to-date and accurate product line data, several private data gathering and disseminating companies emerged during the early 1960's. Using survey procedures that guarantee confidentiality, these companies were able to obtain, by enterprise, a listing of products by four-digit manufacturing SIC industries and the number of workers employed in each product line. In suitably summary form, these data are sold primarily to industrial marketing managers and are organized with the needs of such managers in mind.

It is the purpose of this study to use such data to describe and analyze conglomerate firms in a greater degree of detail than heretofore has been done. The product mix of the diversified firm and its change through time are examined. In addition, comparisons of product mix of different conglomerate firms are made.

An additional application of the detailed product data developed in this study is to examine the differential price trends of the various component industries of the conglomerate firms chosen for analyses. The BLS publishes wholesale price indexes in sufficient detail to permit us to deflate current dollar sales estimates as the four-digit SIC industry level of classification. This is important because, as will be seen, differential price changes can seriously distort the comparison of growth rates. This is perhaps most clearly seen in the relative position of Exxon and General Motors on Fortune's list of the 500 largest industrials. While G. M. ranked second, the gasoline price explosion that occurred after the oil embargo in 1973, boosted Exxon's current dollars sales sufficiently so that in the Fortune's list of 1974, 1975 and 1976, Exxon ranked first and G.M. fell from second place.

The primary objectives of the present study are the development of current and constant dollar sales data by four digit SIC industries for each of ten large diversified conglomerate companies. These estimates are based on detailed manufacturing plant data provided by Marketing Economic Institute. MEI is a private marketing research company reporting detailed data on approximately 40,000 industrial plants which account for nearly 80 percent of the total U.S. value added by manufacture. The company has such data for five

different years spanning the 1965-1976 period, thus providing the basis for comparisons over the eleven-year period 1965-1976. The techniques for estimating detailed product line sales and for deflating these by appropriate price indexes are described in detail in Chapter Two.

The Companies Examined in this Study

The ten companies examined in this study are large conglomerate manufacturing concerns with diverse operations in many markets. Six of the ten companies are leading chemical producers with many diverse product lines. The chemical companies are: Allied Chemical, American Cyanamid, DuPont, FMC, W. R. Grace and Union Carbide. Two are leading electrical and electronic equipment producers—General Electric and TRW. The remaining two—3M and B. F. Goodrich, are the large producers of paper and allied products and rubber products, respectively. Five of the ten companies—American Cyanamid, FMC, 3M, W. R. Grace and TRW had actively engaged in mergers and acquisitions during the period of analysis.

Over the 1965-1976 period, the ten companies as a group grew by 172.3%# in current dollars, while current dollar GNP grew by 143.8%. In 1965, all but one company (TRW) ranked in the top 100 on Fortune's list of the 500 largest U.S. industrials. by 1976, three of the ten companies had increased their relative positions among the top 100 largest industrials, while six companies had experienced a decline and the remaining one had maintained its relative position. (See Table 1). In 1965, on average, the ten companies had manufacturing operations in 20.9 four-digit SIC industries. By 1976, the average number of four-digit industries per company had grown to 24.6.

Evaluation of the Accuracy of the Estimated Sales Data

Having obtained current dollar estimates of sales by product lines, the sum of product line sales should be nearly equal to companywide sales as reported in companies' annual reports to stockholders. Discrepancies however, will inevitably exist between our estimated measure and the reported companywide sales. The sources of these discrepancies can be classified into three categories: (1) the scope and reliability of the raw figures provided by the private marketing research company, (2) the estimation technique and (3) accounting differences between our estimated measure and the companies' reported sales. Each source of discrepancy is examined thoroughly and the directions of bias are noted in Chapter two.

Detailed evaluations of the discrepancies for each company have been made using companies' reports to stockholders, filings with the SEC, various brokerage house reports and a variety of other publications. In this way an in-depth examination of each company was made with respect to product information and historical developments. Such a detailed evaluation and reconciliation of the discrepancies between our estimated measure of sales and reported sales was made for each year and for each company. These are presented in the case studies section of the study included as appendices.

Describing the 1965-1976 Trend Size and Diversification

In Chapter Three we present current and constant dollar estimates for the ten companies with respect to their relative size, growth, degree of diversification and change in the degree of diversification for the period 1965-1976. The trends there presented confirm that significantly different perceptions of growth and change emerge when the characteristics of a

TABLE 1
RANK IN THE FORTUNE'S LIST OF 500 LARGEST
INDUSTRIAL COMPANIES

	<u>1965</u>	<u>1976</u>
Allied Chemical	54	82
American Cyanamid	77	107
DuPont	12	16
FMC	70	97
General Electric	4	9
B. F. Goodrich	64	112
W. R. Grace	59	50
3M	60	53
TRW	107	71
Union Carbide	21	21

conglomerate company are described in constant dollar terms as compared to current dollar terms. For example, when sales growth is measured in current dollars, Allied Chemical appears to have grown faster than 3M over the 1965-1976 period. However, when sales growth is measured in constant dollars, the reverse is true.

Because the product mix of each conglomerate is unique and changes uniquely over time, individual product price changes are needed to yield clear measures of real growth. Comparison of the current and constant dollar growth series with those of several reference series (GNP and various indexes of industrial value of shipment in current and constant dollars) provided insight into the divergence between the estimated current and constant dollar growth series. These comparisons revealed that the divergence between estimated current and constant dollar growth series were small in the first seven to nine years of the period 1965-1976. Beginning in 1972 and 1974, the divergence increased considerably, primarily because of the rise in prices of certain petrochemical products.

Comparison with the Berry Measures of Diversification

Another study that has attempted to measure the degree of diversification of a conglomerate firm is that by Professor Charles Berry.¹ As in the present study, Berry used private marketing research data, the detailed nature of which allowed Berry to examine the proportion of employment assigned to the various products of a conglomerate firm. With this, Berry was able to develop, by applying the Herfindahl-Hirschman Index, a measure of the degree of diversification which would take into account not only the number of industries but also the distribution of employment among the various industries.

The Berry approach was applied in this study, using the estimates developed in this study and the measures found were compared to those of Berry for the year 1965. On a company-by-company basis, a high degree of correspondence was found between Berry's measures and our measures of diversification on the narrower four- and three- digit levels of classification detail. A lower degree of correspondence was found on the broader two-digit level.

On an overall basis, Berry's indexes suggest a higher degree of diversification for the ten companies than do our measures. Several explanations for differences between our measure of diversification and Berry's are offered and are presented in Chapter Three. Among these is our focus on the distribution of estimated sales among the various industries as opposed to Berry's distribution of employment. This approach avoids the implicit assumption made in Berry's analysis that plant production in all industries is proportionate to employment. Put another way, our approach takes explicit account of variations in output per employee among different industries.

Also presented in Chapter Three is a detailed comparison of Berry's source of raw figures and our source. Differences between the two sets of data were found to be due principally to differences in coverage. Berry's source included certain non-manufacturing industries while our source covered the manufacturing sector only.

Differences between current and constant dollar measures of the degree of diversification also were found. Using Herfindahl-Hirschman's diversification index formula to measure the extent and change in the degree of diversification, rank reversals were found when current and constant dollar measures were compared. For example, while DuPont ranked among the ten as

the seventh most diversified company in current 1976 dollars on the four-digit level, it ranked ninth in constant (1967) dollars. Over the 1965-1976 period, DuPont's degree of diversification on the four-digit level decreased by .3% when measured in current dollars, but when measured in constant dollars it decreased by 2.5%. Moreover, differences were found in the specialization ratios of each firm (defined as the proportion of sales contributed by the firm's principal two-digit product) when measured in current and constant dollars. In either current or constant dollars however, each of the ten companies had at least 40% of its overall sales contributed by its principal two-digit product.

Summary of Findings

As indicated above, this study produced current and constant dollar sale series by four-digit SIC industries for ten large and widely diversified conglomerates. These data were then used to test several hypotheses about the relationship between sales growth and changes in the various structural characteristics of the companies (Chapter Four). The sample size is small and this meant that less powerful nonparametric statistical tests had to be used. In a number of cases these tests yielded significant results.

Growth Differences Between Margin and Non-Margin Companies

Preliminary tests were made for sales growth differences between merging and non-merging companies. Results for both current and constant dollar data indicated that merger-orientated companies grew more rapidly than non-merger orientated companies. This finding is not surprising. Virtually every study of the relationship between merger activity and sales growth has found that merger-orientated corporations have generally achieved more rapid sales growth.

This more rapid sales growth can result from the once-and-for-all addition of the acquired companies' sales, from any possible synergistic effects of mergers or some combination of the two effects. To separate the two growth contributions, certain post-acquisition data are required. This data requirement is beyond the scope of the data developed in this study and as a result only a cursory examination has been made of the distinction between growth through mergers per se and internal growth.

Growth Differences Between Chemical and Non-Chemical Companies

Tests were also made for sales growth differences between chemical and non-chemical companies. Current dollar comparisons indicated that chemical companies grew more rapidly than non-chemical companies. However, when the tests were performed using the constant dollar series developed in this study, the comparison indicated no differences in Sales growth between the two groups. The conclusion reached here was that the rapid rise in the prices of certain petrochemical products during the mid to latter part of the 1970's was primarily responsible for the rapid growth in current dollars sales.

Diversification as a Means for Sustaining Rapid Firm Growth

Tests were next made of the validity of a common argument for diversification, i.e., that firms facing unfavorable growth opportunities within their established (primary) markets would be those most likely to grow by diversifying into less closely-related markets. In contrast, firms with substantial potential for growth within their primary markets would tend to expand into areas closely related to the primary markets. The statistical tests indicated that there was no significant relationship between the change in the diversification index within the firm's primary two-digit industry

(diversification being measured on the three- and four-digit levels) and the sales growth of the primary two-digit industry. The tests also found no relationship between change in diversification (on the two-, three- and four-digit levels) outside of the firm's primary industry and sales growth of products outside of that primary industry.

Principal Products and the Recency of Operations in a Two-Digit Industry

These findings were compared with those of Charles Berry in his study of 460 large industrials for the years 1960 and 1965. Although the evidence in both studies pointed to the same conclusion, Berry's model was somewhat different. Instead of defining a firm's set of established (primary) markets as the firm's principal two-digit product, as we had done in this test, Berry used all existing two digit products of the firm as of the base year 1960. Berry's model of corporate growth is that firms diversify into product areas (industries) related to their areas of past success (existing two-digit products-1960) and that it is those corporations whose performance and potential growth have been unsatisfactory which are more likely to branch to new and unrelated areas of productive endeavor. The model of corporate growth used in the present study differed slightly from Berry's in that we defined the areas of past success as the boundaries of the firm's principal two-digit industry.

We next undertook a detailed examination of the recent history of two-digit industries for each company relative to our base year of 1965. This examination revealed that certain two-digit industries had recently become part of the company's structure. We then argue that these recently acquired industries might reflect, in reality, diversification away from the firm's diminishing primary industry's growth performance and that it is difficult to

justify the labelling of these industries as areas of past success. Thus, depending on the time frame selected, Berry's broader definition of areas of past success might yield different results.

Realms of Familiarity and Principal Two-Digit Industries

We found that defining areas of past success as the boundaries of the firm's principal two-digit industry is too limited. Basing the argument on economic and technological grounds, areas of past success were defined to include not only the firm's principal two-digit product, but also any significant secondary two-digit product. Using this definition, a retest was made. The results indicated that there is a strong positive relationship between the sales growth of products in two-digit areas of past success (realms of familiarity) and the change in diversification on the three- and four-digit levels within these areas.

The results suggest that the route to corporate growth in real terms is through diversification within the firm's realm of familiarity, and that this involves diversification at the three -digit level, within the firm's principal two-digit industries. Although less reliable statistically, diversification at the two-digit level into areas outside of the firm's realm of familiarity yeilds a smaller relative contribution to overall growth.

The findings presented here tend to conflict with on of the secondary findings of Berry's study. While Berry concluded that the relationship between diversificatoin within established markets and the rate of growth of these

products is weak, the evidence here suggest that it was stronger. To establish this point, first, two-digit areas of past success (realms of familiarity) instead of a single two-digit "established" primary industry were used. Second, constant dollar measures of growth and diversification instead of current dollar measures were used. Tests based on these definitions and measures indicated that efforts to increase its diversification by investing in industries more familiar than those available outside a firm's immediate economic and technological neighborhood can be expected to reward the firm with a faster growth rate.

CHAPTER II

METHODOLOGY

Problems in Measuring Real Growth of Sales

Measurement of a company's real sales growth would not be difficult if the company produced a single product and if the product were sold in a particular market where changes in the price of the product could be monitored accurately. In this simple situation the real growth sales, which is another way of saying the growth in the physical quantity sold, can be measured by deflating current dollar sales by the change in the price of the product.

Such is not the case with many of our present day multi-product and multi-national corporations. Companies have expanded either internally through new investment or externally through mergers and acquisitions into many and varied products and into areas in which they had not produced and marketed before. It is not unusual, for example to find a chemical company operating in a number of foreign countries and, in addition to its domestic chemical business, engaging in other manufacturing and non-manufacturing operations in the United States. This diversity in product and market requires a more elaborate and detailed examination of the company's operations if one is to accurately measure its real growth.

Different patterns of price changes between countries as well as among products complicate the measurement of the real growth of a multi-product, multi-national firm. These price changes arise from two separate causes: (1) changes in the general price level caused by changes in the purchasing power of money and (2) changes in the prices of individual commodities caused by

changes in the forces of supply and demand. To accurately measure the real growth of the firm then requires (1) the identification of the specific products the company produces, (2) accurate measures of the sales of these products and (3) the specific price changes associated with each product. Thus, to measure real growth of sales, the dollar sales for each product should be deflated by its unique price index, and the individual constant dollar series then aggregated over all products.

In practice this approach is extremely difficult. Most companies, if not all, do not report sales by product lines or geographic areas. Sales are usually reported on a company-wide basis, and for very broadly defined product groups. Thus, sales for a given broadly defined product group could include current dollar sales of several distinct products as well as current dollar sales to foreign customers. In addition, companies seldom maintain a consistent set of definition for their reporting groups, moving items from one group to another occasionally and changing the number of reporting groups from time to time.

Divisional Reporting - An Historical Review

The primary purpose of financial reporting by publicly-held private corporations is to supply essential information to various interested parties, primarily to those which are investors in and creditors of the corporation. Such information is valuable because it enables these parties to more clearly assess performance and evaluate future prospects of the reporting company. Line of business reporting is one aspect of this over-all function of financial reporting and one that has been the subject of much controversy.

Under the original Securities Act of 1933 and the Securities Exchange Act of 1934, public corporations were required to identify and state the relative importance of any product or service or class of products or services which contributed more than 15 percent to the gross volume of business. The Securities Exchange Commission however, generally enforced this rule by requiring a general statement of relative sales of different products or services.² The dollar amount or percentage of sales of each class of similar products was not required. Moreover, even this general disclosure was required only at the time of filing securities registration statements³ and such statements were closely guarded and available only to the Commission.

Beginning in 1964, the government's efforts to require line-of-business reporting were increased. The effort to obtain product sales data began when Senator Philip B. Hart's Senate Subcommittee on Antitrust and Monopoly held hearings on industrial concentration. After receiving testimony to the effect that it had become increasingly difficult to determine the extent of concentration because conglomerate companies did not disclose the sales of their components, the Subcommittee turned to the Securities and Exchange Commission for advice and assistance. The Commission, which has broad authority over such required disclosures under the Securities Act of 1933, admitted that deficiencies did in fact exist in its disclosure requirements and subsequently increased its investigations in this area.

The demand for divisional reporting with respect to sales and profits has come primarily from two sources: (1) the regulatory agencies and (2) the investment community. The benefits of divisional reporting to government agencies include the facilitation of enforcement of anti-trust laws by exposing anti-competitive practices, e.g., predatory pricing in one segment supported by

monopolistic profits in another; the encouragement of new competition attracted by the knowledge that very high profits were being realized by a particular segment of diversified firm⁴ and finally, more exact analysis of a company's historical earnings and future prospects by interested parties such as labor unions and the investment community⁵

On the other hand, opposition to divisional reporting by the business community has largely been along the following lines:

- (1) it will help competitors by providing information on pricing and related policies, to the detriment of the reporting company.
- (2) the cost of developing product and divisional reporting within the company would be prohibitive, and
- (3) such disclosure will provide unions with an opportunity to focus bargaining efforts on units which are realizing strong growth and high profitability.

Starting in the mid-1960's, a number of professional organizations and governmental agencies, including the Financial Analyst's Federation, the Financial Executives Research Foundation, National Association of Accountants and the White House Task Force on Anti-trust Policy sponsored research studies to assess the desirability and feasibility of divisional reporting. Financial Reporting by Diversified Companies by Mautz⁶, the Wheat Report⁷ and the 1968 Presidential Task Force Report on Antitrust Policy⁸ (The Neal Task Force Report) are among the studies that support segment disclosure for annual reports as well as for regular registration statements filed with the Securities Exchange Commission.

The movement to encourage and require the provision of more detailed product line data has continued in recent years in both public and private agencies. The SEC (public) and the Financial Accounting Standards Board (Private), have moved to increase the number of required items of disclosure for companies' 10K, 8K, annual reports to stockholders and other filings. Prompted by the large conglomerate merger wave of the late 1960's, the Federal Trade Commission (FTC) also moved for more disclosures. The FTC contents that divisional reporting is essential for the analysis of competition.

After lengthy and numerous hearings, the SEC finally issued requirements, effective August 14, 1969, for reporting divisional sales and profits in registration statements (Forms S-1, S-7 and 10). In 1970, these requirements, effective December 31, 1970, were extended to annual reports filed with the SEC on form 10K, and in 1974 they were extended to annual reports to stockholders. Subsequent legislation required companies to supply line of business reporting to the FTC.⁹ However, it was not until 1978 that the private FASB proposed that companies provide sales and earnings breakdown by product segment as well as geographical location.

Limitations of Divisional Reporting

While a move in the right direction, the above requirements, even though combined with the 1974 SEC requirement that annual reports contain a five year summary of key product line operating statistics, still do not provide an adequate basis for computing nominal growth by product lines, let alone real growth. Sales and earnings are required to be broken down only into very broad categories so that individual products are not easily identifiable. Sales data are required, for example for a company's chemical group as a whole. The company may produce a number of distinct chemical products, for which individual sales

and price movements are not reported. Although several systems for classifying business activities are available, such as the Standard Industrial Classification, ¹⁰ and the Enterprise Standard Industrial Classification, the SEC and FASB have both left the determination of segmentation to the reporting companies.

Complicating the matter further, there is a tendency for companies to re-define their divisional or product line categories which are not fully comparable over time. In certain cases the problem of the product line redefinition was overcome in part by examining the company's 5-year summary of key operating statistics contained in annual reports. Of the 5-year summaries examined in the preliminary stages of the research, most were reported on a pro forma basis, i.e., sales (and other key operating statistics) for the previous 4 years had been restated to reflect the new definition. In this manner groups were described that were comparable over at least a 5-year period.

Depending on the number of times the product lines are re-defined, the 5-year summaries of key operating statistics will be of greater or lesser value. If, by change, there were no further changes in the following 5 year period, then comparable groups over a 10-year period could be examined. If on the other hand, another format were adopted for the following 5 years, then there would be two different sets of 5-year summaries covering a 10-year period. In the extreme case of a new redefinition covering a 10-year period. In the extreme case of a new redefinition in every year for the next 5 years, six different sets of 5-year summaries covering the 10-year period would exist. Each set provides comparable groups over a given 5-year period - the year of implementation of the new format plus the previous 4 years.

Another complication is introduced if the company had actively engaged in mergers, acquisitions and divestitures which, more often than not, are accompanied by a re-definition of product line. Even though the current pro forma 5 year summary describes comparable groups, an acquisition (or divestiture) in the current year will distort the comparison of sales of the current year with sales of the previous 4 years. The distortion arises because restated sales of the previous 4 years include (exclude) the historical sales of the newly acquired (divested) business. Thus, whenever an acquisition (a divestiture) occurs, restated sales of the previous 4 years will exceed (will be below the reported sales the company actually experienced.)

Finally, many companies have foreign operations which are not broken down into categories or reported separately. Thus, in addition to the problems of obtaining sales by product lines, there also arises the probability of possibly diverse domestic and foreign price changes.¹¹

The Method

The approach employed in this study does not utilize the existing breakdown of product line sales and profits. Rather it focuses on the estimation of domestic value of shipments by 4-digit SIC manufacturing industries for each year under observation. The estimation of value of shipments, by 4-digit SIC industry is based on employee data for these SIC industries. To obtain real growth in sales, each 4-digit product sales estimate is deflated by its corresponding 4-digit wholesale (producer) price index.

The approach employed here consists of four steps:

- the first step is to identify the products of the company according to a 4-digit SIC code for the years under examination.
- the second step is to determine the number of employees of the company in each of the SIC industries identified in the first step for each of the years under examination.
- the third step is to estimate current dollar sales (value of shipments) for SIC industry based on the ratio of value of shipments to employees for years under examination.
- the fourth step is to deflate the estimated current dollar sale for each product line by appropriate price index.

Describing the Detailed Data Used in the Estimation of Sales

The source utilized to accomplish the first and second steps is Marketing Economics Key Plants, a bi-annual publication of the Marketing Economics Institute, Ltd. MEI is a private marketing research company which has developed marketing purposes. The data are designed for managers responsible for marketing, sales promotion, market research and planning. Its Marketing Economics Key Plants reports are available for the years 1967, 1970-71, 1973, 1975-76 and 1977-78. Each report contains information on approximately 40,000 industrial plants in the U.S. which account for 12 percent of the number of plants in the country and nearly 80 percent of the total U.S. value added by manufacture. Each plant is listed by company, address, principal 4-digit SIC product, and number of workers employed. The task of identifying the products

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of a company and the number of employees associated with each product involved identifying the plants associated with the company and summing, for each SIC industry, the number of workers in the company's plants having the classification.

The method employed by MEI to obtain plant names and number of workers is based on an elaborate and detailed process of cross referencing. MEI maintains comprehensive library of information on U.S. industrial plants with 100 or more employees by regularly checking with State Directories, local Chamber of Commerce, the County Business Pattern publications of the Bureau of the Census and the Social Security Administration. Using these sources, MEI is able to identify key plants (100 or more employees) on a geographical basis. Then using local sources, MEI supplements and confirms this information. Among other things, it consults local telephone directories and Post Offices for changes in addresses or names. More importantly, local checking provides a means of direct contact with the plant itself so that the number of employee figures can be verified. To preserve confidentiality, MEI rounds its detailed employment data to the nearest hundred employees. Although MEI attempts to confine its measure of employment to the number of production workers, in the majority of the cases total employees were reported instead.

Another source of verification is the data users themselves. Feedback (corrections, verification, updates) is received from clients who are willing to provide data on their own operations. Other knowledgeable sources also provide much useful information.

Since MEI relies so heavily on local sources and direct confirmation, there is a considerable time lag in the publication of its tabulations. In pursuing this point with MEI, it was learned that the lag time varied somewhat with each publication and that the publication did not specifically describe the year to which the data applied. The lag time was thus estimated by comparing, on a company-by-company basis, the SIC numbers from MEI directories with the merger and acquisition activity of companies. From various sources including annual reports, 10K, F.T.C. Statistical Report on Mergers and Acquisitions, and the Conference Board's Announcements of Mergers and Acquisitions, it was possible to detect new SIC additions or deletions of a company for any given year. Although the comparison did not yield a 100 percent correlation, it nevertheless confirmed the approximate lag estimated by MEI. This was as follows:

Year of Publication:	1967	1970-71	1973	1975-1976	1977-78
Year of Data:	1965	1968	1972	1974	1976

The 1967 Standard Industrial Classification system was used for the years 1965, 1968 and 1972, and the 1972 Standard Industrial Classification system was used for the years 1974 and 1976. To facilitate the analysis, all classifications were converted to the 1972 SIC codes. This created no problems since each plant was classified according to its primary product and in converting from 1967 to 1972 codes, a 1 to 1 correspondences remained. Furthermore, since the addresses of the plants were known, the change in the SIC system was easily discerned from the MEI directories.

To estimate current dollar sales for each SIC industry and for each of the years under examination, we relied on the Census of Manufacturer's Annual

Survey of Manufacturers for the years 1965, 1968, 1974 and 1976. For 1972, the Census of Manufactures was used. The Annual Survey permitted the calculation of the value of shipment per worker for each of the industries being examined. Multiplying the value of shipments per worker ratios by the number of workers for the company's plants in each industry yielded the measure of current dollar sales in the 4-digit category.

Implicit in this procedure, of course, was the assumption that each plant operates at the industry's average value of shipments per worker. This is a bold but necessary assumption. There is variation in efficiency and technology among plants in the same industry and over time. However, the degree and direction of these errors is probably consistent over, and as such should not seriously distort the comparative measure of constant dollar growth.

Using Producer Price Indices as Deflator of Sales Estimates

The fourth step was to estimate constant dollar sales by using the BLS Producer Price Index (PPI) to translate estimated current dollar into constant (1967) dollar sales for each of the company's 4-digit industries. The Producer Price Index (formerly the Wholesale Price Index) measures average changes in prices received in primary markets of the U.S. by producers of commodities. In generating the PPI series, the Bureau of Labor Statistic uses actual transaction price whenever possible.

The PPI is organized into two basic structures: (1) the stage-of-processing structure—which distinguishes products by degree of fabrication, i.e. finished goods, intermediate or semi-finished goods and crude materials and (2) the commodity structure—which distinguishes products by similarity of end-use

or material composition. Due to the diversity and complexities of the products involved with out sample, the commodity structure is employed in this study.¹²

Producer Price Indexes are published for 7 levels of commodity groupings; 8-digit level, 7-digit level, 6-digit level, 5-digit level, 4-digit level, 3-digit level and the 2-digit level. At the 2-digit level, the most general description of commodity groups, there are 15 major commodity groups:

<u>Major Commodity Group</u>	<u>Commodity Code</u>
Farm products	01
Processed foods and feeds	02
Textile products and apparel	03
Hides, skins, leather and related products	04
Fuels and related products and power	05
Chemicals and allied products	06
Rubber and plastic products	07
Lumber and wood products	08
Pulp, paper and allied products	09
Metals and metal products	10
Machinery and equipment	11
Furniture and household durables	12
Nonmetallic mineral products	13
Transportation equipment	14
Miscellaneous products	15

The four steps as outlined above will yield product line estimates defined according to a common classification systems and in categories which will permit deflation by the bureau of Labor Statistics' PPI series. This method

of obtaining product line data was applied to a small number (10) of large companies and was tested against company reported figures of accuracy.

Selection of the Sample

Three criteria were used in the selection of companies for this study. The first is that they had to be conglomerate in structure i.e., with operations in a number of different markets. Second, they had to be relatively large in absolute size and usually referred to as "conglomerates" and third, data on them had to be relatively abundant. Since the term "conglomerate" has never been commonly defined, the designation of the companies having this characteristic must be somewhat subjective. This study relies primarily on Fortune Magazine's definition of the conglomerates and used its list of 46 conglomerates as the principal basis for selection.

Fortune's definition of conglomerates takes into account the number of different unrelated products a company produces and involves a recategorization of the 78 major classes of business (at the 2-digit level) as identified by the Standard Industrial Classification Manual - 1965. Fortune limited its examination to the 500 largest industrial companies of 1967 and analyzed each company with respect to the number of categories in which each was operating during 1967. Having ranked the 500 companies according to the number of categories, Fortune then defined as conglomerates those companies having operations in eight or more categories. The Fortune list is presented in Table 2.

Characteristics of the Companies Examined in this Study

Eight of the ten companies selected for this study were selected from Fortune's list of conglomerates. The other two, TRW and Union Carbide, were

TABLE 2
FORTUNE'S LIST OF 46 CONGLOMERATES

<u>Company</u>	<u>Fortune Rank, 1967</u>	<u>Number of Categories</u>
Allied Chemical	64	9*
American Cyanamid	94	9*
American Machinery & Foundry	184	10
Armour	34	11
Armstrong Cork	188	8
Avco	84	9
Bendix	61	10
Borden	42	9
Borg-Warner	92	12
Brunswick	223	11
Castle & Cook	249	8
Chrysler	5	9
Consolidated Electronics	260	8
Dow Chemical	53	10
DuPont	13	9*
Eagle-Picher	392	8
Eltra	210	11
Evans Products	285	8
FMC	58	10*
Fairchild Camera	347	8
Farmland Industries	237	8
Firestone Tire & Rubber	37	10
Ford Motor	3	8

TABLE 2 (Continued)
 FORTUNE'S LIST OF 46 CONGLOMERATES

<u>Company</u>	<u>Fortune Rank, 1967</u>	<u>Number of Categories</u>
General Dyanmics	32	10
General Electric	4	14*
General Precision	187	8
General Tire	90	17
Goodrich (B.F.)	83	8*
Goodyear	22	8
Grace (W.R.)	43	12*
Gulf & Western	135	8
I.B.M.	7	8
I.T.T.	21	13
Johnson & Johnson	167	8
Kaiser Industries	110	8
Kidder (Walter)	204	11
Litton Industries	44	18
Locked Aircraft	30	10
Minnesota Mining & Mfg.	65	8*
National Distillers	162	9
Ogden	104	9
Olin Matieson	97	9
Rexall	161	10
Texas Instruments	152	9
Textron	49	8
Universal American	361	8

included because of their size and their considerable diversification within the machinery and chemical industries, respectively. Six of the ten companies are leading chemical producers with many diverse product lines. The chemical companies are: Allied Chemical, American Cyanamid, DuPont, FMC, W. R. Grace and Union Carbide. Two are leading electrical and electronic equipment producers - General Electric and TRW. The remaining two - 3M and B. F. Goodrich are large producers of paper and allied products and rubber products respectively. Five of the ten companies - American Cyanamid, FMC, 3M, W. R. Grace and TRW had actively engaged in mergers and acquisitions during the period of analysis.

Presented in Table -3 are the companywide sales¹³ in current dollars as reported, and index of sales for each company separately and for the 10 companies as a whole for the years 1965, 1968, 1972, 1974 and 1976. Over the 1965-76 period, and the 10 companies as a whole grew 172.3%. Individual sales growth varied significantly among the companies, ranging from a high of 340.5% to a low of 103.7% (B. F. Goodrich). In Table-4 below, companywide sales growth of the 10 companies as a whole are compared with current dollar growth of G.N.P. and companywide sales growth of Fortune's 500 largest industrials. In each of the 4 time intervals, sales growth of Fortune's 500 largest industrials exceeded the combined sales growth of the 10 companies. When the combined sales growth of 10 companies is compared with growth of GNP in current dollars, sales growth of the 10 companies exceeded GNP growth in two of the 4 periods.

Presented in Table-5 are the companies sales rank in Fortune's list of the 500 largest industrials along with the companies sales rank among themselves

TABLE 3
 REPORTED COMPANYWIDE SALES AND INDEX OF SALES
 (In Millions of Dollars)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
ALLIED CHEMICAL	\$ 1121.0	\$ 1263.0	\$ 1501.0	\$ 2216.0	\$ 2630.0
Index	100.0	112.7	133.9	197.7	234.6
AMERICAN CYANAMID	863.0	1023.0	1359.0	1780.0	2094.0
Index	100.0	118.5	157.5	206.3	242.6
DUPONT	2999.0	3455.0	4366.0	6910.0	8361.0
Index	100.0	115.2	145.6	230.4	278.8
FMC	928.9	1376.2	1497.7	2075.0	2144.7
Index	100.0	148.2	161.2	223.4	230.9
GENERAL ELECTRIC	6214.0	8382.0	10239.0	13413.0	14697.0
Index	100.0	134.9	164.8	215.9	252.6
W. R. GRACE	1003.0	1738.0	2315.0	3472.0	3615.0
Index	100.0	173.3	230.8	346.2	360.4
B. F. GOODRICH	980.1	1139.7	1506.8	1966.2	1996.0
Index	100.0	116.3	153.7	200.6	203.7
3M	1000.3	1405.0	2114.1	2937.0	3514.0
Index	100.0	140.5	211.3	293.6	351.3
TRW	655.0	1488.0	1688.0	2486.0	2929.0
Index	100.0	223.8	253.8	373.8	440.5
UNION CARBIDE	2339.0	2686.0	3261.0	5320.0	6346.0
Index	100.0	114.8	139.4	227.4	271.3
TOTAL	\$ 18113.3	\$ 23955.9	\$ 29847.6	\$ 42575.2	\$ 49326.7
Index	100.0	132.3	164.8	235.0	272.3

TABLE 4
 Percentage Change in GNP and Sales:
 10 Companies, Fortune's 500
 (in current dollars)

<u>Periods</u>	<u>% Change in Sales 10 Companies</u>	<u>% Change in Sales Fortune's 500</u>	<u>% Change GNP</u>
1965-1968	32.3%	36.5%	26.2%
1968-1974	24.6	37.6	32.6
1972-1974	42.6	49.3	20.6
1974-1976	15.9	16.6	20.8
1965-1976	172.3	227.0	143.8

for the years 1965, 1968, 1972, 1974, and 1976. Over the 1965-1976 period, 6 of the 10 companies - Allied Chemical, American Cyanamid, DuPont, FMC General Electric and B. F. Goodrich lost their respective position in Fortune's list. Three companies - W. R. Grace, 3M and TRW gained in relative position and the remaining company - Union Carbide managed to re-attain its 1965 21st place status in 1976 after in-between year dips.

Within the sample, General Electric, DuPont and Union Carbide consistently ranked first, second and third respectively for each year under observation. General Electric's sales were about 2 times the sales of DuPont. DuPont's sales in turn were about 30% higher than Union Carbide's sales. Rank ordering of the other companies fluctuated somewhat over time. In 1965, Allied Chemical was ranked 4th and had sales of less than one-half the sales volume of Union Carbide. In the later years, Allied Chemical's rank dropped to either 7th or 8th place.

TABLE 5
COMPANYWIDE SALES RANK

		<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
ALLIED CHEMICAL	Fortune rank	54	73	89	85	82
	Sample rank	4	8	8	7	7
AMERICAN CYANAMID	Fortune's rank	77	102	106	107	107
	Sample rank	9	10	10	10	9
DUPONT	Fortune's rank	12	15	16	17	16
	Sample rank	2	2	2	2	2
FMC	Fortune's rank	70	65	91	91	97
	Sample rank	8	7	9	8	8
GENERAL ELECTRIC	Fortune's rank	4	4	4	8	9
	Sample rank	1	1	1	1	1
B. F. GOODRICH	Fortune's rank	64	82	88	96	112
	Sample rank	7	9	7	9	10
W. R. GRACE	Fortune's rank	59	45	45	44	50
	Sample rank	5	4	4	4	4
3M	Fortune's rank	60	62	51	59	53
TRW	Fortune's rank	107	57	75	75	71
	Sample rank	10	5	6	6	6
UNION CARBIDE	Fortune's rank	21	26	27	22	21
	Sample rank	3	3	3	3	3

Meanwhile, W. R. Grace became Union Carbide's closest rival for 3rd place with sales of approximately 63% the sales volume of Union Carbide.

Estimation of Domestic Manufacturing Output

The objective of this study is to develop product line data using a common classification system and one which permits deflation by Bureau of Labor Statistics' PPI series. The first step in the process is the estimation of the value of shipments for each of the company's domestic manufacturing plants which are listed by 4-digit SIC industries in the MEI reports for the years 1965, 1968, 1972, 1974, and 1976. These estimates are derived by multiplying each plant's employment figures by a value of shipments per employee ratio. The calculated figures of this step for each company by 4-digit SIC industries are presented in the case studies that follow. Over the 1965-76 period, the 10 companies had operations in a total of 164 4-digit SIC (see Table 6-8 for individual company's variation in the number of 4, 3, and 2 digit SIC industries over the 1965-76 period).

Comparisons of Estimates with Reported Sales

Comparisons of sales as reported by the companies to the current dollar sales estimates made in this study reveal discrepancies of greater or lesser magnitude. Presented in Table 9 are the ratios of total value of shipments estimates made in this study to publicly reported companywide sales for each company and for each year under observation. From 1965, the sum of the 10 companies' estimated value of shipments is 76.5% of the sum of their reported companywide sales. For 1968 it is 74.3%, for 1972 it is 74.7%, for 1974 it is 70.6% and for 1976 it is 72.5% of the sum of their companywide sales.

TABLE 6
NUMBER OF 4-DIGIT SIC CATEGORIES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>	<u>TOTAL SIC IND. DURING PERIOD</u>
ALLIED CHEMICAL	17	15	15	16	15	21
AMERICAN CYANAMID	16	17	17	16	16	19
DUPONT	14	14	17	22	24	24
FMC	22	27	31	32	35	36
GENERAL ELECTRIC	52	52	53	52	52	57
W. R. GRACE	20	29	34	33	30	37
B. F. GOODRICH	11	11	10	9	9	12
3M	19	19	21	22	23	23
TRW	18	25	25	26	26	28
UNION CARBIDE	<u>20</u>	<u>20</u>	<u>17</u>	<u>15</u>	<u>16</u>	<u>21</u>
TOTAL DIFFERENT 4-DIGIT	131	142	147	150	148	
TOTAL DURING 1965-1976 PERIOD	164					

TABLE 7
NUMBER OF 3-DIGIT SIC CATEGORIES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
ALLIED CHEMICAL	11	10	9	10	9
AMERICAN CYANAMID	11	12	12	12	12
DUPONT	10	10	13	17	18
FMC	12	13	16	17	19
GENERAL ELECTRIC	30	30	31	29	29
W. R. GRACE	14	22	24	23	21
B. F. GOODRICH	11	11	9	8	8
3M	16	16	18	18	18
TRW	17	21	20	21	21
UNION CARBIDE	<u>17</u>	<u>17</u>	<u>14</u>	<u>13</u>	<u>13</u>
TOTAL DIFFERENT 3-DIGIT	67	74	75	75	73
TOTAL DURING 1965-1976 PERIOD 82					

TABLE 8
NUMBER OF 2-DIGIT SIC CATEGORIES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
ALLIED CHEMICAL	6	4	4	5	6
AMERICAN CYANAMID	5	6	5	5	5
DUPONT	6	6	6	9	9
FMC	5	5	6	7	8
GENERAL ELECTRIC	10	10	11	10	10
W. R. GRACE	8	10	11	10	9
B. F. GOODRICH	6	6	5	5	5
3M	9	9	9	9	9
TRW	8	8	8	8	8
UNION CARBIDE	<u>9</u>	<u>9</u>	<u>8</u>	<u>7</u>	<u>7</u>
TOTAL DIFFERENT 2-DIGIT	17	17	17	16	16
TOTAL DURING 1965-1976 PERIOD 18					

TABLE 9
RATIOS OF ESTIMATED SALES TO COMPANYWIDE SALES
(In Millions of Dollars)

<u>Allied Chemical</u>					
<u>Estimated Sales</u>	\$1040.1	\$1131.1	\$ 1390.3	\$ 2246.3	\$ 2793.8
Companywide Sales	1121.0	1263.0	1501.0	2216.0	2630.0
Ratio	.927	.895	.926	1.013	1.062
<u>American Cyanamid</u>					
Estimated Sales	611.5	724.2	978.7	1321.7	1673.8
Companywide Sales	863.0	1023.0	1349.0	1780.0	2094.0
Ratio	.708	.707	.720	.742	.799
<u>DuPont</u>					
Estimated Sales	2774.4	3020.2	3945.5	6082.9	7354.9
Companywide Sales	2999.0	3455.0	4366.0	6910.0	8361.0
Ratio	.925	.874	.903	.880	.879
<u>FMC</u>					
Estimated Sales	812.7	1306.8	1676.7	2104.3	2615.0
Companywide Sales	928.9	1376.2	1397.7	2074.0	2144.7
Ratio	.874	.949	1.119	1.014	1.219
<u>General Electric</u>					
Estimated Sales	4371.0	6074.6	7497.7	8660.2	9660.4
Companywide Sales	6214.0	8382.0	10239.0	13413.0	14697.0
Ratio	.703	.724	.732	.645	.615
<u>W. R. Grace</u>					
Estimated Sales	468.3	879.3	1128.4	1803.0	1954.8
Companywide Sales	1003.0	1738.0	2315.0	3472.0	3615.0
Ratio	.466	.505	.487	.519	.540

TABLE 9 (Continued)
RATIOS OF ESTIMATED SALES TO COMPANYWIDE SALES
(In million of dollars)

<u>B. F. Goodrich</u>					
Estimated Sales	667.6	878.8	1099.8	1390.5	1640.9
Companywide Sales	980.1	1139.7	1506.8	1966.2	1996.0
Ratio	.681	.771	.729	.707	.822
<u>3M</u>					
Estimated Sales	630.0	803.9	1037.6	1310.3	1647.4
Companywide Sales	1000.3	1405.0	2114.1	2937.0	3514.0
Ratio	.629	.572	.490	.446	.468
<u>TRW</u>					
Estimated Sales	788.8	1097.5	1335.7	1643.0	2113.1
Companywide Sales	655.0	1488.0	1688.0	2486.0	2929.0
Ratio	1.186	.737	.791	.660	.721
<u>Union Carbide</u>					
Estimated Sales	1696.8	1872.3	2205.5	3504.0	4289.6
Companywide Sales	2339.0	2686.0	3261.0	5320.0	6346.0
Ratio	.724	.697	.676	.658	.675
<u>Total</u>					
Estimated Sales	13861.1	17788.7	22295.9	30066.2	35743.7
Companywide	18113.3	23955.9	29847.6	42575.2	49326.7
Ratio	.765	.743	.747	.706	.725

Sources of Discrepancies

The apparent discrepancies here are due principally to the noncomparability in definition and coverage between our estimated measures and the reported companywide sales. Recall that our estimates of current dollar sales are subject to the following qualifications:

- (1) sales estimates are based on manufacturing plants only; the non-manufacturing sectors are not covered by the MEI directories
- (2) sales estimates are based on domestic operations; foreign operations are not included in MEI's population
- (3) sales estimates are based on domestic operations; foreign operations are not included in Mei's population
- (3) sales estimates are based on "key plants", i.e., plants with less than 100 workers are excluded and
- (4) the number of employees are rounded off to the nearest hundred.

Thus, the discrepancies between our estimated figures and the reported companywide sale figures can be attributed to the above mentioned characteristics of the data and perhaps also to the extrapolation of shipments/worker data technique utilized here. Moreover, since our estimate is more directly the equivalent of the value of a company's domestic manufacturing production than if its sales, discrepancies will exist due to differences between these two measures. In comparing reported sales with estimated current dollar sales, such things as inventory changes and accounting practices also must be considered.

The Scope and Reliability of MEI Data

The limitations outlined above necessarily limit comparability of estimates of domestic manufacturing activities based on the MEI data with that

based on reported sales data in the company's reports. The MEI directories supply data on domestic manufacturing plants and as such do not cover foreign operations or non-manufacturing plants and as such do not cover foreign operations or non-manufacturing activities. However, even when it is possible to exclude foreign and non-manufacturing activities from reported sales, discrepancies will still occur because:

- (a) only "key plants" are listed by MEI, plants with less than 100 employees are excluded and
- (b) the number of employees are rounded to the nearest hundred, thus when the actual number of workers is between 100 and 149 it is recorded as 100; when the actual is between 150 and 249 it is recorded as 200, etc.

These two limitations can lead to greater or lesser discrepancies depending upon the distribution of plants in various employment size categories. However, the extent and direction of the discrepancies though created are difficult to assess. For one thing the MEI employment classes are not coextensive with those in the Census reports and therefore cannot be directly compared. If the actual distribution is skewed to the right, then the rounding procedure would produce an overcount of the total number of employees. Conversely, if the actual distribution is skewed to the left, the rounding procedure would produce an undercount of the total number of employees.

A comparison of 1972 Census and MEI data reveals that, for manufacturing as a whole, MEI reports 15.2 percent more plants with 100 or more employees than does the Census. A primary explanation for this, is that MEI

counts a plant if its highest seasonal employment was greater than 100 while Census uses average employment. With respect to total number of employees, MEI report 14.6 percent more employees (for plants over 100) than Census reports for all plants. The greater total number of employees reported by MEI is due apparently to the greater number of reported plants and possibly to rounding of the employee number to the nearest hundred. The greater total number of employees reported by MEI is expected to bias upward our estimates of the level of sales but probably does not significantly affect our estimates of growth of total sales.

In light of the above comparison and despite the attempt by MEI to confine its measure of employment to the number of production workers, a further check with MEI revealed that they can be certain the number of production workers has been reported for only about ten percent of the plants reporting. In all likelihood the remaining 90 percent probably reported total number of employees. Consequently, using value of shipments per employee instead of value of shipments per production worker in the third step of our procedure would undoubtedly yield lesser bias.

The sheer size of MEI's data base makes total accuracy impossible, of course, but nevertheless the procedure is subject to considerable learning curve properties. The identification of plants and assignments of employees by SIC has improved considerably over time as sources are developed and feedback increases. Errors in plant identification and size are not unknown, but on the whole the data are adequate and useful for the purpose intended here.

The Estimation Procedure - A Source of Discrepancy

The assumption that each plant operates at the industry's average value of shipments per employee will also contribute to the discrepancies between estimated current dollar sales and reported sales. There are differences in economies of scale and differences in technology among plants in the same industry and over time. Thus, those plants with relatively high productivity will have their shipments underestimated by use of the average shipment per employee ratio and, in like manner, overestimation will exist for low productivity establishments.¹⁴ As a practical matter, however, it is difficult to establish the nature and importance of errors thus created.

Strikes, limitation of inputs and other production difficulties will also contribute to the discrepancies. Since each plant is assumed to operate at its industry's average value of shipments per employee, this implies also that each plant has experienced similar production circumstances. For example, if an industry-wide strike occurs in an industry, the above assumption implies that each plant in the industry was equally affected. That is, each plant suffers production losses proportionate to its size. Similarly, if for whatever reason, the supply of raw materials is interrupted, the above assumption again implies that all plants or all firms with plants in this industry were proportionately affected. If however, a plant or set of plants of a company suffers disproportionately more (less), as compared to the industry, then our estimates will be greater (less) than reported sales for that company.

Accounting Differences Between our Estimated Measure and Reported Sales

Another source of discrepancy lies in the varied accounting practices used in reporting sales. Accounting principles used in filing annual reports, 10K reports and so forth vary among companies, though time as well as for significant structural changes of the company.

To accurately reconcile the differences between reported figures and our estimated figures, one must pay particular attention to the dates of mergers, acquisitions and divestitures and the accounting principles involved in handling these transactions. If for example an acquisition occurred in the middle of the year and the company treated this as a pooling of interest transaction, then the acquired company's sales would be reported for the whole year. If on the other hand, it was treated as a purchase transaction then sales would be reported for half the year. This would not be consistent with our estimate because the method employed here assumes the employee count was the same throughout the year. Similarly, if a divestiture occurred in the middle of the year, part of the annual sales would be reported under Discontinued Operation while no estimate would exist for this particular plant. To further complicate the situation, many companies use purchase accounting for some transactions and pooling of interest accounting for other transactions. Also, in a single transaction there may be elements of both a purchase and a pooling of interest, making the recociliation even more difficult.

As mentioned earlier, another source of discrepancy between our estimated figures and reported figures is the differences between production and sales. Recall that our estimates are based on the number of workers employed in domestic manufacturing productoin rather than on sales data. As such our estimates ideally should be compared with an equivalent corporate aggregate. The comparable corporate which reflects domestic production would be domestic sales plus net change in inventory plus net exports. Our

employee-based estimates of production would approximate reported sales if there were no accumulation or depletion of inventory in the year. If however, inventory were accumulated our estimate sales, based on production, would exceed actual sales. Similarly, if inventory were depleted production and hence our estimate of sales would be lower than reported sales.

Discrepancies between our estimates of sales and reported sales caused by inventory change are particularly acute for heavy industrial equipment producers such as General Electric, FMC and TRW. Deliveries of such heavy industrial equipment are frequently postponed and orders are cancelled in the face of an economic downturn. To properly reconcile the differences between reported sales and our estimates of sales, an adjustment must be made to account for dollar value changes in inventory. When this adjustment cannot be made (for lack of data) sales would be over-estimated when inventory is accumulated and underestimated when inventory is depleted.

In addition to adjusting for changes in inventory, adjustments must also be made for imports and exports. Domestic production supplies both domestic demand and foreign demand in terms of direct exports to foreign customers and/or foreign intra-company transfer. Hence to transform reported sales to a corporate aggregate that is more directly equivalent to domestic production, we must also account for the net exports. When dollar value data on net exports are not available and adjustments cannot be made, domestic sales would be over-estimated when exports exceed imports and conversely, underestimated when imports exceed exports.

Adjustments to Reported Sales Data for Comparability with Our Estimates

Given the domestic manufacturing production scope of our study and the potential for errors in our estimation, an in-depth examination of each company was undertaken so as to permit adjustments in the reported sales data to make them comparable to domestic manufacturing production. In our investigation of the 10 companies, various sources were examined to obtain sales, product information and historical developments for each company. Historical sales data were obtained principally from annual reports to stockholders and 10K reports filed with the SEC. Various brokerage house reports and magazines such as Wainwright's reports, Oppenheimer Inc. Reports, Chemical Bank Investment Research Reports and Fortune magazine were consulted to obtain additional product information and information on particular circumstances surrounding the historical growth of these companies. F.T.C. Statistical Reports on Mergers and Acquisitions and the Conference Board's Announcement of Mergers and Acquisitions were examined to confirm and supplement information on mergers, acquisitions and divestitures.

Sales by product groups were obtainable directly from their reports for the majority of the companies and for most years in the period 1965 -1976. For some companies, it was necessary to derive sales breakdowns for earlier years by examining the company's 5-year summary of key operating statistics. All 10 companies typically defined their various product groups under a single category - Consumers Group. In addition, the majority of the 10 companies have from time to time redefined their product groups and increased or decreased the total number of reporting groups.

In our examination of the reports issued by the companies, we attempted to extract measures of domestic sales plus exports, net of non-manufacturing sales and net of imports. In concept, this measure is the equivalent of domestic manufacturing output which was the magnitude we estimated. A company-by-company evaluation of the discrepancies between the two measures is given in the case studies section.

Comparable Aggregates as Contained in Corporate Annual Reports

The comparable reported corporate aggregates to which our estimates were compared varied somewhat in definition among the companies. This was primarily a reflection of the varied accounting practices employed in reporting foreign sales. The method of reporting foreign sales varied among the 10 companies as well as within the same company through time. As Table-10 reveals, the foreign sales sector is not an insignificant part of overall company activity in each of our companies. Moreover, foreign sales' share of companywide activity increased quite dramatically over the period for most of the companies. In one case, Allied Chemical, domestic sales couldn't be isolated from companywide sales for any year. Foreign sales data also were not obtainable for General Electric for 1965 and B. F. Goodrich for 1965 and 1968. Foreign sales that were available however, were usually reported as an aggregate amount (not broken down by product groups) and consisted of sales to foreign customers of products manufactured by consolidated foreign subsidiaries as well as exports of domestically manufactured products. For the majority of the companies, neither exports from domestic operations nor sales of foreign subsidiaries could be isolated from foreign sales data. In addition,

TABLE 10
FOREIGN SALES AS PERCENT OF COMPANYWIDE SALES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Allied Chemical	N/A	N/A	N/A	N/A	N/A
American Cyanamid	17.8%	19.4%	28.4%	35.4%	35.0%
DuPont	11.1	12.7	18.3	27.5	27.1
FMC	9.6	12.8	16.2	19.8	28.0
General Electric	N/A	13.8	17.9	24.0	25.6
W. R. Grace	34.6	34.8	32.8	37.6	29.6
B. F. Goodrich	N/A	N/A	24.7	28.7	26.1
3M	30.0	33.1	37.8	40.5	38.6
TRW	12.9	13.6	26.9	32.3	34.2
Union Carbide	23.0	25.0	30.0	34.0	33.0

some companies excluded sales of products to customers in Puerto Rico and/or Canada from their foreign sales figures. Sales to these areas were treated as part of domestic sales.

In the majority of the cases, dollar value on imports and dollar value changes in inventory could not be obtained for most of the years under observation. In certain cases, non-manufacturing activities were not reported separately, neither were data on imports of foreign non-manufactured products. In addition, for particular companies, certain data were obtainable for some years and not available for some other years. However, once a definition for domestic productions was selected for a company, its definition remained unchanged from year to year in the test of our estimates.

On the whole it may seem that these shortcomings would pose a serious obstacle in the test of our estimates and the company's proxy for domestic production were small. These discrepancies were traced to certain missing components (which prevented a closer approximation of domestic production) whose dollar magnitudes were also small. In a few other cases, discrepancies were traced to the accounting principles used in handling mergers and acquisitions.

Presented in Table-11 are the ratios of our estimated sales to comparable corporate aggregates for each company and for each year under observation. Comparable corporate aggregates could not be determined for General Electric for 1965 and B. F. Goodrich for 1965 and 1968. As Table-10 shows, the ratios averaged .96 over the 5 years and over the 10 companies. It ranged from a high

TABLE 11

RATIOS OF ESTIMATED SALES TO REPORTED COMPARABLE AGGREGATES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Allied Chemical	.93	.90	.93	1.01	1.01
American Cyanamid	.86	.88	1.00	1.15	1.23
DuPont	.96	.92	1.00	1.05	1.05
FMC	.91	1.01	1.21	1.10	1.35***
General Electric	---	.84	.89	.85	.91
W. R. Grace	.71*	.81	.75	.87	.87
B. F. Goodrich	---	---	.97	.99	1.09
3M	.90	.86	.79	.75	.76
TRW	1.36**	.85	1.05	.92	1.01
Union Carbide	<u>.94</u>	<u>.92</u>	<u>.97</u>	<u>1.00</u>	<u>1.01</u>
Simple Average	.95	.89	.96	.97	1.03

*The reported corporate aggregate exceeded our estimated sale because we couldn't net our W.R. Grace's steamship operation and its wholesale and retail distribution system from domestic sales.

**The discrepancy here was traced to a high level of inventory accumulation

***The discrepancy here was traced to the mid-1976 divestitures of FMC's Fibers Division and its Peerless Pump Division.

of 1.36 to a low of .71. In only 11 of the 47-year-company comparisons was there a discrepancy of greater than 15 percentage point.

Estimated Sales in Constant Dollars - A Measure of Real Growth

Having made detailed current dollar estimates by 4-digit industries, the next step was to deflate our estimated value of shipments in these 4-digit SIC industries in our sample, a single producer price index at the 4-digit level was employed. In cases where the 4-digit index was not available or incomplete, the 3-digit or 2-digit index had to be substituted. As a last resort, when neither the 2-, 3-, or 4-digit indexes were available, a 5-, 6- or 7- digit index was used. The detailed constant dollar estimates for each company are presented in the case studies section, below.

The constant dollar estimates of shipments in 4-digit SIC industries for each year were then summed, and the resultant total was taken as the measure of the company's estimated sales for each year in 1967 dollars. These totals and their corresponding totals in current dollars for the 10 companies are presented in Table-12. As a measure of real sales growth, these totals in constant dollars were indexed with 1965 as the base year.

Insofar as the weighting system used by the BLS results in Laspeyres price index, the measure of real sales growth described here is subjected to a downward bias. As can be shown, the constant dollar sales index is a weighted average of SIC specific Pasche quality indexes where the weights are the fraction of base period sales accounted for by each SIC.¹⁵ Thus, because of the inverse correlation that commonly exists between changes in price and changes in quality, the BLS PPI series would yield a stronger upward bias for these

products whose prices rose the highest and consequently would yield a greater downward bias in our measure of real sales growth.

in addition to the short-run index problem discussed above, the BLS PPI series are faced with a number of other criticisms. These include such long-run factors as growth of the economy, introduction of new products, changes in types of goods demanded by consumers and new technologies for producing them. Although these and other factors are important and may lead to misleading price indexes, the combination of inflation and recession in recent years emphasize the need to be deflated by price indexes which directly relate to the industries and products in question. It is not the general Wholesale Price Index which is needed but its more detailed components.

A number of different studies have attempt to evaluate the validity of wholesale price data. Among these are- Considerations on the Choice of Price or Unit Value Deflators for Census Benchmark Production Index,¹⁶ The Behavior of Industrial Prices.¹⁷ The Measurement of Durable Goods Prices¹⁸ and The Wholesale Price Index: Review and Evaluation.¹⁹ The general conclusion of these studies is that "there are deficiencies which need to be corrected before the wholesale price data will provide an adequate and reliable basis for measuring price behavior."²⁰ However, in view of the lack of other detailed price indexes and the secondary conclusion of the Interagency Committee on Real Output that in general the wholesale price data were better measures of price change than the Census Unit Value, the use of the BLS PPI series in this study will have to suffice.

As a result of deflating estimated sales in current dollars, we were able to ascertain a different and perhaps a more exact description of the relative size

and growth in size of these companies. Presented in Table-13 are period to period growth in current and constant dollar sales estimates. Over the 1965-76 period, estimated sales in constant dollars of the 10 companies as a whole grew by 49.4%, a rate considerably lower than the corresponding estimated sales growth in current dollars (157.9%). The divergence between current and constant dollar sales growth is most pronounced for the chemical companies in our sample.

Price changes are not uniform through time nor among industries, and product mixes do not stay constant through time nor are they equivalent among companies. Consequently, associated with each company's product index. This price index reflects the price changes unique to the company's product mix. The ratio of the index of estimated sales in current dollar to the index of estimated sales in constant dollars is equivalent of the weighted price index which is implicit in the divergent movements of the current and constant dollar series.

Presented in Table-14 are the price indexes of the companies separately and as a whole. Over the first 7 years of our 11 year period (1965-1972), our estimated weighted average price index for the 10 companies as a whole shows a 12.4% increase. The highest 1965-1972 price rise was the 19.8% experienced by TRW. In the next two years 1972-1974, the implicit price index for the group as a whole rose 28.1%, and for 1974-1976, the last two years it rose 19.9%. In the latter two periods, 5 of the 6 chemical companies in our sample had price increases above the weighted average of the 10 companies as a whole.

TABLE 12

ESTIMATED SALES IN CURRENT AND CONSTANT (1967) DOLLARS
(In Millions of Dollars)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
<u>Allied Chemical</u>					
Current Dollars	\$ 1040.0	\$ 1131.1	\$ 1390.3	\$ 2246.3	\$ 2793.8
Constant Dollars	1051.1	1161.1	1414.8	1439.4	1460.5
<u>American Cyanamid</u>					
Current Dollars	611.5	724.2	978.7	1321.7	1673.8
Constant Dollars	623.7	720.5	950.0	966.8	1012.5
<u>DuPont</u>					
Current Dollars	2774.4	3020.2	3945.5	6082.9	7354.9
Constant Dollars	2799.2	2981.6	3703.1	4241.9	4381.7
<u>FMC</u>					
Current Dollars	812.7	1306.8	1676.7	2104.3	2615.0
Constant Dollars	840.1	1293.4	1507.9	1452.2	1395.5
<u>General Electric</u>					
Current Dollars	4371.0	6074.6	7497.7	8660.2	9660.4
Constant Dollars	4529.2	5946.2	6672.7	6700.4	6308.3
<u>W. R. GRACE</u>					
Current Dollars	468.3	978.3	1128.4	1803.0	1954.8
Constant Dollars	476.3	875.3	1042.8	1185.9	1077.1
<u>B. F. Goodrich</u>					
Current Dollars	667.6	878.8	1099.8	1390.5	1640.9
Constant Dollars	693.6	850.6	989.1	984.5	951.9
<u>3M</u>					
Current Dollars	630.0	803.9	1037.6	1310.3	1647.4
Constant Dollars	657.4	793.0	937.2	969.0	1034.0
<u>TRW</u>					
Current Dollars	788.8	1097.5	1335.7	1643.0	2113.1
Constant Dollars	817.0	1068.9	1154.5	1200.5	1330.7
<u>Union Carbide</u>					
Current Dollars	1696.8	1872.3	2205.5	3504.0	4289.6
Constant Dollars	1747.5	1861.6	2031.2	2311.0	2313.4

TABLE 13

PERIOD TO PERIOD GROWTH IN CURRENT AND CONSTANT DOLLARS

	<u>1965-68</u>	<u>1968-72</u>	<u>1972-74</u>	<u>1974-1976</u>	<u>1965-1976</u>
<u>Allied Chemical</u>					
Current Dollars	8.8%	22.9%	61.6%	24.4%	168.6%
Constant Dollars	10.5	21.8	1.7	1.5	38.9
<u>American Cyanamid</u>					
Current Dollars	18.4	35.1	35.1	26.7	173.7
Constant Dollars	15.5	31.9	1.8	4.7	62.3
<u>DuPont</u>					
Current Dollars	8.9	30.6	54.2	20.9	165.1
Constant Dollars	6.5	24.2	14.5	3.3	56.5
<u>FMC</u>					
Current Dollars	60.8	28.3	25.5	24.3	221.8
Constant Dollars	54.0	16.6	-3.7	-3.9	66.1
<u>General Electric</u>					
Current Dollars	39.0	23.5	15.4	11.6	121.0
Constant Dollars	31.3	12.2	0.4	-5.8	39.3
<u>W. R. Grace</u>					
Current Dollars	87.8	28.3	59.8	8.4	317.4
Constant Dollars	83.8	19.1	13.8	-9.2	126.1
<u>B. F. Goodrich</u>					
Current Dollars	31.6	25.2	26.5	18.0	145.8
Constant Dollars	22.6	16.3	-0.5	-3.3	37.2
<u>3M</u>					
Current Dollars	27.6	29.1	26.3	25.7	161.5
Constant Dollars	20.6	18.2	3.4	6.7	57.3
<u>TRW</u>					
Current Dollars	39.1	21.7	23.0	28.6	167.9
Constant Dollars	30.8	8.0	4.0	10.9	62.9
<u>Union Carbide</u>					
Current Dollars	10.3	17.9	58.8	22.4	167.9
Constant Dollars	6.5	9.1	13.8	0.2	32.4
<u>Weighted Average</u>					
Current Dollars	28.3	25.4	34.8	18.9	157.9
Constant Dollars	23.3	16.2	5.2	-0.9	49.4

Comparable Corporate Aggregates - Another Measure of Real Growth?

Our implicit company price index can be used to provide another measure of the company's real (constant dollar) growth. Comparable corporate aggregates contained in a company reports for each year under observation (Table-15A can be transformed to constant dollar basis by deflating the current dollar values with our implicit company price index (presented in Table 15B). This measure would then provide another way of evaluating the real growth of a company. Recall that comparable corporate aggregates were extracted from company reports for the purpose of testing our estimates. These reported aggregates, as explained above, are only approximations to domestic manufacturing production. Their dollar values do not exactly equal the dollar values of our estimates, which also approximate domestic manufacturing production. Consequently, real growth as measured by the growth of comparable corporate aggregates in constant dollars would differ from real growth as measured by the growth of estimated sales in constant dollars.

Period to period comparisons of the two measures are presented in Table-16. As expected, the growth patterns exhibited by these two measures differed greatly. This inconsistency can be attributed to the discrepancies between estimated sales and comparable corporate aggregates for each company and for each year under observation (see Table-11). If comparable corporate aggregates were exactly equal to estimated sales, then the two growth patterns would be identical. Insofar as discrepancies between estimated sales and its corresponding corporate aggregates are traceable to factors other than our estimating procedure, the interpretation of real growth as measured by the constant dollar growth in comparable corporate aggregates would be meaningless. If for example, discrepancy in the initial year was due to the exclusion of dollar sales of a division that was divested late in the year, the

TABLE 14

RATIO OF INDEX OF ESTIMATED CURRENT DOLLAR SALES TO
INDEX OF ESTIMATED CONSTANT DOLLAR SALES (IMPLICIT PRICE INDEX)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Allied Chemical	100	98.5	99.3	157.8	193.4
American Cyanamid	100	102.5	105.1	139.4	168.6
DuPont	100	102.3	107.5	144.8	169.4
FMC	100	104.4	114.9	149.7	193.7
General Electric	100	105.9	116.6	133.9	158.7
W. R. Grace	100	102.2	110.1	154.6	184.6
B. F. Goodrich	100	107.3	115.5	146.8	179.2
3M	100	105.8	115.5	141.1	166.2
TRW	100	106.3	119.8	141.8	164.5
Union Carbide	<u>100</u>	<u>103.6</u>	<u>111.9</u>	<u>156.2</u>	<u>190.9</u>
Weighted Average	100	104.1	112.3	143.9	172.6

TABLE 15A
 REPORTED COMPARABLE AGGREGATE IN CURRENT DOLLARS

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
ALLIED CHEMICAL	1121.0	1263.0	1501.0	2216.0	2630.0
Index	100	112.7	133.9	197.7	234.6
AMERICAN CYANAMID	709.0	824.0	973.0	1149.0	1361.0
Index	100	116.4	137.4	162.1	192.0
DUPONT	2890.0	3291.0	3959.0	5817.0	7028.0
Index	100	113.9	137.0	201.3	243.2
FMC	890.9	1294.2	1387.3	1906.1	1939.8
Index	100	145.3	155.7	214.0	217.7
GENERAL ELECTRIC	N/A	7228.0	8409.0	10195.0	10672.0
Index	---	100	116.3	141.0	147.6
W. R. GRACE	655.0	1081.0	1500.0	2081.0	2236.0
Index	100	165.0	229.0	317.7	341.4
B. F. GOODRICH	N/A	N/A	1134.8	1402.0	1475.7
Index	---	---	100	123.5	130.0
3M	700.2	940.0	1314.1	1747.0	2158.0
Index	100	134.2	187.7	249.5	308.2
TRW	579.0	1285.0	1272.0	1777.0	2091.0
Index	100	221.9	219.7	306.9	361.1
UNION CARBIDE	1809.0	2025.3	2270.5	3496.0	4253.0
Index	100	112.0	124.5	193.3	235.1

TABLE 15B

REPORTED COMPARABLE AGGREGATE IN
CONSTANT DOLLARS

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
ALLIED CHEMICAL	1121.0	1288.8	1516.0	1402.5	1355.7
Index	100	115.0	135.2	125.1	120.9
AMERICAN CYANAMID	709.0	808.8	927.6	826.6	805.3
Index	100	114.1	130.8	116.6	113.6
DUPONT	2890.0	3226.5	3665.7	4039.6	4158.6
Index	100	111.6	126.8	139.8	143.9
FMC	890.9	1232.6	1206.3	1270.7	999.0
Index	100	138.4	135.4	142.6	112.1
GENERAL ELECTRIC	N/A	6818.9	7187.2	7608.2	6711.9
Index		100	105.4	111.5	98.4
W. R. GRACE	655.0	1059.8	1363.6	1342.6	1215.2
Index	100	161.8	208.2	205.0	185.5
B. F. GOODRICH	N/A	N/a	986.8	960.3	843.3
Index	---	---	100	97.3	85.5
3M	700.2	886.8	1142.7	1239.0	1300.0
Index	100	126.6	163.2	176.9	185.7
TRW	579.0	1212.3	1029.2	1194.3	1175.6
Index	100	209.4	177.8	206.3	203.0
UNION CARBIDE	1809.0	1966.3	2027.2	2226.8	2215.1
Index	100	108.7	112.1	123.1	122.4

TABLE 16

PERIOD TO PERIOD CONSTANT DOLLAR GROWTH:
ESTIMATED VS. COMPARABLE AGGREGATES

	<u>1965-68</u>	<u>1968-72</u>	<u>1971-74</u>	<u>1974-76</u>	<u>1965-76</u>
<u>Allied Chemical</u>					
Estimated	10.5%	21.8%	1.7%	1.5%	38.9%
Comparable	15.0	17.6	-7.5	-3.4	20.9
<u>Amercian Cyanamid</u>					
Estimated	15.5	31.9	1.8	4.7	62.3
Comparable	14.1	14.6	-10.5	-3.6	13.6
<u>DuPont</u>					
Estimated	6.5	24.2	14.5	3.3	56.5
Comparable	11.6	13.6	10.3	2.9	43.9
<u>FMC</u>					
Estimated	54.0	16.6	-3.7	-3.9	66.1
Comparable	38.4	-2.2	5.3	-21.4	12.2
<u>General Electric</u>					
Estimated	31.3	12.2	0.4	-5.8	39.3
Comparable	N/A	5.4	5.8	-11.7	N/A
<u>B. F. Goodrich</u>					
Estimated	22.6	16.3	-0.5	-3.3	37.2
Comparable	N/A	N/A	-2.7	-12.1	N/A
<u>W. R. Grace</u>					
Estimated	83.8	19.1	13.8	-9.2	126.1
Comparable	61.8	28.7	26.8	-9.5	85.5
<u>3M</u>					
Estimated	20.6	18.2	3.4	6.7	57.3
Comparable	26.6	28.9	8.4	5.0	85.7
<u>TRW</u>					
Estimated	30.8	8.0	4.0	10.9	62.9
Comparable	109.4	-15.1	16.0	-1.6	103.0
<u>Union Carbide</u>					
Estimated	6.5	9.1	13.8	0.2	32.4
Comparable	8.7	3.1	9.8	-0.6	22.4

comparable corporate aggregate for that year would be lower than our estimate (and lower than the actual sales for that year). Therefore, the calculation of growth given this base year, would be overstated.

Similarly, if we were to use our implicit company price index to deflate reported companywide sales to obtain yet another measure of real growth, the interpretation of this measure would be equally, if not more problematic. For one thing, our implicit price index applies to domestic manufactured products only. Thus, in addition to the difficulties posed by the varied accounting practices in handling mergers and divestitures, we would also introduce the error of deflating nonmanufactured products and products produced and sold abroad.

CHAPTER III

PRESENTATION OF FINDINGS

Most analyses of corporate growth and change use current dollar series rather than constant dollar series. As is well recognized in much of economic analysis, however, constant dollar series yield more meaningful descriptions of change than do current dollar series. Economists have traditionally used current dollar data because they were the only data available. When growth is measured by calculating the percentage increase in nominal sales over a given period, an upward bias is likely to occur because prices usually have tended to rise through time.

This chapter presents a comparison between current and constant dollar series for the ten companies we studied with respect to their relative size and growth. In addition, since current and constant dollar series are estimated by detailed (4-digit) product categories, the share of a company's principal product and the company's degree of diversification (as mentioned by Berry's Diversification Index) will be described in constant dollar terms as well as in current dollar terms.

Range in Size

Estimated for the ten companies in current and constant dollars for the years 1965, 1968, 1972, 1974, and 1976 are plotted in Charts A and B. As the charts reveal, General Electric, DuPont and Union Carbide are the three largest companies in our sample with sales significantly greater than the remaining seven companies. For the remaining seven companies, size differences are relatively small by comparison. From 1965 through 1976, the relative range in

sales of the seven companies decreased slightly when sales are measured in current dollars and decreased significantly when sales are measured in constant dollars (see Table 117). The current dollar measures suggest that the growth in sales in varied somewhat among the seven companies while the constant dollar measures suggest a less varied growth pattern for the seven companies. The disparity between the two types of data is, of course, due to differences in price patterns among the companies.

Rank of Estimated Sales

When estimated sales of the ten companies in current and constant dollars are ranked (Table 18), we find that General Electric, DuPont and Union Carbide consistently ranked 1, 2, and 3 respectively for all years in both current and constant dollar terms. Comparing the remaining seven companies' sales rank in current and constant dollars with their reported companywide sales rank. The discrepancy between estimated sales rank ordering in current dollars and companywide sales rank ordering can be attributed to the changing importance of foreign sales and non-manufacturing sales among the companies (see case studies). The discrepancy between estimated sales rank ordering in constant dollars and companywide sales rank ordering can be attributed to these factors as well as to varying price patterns among the companies.

Comparing the relative position of the companies among themselves on a period-to-period basis, we note considerable stability in each estimated sales rank, both in current and in constant dollars. For the majority of successive period-to-period rank changes, relative position changed by only one rank. The

CHART A

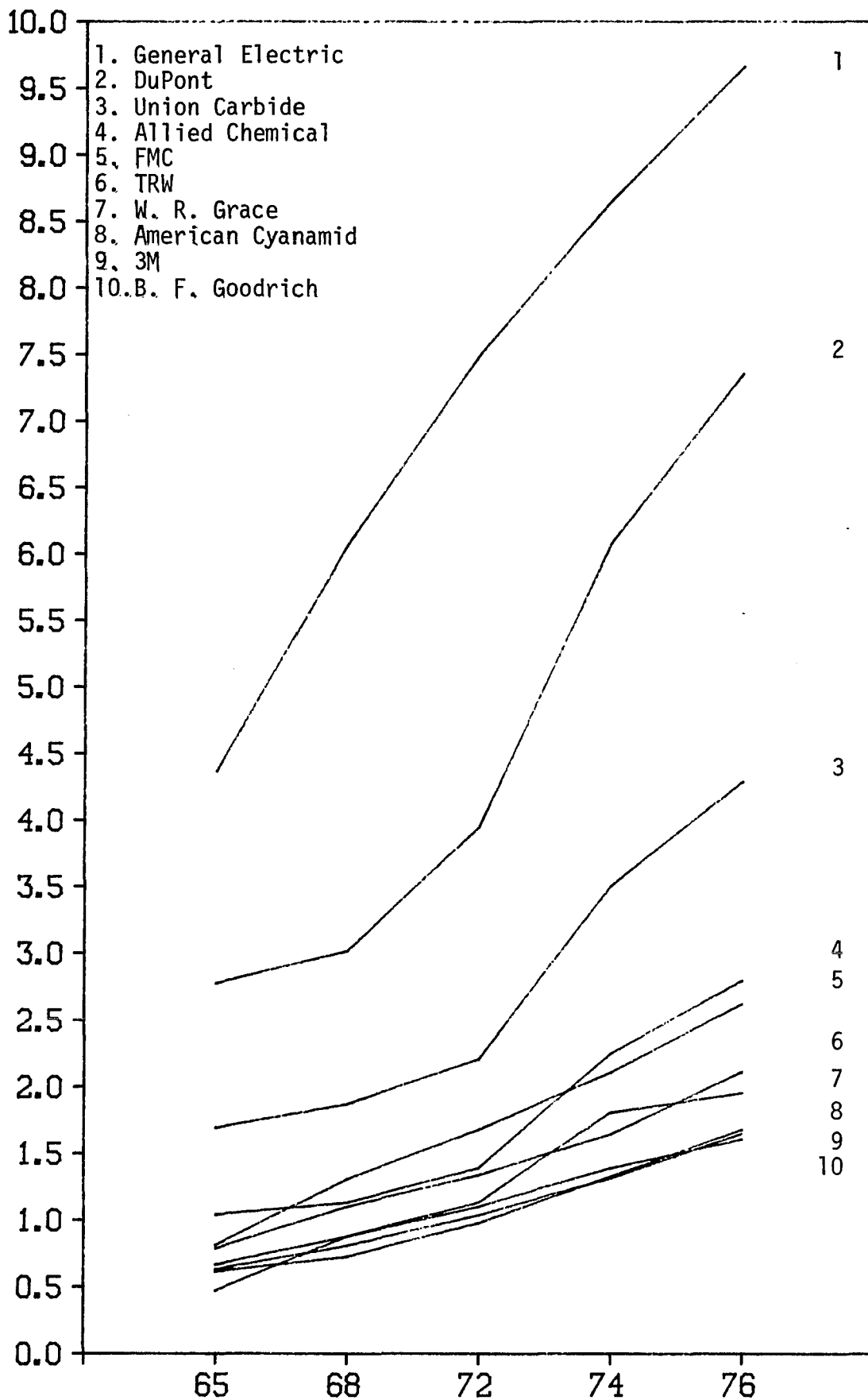


CHART B

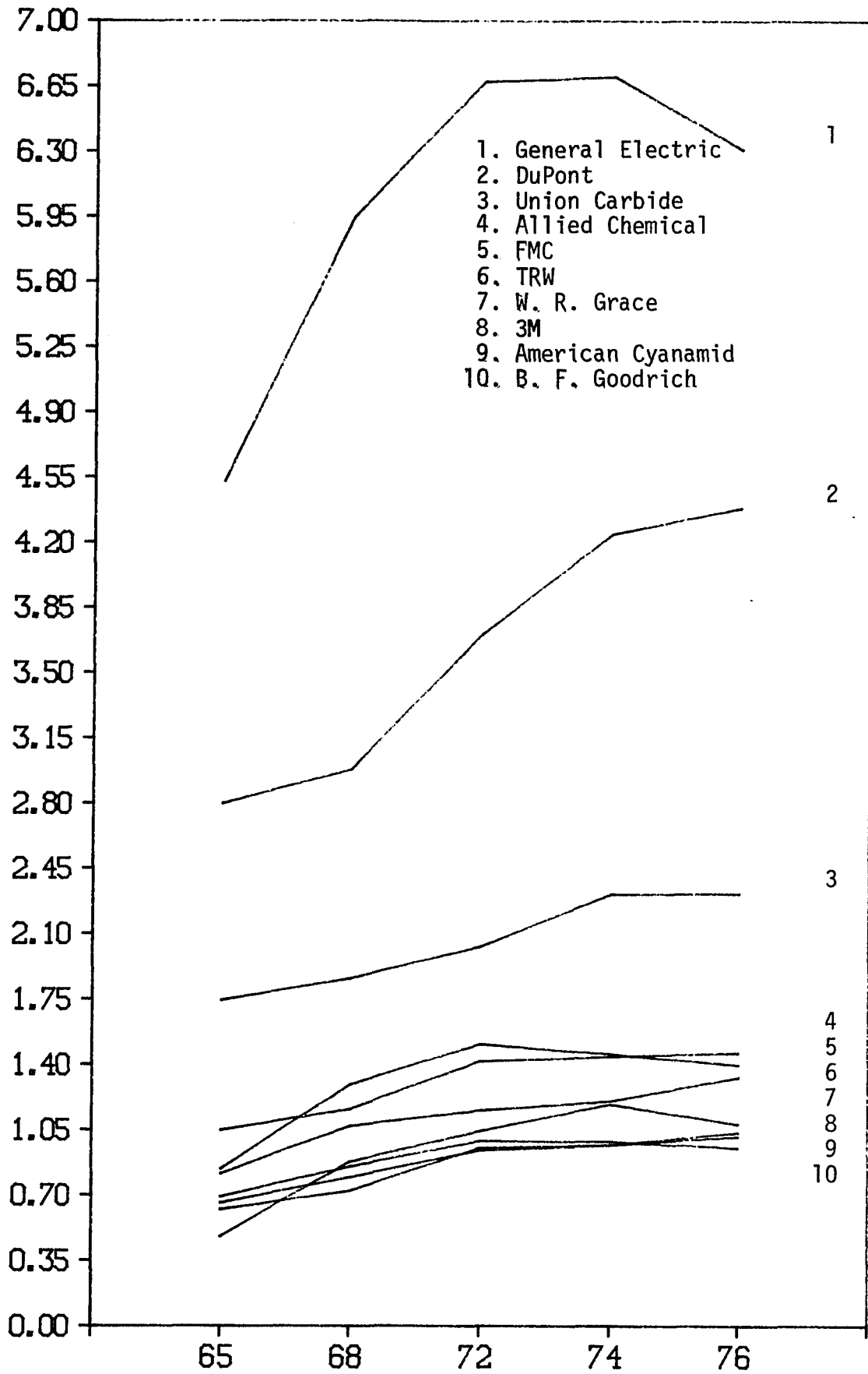


TABLE 17

RELATIVE RANGE IN SALES OF THE SEVEN SMALLER COMPANIES
(Sales in millions of dollars)

	Current Dollars			Constant Dollars		
	<u>Sales Range</u>	<u>Average Sales</u>	<u>Range Avg. Sales</u>	<u>Sales Range</u>	<u>Average Sales</u>	<u>Range/ Avg. Sales</u>
1965	\$ 571.7	\$ 1386.11	.41	\$ 574.8	\$ 1423.51	.40
1968	582.6	1778.87	.33	572.9	1755.29	.33
1972	898.0	2229.59	.31	570.7	2040.33	.28
1974	936.0	3006.62	.31	485.4	2145.18	.23
1976	1152.9	3574.37	.32	.508.6	2136.56	.24

TABLE 18
COMPANYWIDE SALES (REPORTED) RANK AND ESTIATED SALES RANK IN CURRENT
AND CONSTANT DOLLARS-1965, 1968, 1972, and 1976
(Number in parenthesis are ranks for the seven smaller companies)

	1965		1968		1972		1974		1976	
	<u>Comp.</u> <u>Wide</u>	<u>Est.</u> <u>Sales</u>	<u>Comp.</u> <u>Wide</u>	<u>Est.</u> <u>Sales</u>	<u>Comp.</u> <u>Wide</u>	<u>Est.</u> <u>Sales</u>	<u>Comp.</u> <u>Wide</u>	<u>Est.</u> <u>Sales</u>	<u>Comp.</u> <u>Wide</u>	<u>Est.</u> <u>Sales</u>
<u>Allied Chemical</u>										
Current Dollars	4	4 (1)	8	5 (2)	8	5 (2)	7	4 (1)	7	4 (1)
Constant Dollars		4 (1)		5 (2)		5 (2)		5 (2)		4(1)
<u>American Cyanamid</u>										
Current Dollars	9	9 (6)	10	10 (7)	10	10 (7)	10	9 (6)	9	8 (5)
Constant Dollars		9 (6)		10 (7)		9 (6)		10 (7)		9 (6)
<u>DuPont</u>										
Current Dollars	2	2	2	2	2	2	2	2	2	2
Constant Dollars		2		2		2		2		2
<u>FMC</u>										
Current Dollars	8	5 (2)	7	4 (1)	9	4 (1)	8	5 (2)	8	5 (2)
Constant Dollars		5 (2)		4 (1)		4 (1)		4 (1)		5 (2)
<u>General Electric</u>										
Current Dollars	1	1	1	1	1	1	1	1	1	1
Constant Dollars		1		1		1		1		1
<u>W. R. Grace</u>										
Current Dollars	5	10 (7)	4	7 (4)	4	7 (4)	4	6 (3)	4	7 (4)
Constant Dollars		10 (7)		7 (4)		7 (4)		7 (4)		7 (4)
<u>B. F. Goodrich</u>										
Current Dollars	7	7(4)	9	8 (5)	7	8 (5)	9	8 (5)	10	10 (7)
Constant Dollars		7 (4)		8 (5)		* 8 (5)		8 (5)		10 (7)
<u>3M</u>										
Current Dollars	6	8 (5)	6	9 (6)	5	9 (6)	5	10 (7)	5	9 (6)
Constant Dollars		8 (5)		9 (6)		10 (7)		9 (6)		9 (5)
<u>TRW</u>										
Current Dollars	10	6 (3)	5	6 (3)	6	6 (3)	6	6 (3)	6	6 (3)
Constant Dollars		6 (3)		6 (3)		6 (3)		6 (3)		6 (3)
<u>Union Carbide</u>										
Current Dollars	3	3	3	3	3	3	3	3	3	3
Constant Dollars		3		3		3		3		3

exceptions to this are: W. R. Grace - going from 10th in 1965 to 7th in 1968 and B. F. Goodrich - going from 8th in 1974 to 10th in 1976 under both current and constant sales ranking schemes.

Comparing ranks of estimated sales in constant dollars with their ranks in current dollars, we note that the rank order patterns are basically unchanged except for the following shifts:

- 1) for 1972, American Cyanamid switched ranks with 3M
- 2) for 1974, there were three switches - FMC displaced Allied Chemical for 4th place, TRW displaced W. R. Grace for 6th place and 3M displaced American Cyanamid for 9th place.
- 3) for 1976, 3M displaced American Cyanamid for 8th place

These changes are of particular importance because of the majority of the changes involved first an up-ranking and then a down-ranking of three companies, Allied Chemical, American Cyanamid and W. R. Grace. As will be shown, these changes are traceable to the extreme changes in prices of certain petrochemical products.

Price Patterns

In Table 14 of Chapter II, it was noted that the price index for each company exhibited a relatively flat pattern during the first seven years of the 1965-1976 period and then a sharply rising pattern beginning in 1972. This escalating price pattern was more pronounced for the chemical companies, with three of the four non-chemical companies (General Electric, TRW and 3M) showing the lowest price increases over the 1965-1976 period and four of the six chemical companies (Allied Chemical, American Cyanamid, W. R. Grace and Union Carbide) showing the highest price increases.

This initially flat and then escalating price pattern is also exhibited by various broad price indexes. In Table-19, the weighted price index of the ten companies is compared with PPI for all commodities and PPI for all industrial commodities. Over the 1965-1972 period, the implicit price index for the group as a whole rose 12.3% while the PPI series for all commodities rose 23.2% and for all industrial commodities it rose 3%. From 1972 to 1974, our estimated weighted price index show a 28.1% price increase while the latter two indexes rose 34.5% and 30.4% respectively. In the last two years, 1974-1976, the implicit price index for the ten companies as a whole rose at a rate (19.9%) that, for the first time, is greater than that of prices in general, as indicated by the other two indexes (14.3% and 18.6%).

Implicit Company Price Index Compared with Relevant Major Industry PPI Series

The weighted price pattern of the six chemical companies over the 1965-1976 period closely resembled the price pattern of the overall chemical & allied products' PPI series (Table 20). For 1968, the chemical & allied products PPI was 100.8 and the weighted average price index of the chemical companies was 102.3. The company showing the largest deviation from the PPI was FMC, whose 1968 index was 104.4. For 1972, the PPI advanced to 105.3 while the weighted price index advanced to 108.3. The company with the largest deviation from the 1972 PPI again was FMC with an index of 114.9. From 1972 to 1974, PPI advanced 40.8% to 148.3 while the weighted price index for the six chemical companies advanced 38.3% to 149.8. From 1974 to 1976, PPI increased 27.5% to 189.1 and the weighted price index (for the chemical companies) increased 20.8% to 180.9.

TABLE 19

WEIGHTED PRICE INDEX OF THE TEN COMPANIES COMPARED WITH TWO PPI SERIES, 1965-1976

	<u>1965</u>	<u>% Chng.</u>	<u>1968</u>	<u>% Chng.</u>	<u>1972</u>	<u>% Chng.</u>	<u>1974</u>	<u>% Chng.</u>	<u>1976</u>
<u>Weighted Price Index of The Ten Companies</u>	100.0	+4.1%	104.1	+7.9%	112.3	+28.1%	143.9	+19.9	172.9
<u>PPI</u>									
1) All Commodities	100.0	+6.1	106.1	+16.1	123.2	+34.5	185.7	+14.3	189.4
2) All Industrial Commodities	100.0	+6.3	106.3	+15.1	122.3	+30.4	179.5	+18.6	189.2

TABLE 20

INDIVIDUAL IMPLICIT COMPANY PRICE INDEX WITH APPROPRIATE PPI SERIES, 1965-1976

	<u>1965</u>	<u>% Chng.</u>	<u>1968</u>	<u>% Chng.</u>	<u>1972</u>	<u>% Chng.</u>	<u>1974</u>	<u>%Chng.</u>	<u>1976</u>
<u>Chemical Companies</u>									
Allied Chemical	100.0		98.5		99.3		177.8		193.4
		-1.5%		+0.8%		+58.9%+		22.6%	
American Cyanamid	100.0		102.5		105.1		139.4		186.6
		+2.5		+2.5		+32.6		+20.9	
DuPont	100.0		102.3		107.5		144.8		169.4
		+2.3		+5.1		+34.7		+17.0	
FMC	100.0		104.4		114.9		149.7		193.7
		+4.4		+10.1		+30.3		+29.4	
W. R. Grace	100.0		102.2		110.1		154.6		184.6
		+2.2		+7.7		+40.4		+19.4	
Union Carbide	100.0		103.6		111.9		156.2		190.6
		+3.6		+8.0		+39.6		+22.0	
<hr/>									
Weighted Average for Chemical Companies	100.0		102.3		108.3		149.8		180.9
		+2.3		+5.9		+38.3		+20.9	
PPI-Chemical & Allied Products	100.0		100.8		105.3		148.3		189.1
		+0.8		+4.5		+40.8		+27.5	

TABLE 20 (Continued)

INDIVIDUAL IMPLICIT COMPANY PRICE INDEX COMPARED WITH APPROPRIATE PPI SERIES, 1965-1976

	<u>1965</u>	<u>%Chng.</u>	<u>1968</u>	<u>% Chng.</u>	<u>1972</u>	<u>% Chng.</u>	<u>1974</u>	<u>% Chng.</u>	<u>1976</u>
<u>Machinery & Equipment Companies</u>									
TRW	100.0		106.3		119.8		141.8		184.5
		+6.3		+12.7%		+18.4%		+16.0%	
General Electric	100.0		105.9		116.6		133.9		158.7
		+5.9		+10.1		+14.8		+18.5	
Weighted Average of Machinery & Equip- ment Companies	100.0		105.9		116.9		135.1		159.7
		+5.9		+10.4		+15.5		+18.2	
PPI-Machinery & Equipment	100.0		109.9		125.6		148.5		182.1
		+9.9		+14.3		+18.2		+22.6	
<hr/>									
B. F. Goodrich	100.0		107.3		115.5		146.8		179.2
		+7.3		+7.6		+27.1		+22.1	
PPI-Rubber & Plastic Products	100.0		107.8		114.0		142.0		166.0
		+7.8		+5.8		+24.6		+18.9	
<hr/>									
3M	100.0		105.8		115.5		141.1		186.2
		+5.8		+9.2		+22.2		+17.8	
PPI-Pulp, Paper & Allied Products	100.0		105.1		117.9		177.7		186.5
		+5.1		+12.2		+33.8		+18.3	

Over the 1965-1972 period, the chemical & allied products' PPI series increased at a much slower rate, the PPI's for all commodities and all industrial commodities. Chemical prices had been held down by overcapacity in the middle sixties and price control in the early seventies. With the oil embargo in 1973 and the end of Federal price controls, all price indexes showed significant increases. The increase for chemical & allied products from 1972 to 1974 however, was much greater than that for industrial prices in general, 40.8% vs. 34.5% for all commodities and 30.4% for all industrial commodities. Three factors accounted for the relatively rapid increase in chemical prices: removal of price controls; increases in the price of oil, a major raw material feedstock; and high levels of demand, which exceeded supplies of nearly all the multitude of industrial chemicals (see case studies). Hence, the down-ranking scheme is thus quite consistent with the broad pattern of price change.

Table-20 also presented the implicit price index of each of the other four companies and compares it with a PPI series that corresponds to the principal product of each company. In general, each company's price pattern conforms closely to the pattern exhibited by its principal product's PPI series in that over the first seven years, price increases were relatively mild (but greater than the rise in prices in chemical and allied products) and over the next four years, prices jumped significantly.

Broad Economic Developments in the 1965-1976 Period - A Digression

During the period of analysis , 1965-1976, the economy had experienced a period of general expansion, a mild recession in mid period 1969-1970 and a severe recession toward the end, with 1976 representing a year of recovery following the recession of November 1973-May 1975. During hte early part of the 1960's, aided by the escalation of the war in Vietnam, the economy was operating near capacity. This escalation in government defense spending is reflected in the sales mix of companies such as TRW and General Electric (see case studies).

The economy continued to grow during the mid 1960's. Real GNP had risen 4.7% during 1965, 6.4% during 1966, 2.4% during 1967 and 5.0% during 1968. During the same period, the pattern of price changes was relatively flat. The consumer Price Index (CPI) had advanced 2.9% in 1966 and 1967 and advanced another 4.2% in 1968. The Producer Price Index (PPI) showed similar increases: 3.3% for 1966, 0.2% for 1967 and 2.5% for 1968. In 1969, restrictive policies were instituted to combat the rise in prices and a mild recession was beginning. Despite these developments, the CPI advanced 5.4% and the PPI advanced 3.9%. This eventually led to the 90 day Federal Price-Wage freeze in mid-August 1971 and subsequently to mandatory controls which lasted until April 1974. The expiration of controls, combined with the November 1973 oil embargo by the OPEC nations led to sharply rising prices. The CPI had increased by 4.5% in 1970 , by 4.3% in 1971 and by 3.3% in 1972. In 1973 however, it rose 6.2% and 11.0% in 1974. The PPI behaved somewhat differently, increasing by 3.5% in 1970, 3.3 in 1971 and 4.5% in 1972 and then by 13.1% in 1973 and 18.9% in 1974.

While the economy was going through this period of inflation, it was at

the same time suffering through a severe recession that had begun in late 1973 and didn't end until early 1975. This confluence of rising prices and declining real growth resulted in a serious setback for the economy in general and the chemical industry in particular. Current dollar BNP grew 11.6% in 1973, 8.1% in 1974 and 8.2% in 1975 while GNP in constant dollars grew only 5.5% in 1973, and declined 1.4% and 1.3% in 1974 and 1975 respectively. The chemical industry was particularly affected because the energy crunch not only more than doubled the price of energy, it also restricted the availability of many of the industry's raw materials. Industry reactions to the energy crisis ranged from self-initiated energy conservation programs to seeking alternative and additional overseas sources of feedstocks. Government reaction on behalf of the chemical industry was the imposition of mandatory allocation of petroleum products used for petrochemicals. "During 1974 producers have been largely operating at capacity, except where this was impractical for lack of raw materials or feedstocks".¹⁵ As an example of this impact of feedstock shortages, production of ethylene declined by more than 7 percent from peak production levels of September 1973 during the months immediately following the embargo."¹⁶ Ethylene is a petrochemical derived from natural gas liquids and refinery gases, and is used as basic material for the organic chemical industry.

The economy rebounded in 1976, current dollar GNP experienced an 11.6% gain and constant dollar GNP a 6.0% gain. Although prices continued to climb, the rate of increase was considerably lower than the rate of increase during the 1973-1975 period.

TALBE 21

**RATE OF GROWTH OF GNP IN CURRENT AND CONSTANT DOLLARS
FOR THE PERIODS: 1965-68, 1968-72, 1972-74, 1974-76 and 1965-76**

<u>GNP</u>	<u>1965-1968</u>	<u>1968-1972</u>	<u>1972-1974</u>	<u>1974-1976</u>	<u>1965-1976</u>
Current Dollars	26.2%	32.6%	20.6%	20.8%	143.8%
Constant Dollars	14.4%	9.9%	4.1%	4.6%	38.8%

Estimated Sales Growth in Current and Constant Dollars

As a result of deflating estimated sales in current dollars for each year, we were able to obtain sales growth in real terms as well as sales growth in nominal terms. In the previous chapter, we saw that the ten companies as a whole grew 157.9% over the 1965-1976 period when sales were measured in current dollars but grew only 49.9% when sales were measured in constant dollars. This divergence is not so extreme as it might seem because a similarly divergent pattern was exhibited by GNP in current dollars (143.8% vs. 36.8%).

Comparing period to period growth of each company in current and constant dollars (see Table-13 of Chapter II) with the growth in GNP current in and constant dollars (see Table 21 below) we find that:

- 1) Over the whole 11 year period, 1965-1976, the currency dollar growth rate of each company exceeded current dollar growth rate of GNP. On a constant dollar basis, only nine of the ten companies had a higher growth rate than GNP, the one exception being Union Carbide (32.4% vs. 36.8%).
- 2) Over the 1965-1969 period, the current dollar sales growth rate of six companies - FMC (60.8%), General Electric (39.0%), W. R. Grace (87.8%), B. F. Goodrich (31.6%), 3M (27.6%) and TRW (39.1%) exceeded current dollar growth rate of GNP (26.2%). On a constant dollar basis, seven companies outpaced GNP (14.4%) - American Cyanamid (15.5%), FMC (54.0%), General Electric (31.3%), W. R. Grace (83.8%), B. F. Goodrich (22.6%), 3M (20.6%) and TRW (30.8%). Significant acquisitions during this period were the principle factor in the rapid growth of the majority of the companies (see case studies).

- 3) Over the 1968-1972 period, GNP in current dollars grew faster than all companies except American Cyanamid (32.6% vs. 35.1%). On a constant dollar basis, however, eight companies outpaced GNP (9.9%) Allied Chemical (31.8%), American Cyanamid (31.9%), DuPont (24.2%), FMC (16.6%), General Electric (12.2%), W. R. Grace (19.1%), B. F. Goodrich (16.3) and 3M (18.2%). Depressed chemical prices relative to prices in general produced a faster growth in constant dollars for the majority of the companies. Continued acquisition activity by American Cyanamid also contributed to its high real growth rate.
- 4) Over the 1972-1974 period, current dollar estimated sales growth rate of nine companies - Allied Chemical (61.6%), American Cyanamid (35.1%), DuPont (54.2%), FMC (25.5%), W. R. Grace (59.8%), B. F. Goodrich (26.5%), 3M (26.3%), TRW (23.0%) and Union Carbide (58.8%) exceeded current dollar GNP growth rate (20.6%). On a constant dollar basis however, GNP (4.6%) outpaced seven companies - Allied Chemical (1.7%), American Cyanamid (1.8%), FMC (-3.7%), General Electric (0.4%), B. F. Goodrich (-0.5%), 3M (-3.4%), TRW (4.0%). The chemical price explosion that began in late 1973 and the general slackening in demand which particularly affected heavy equipment producers, such as General Electric and TRW, are primarily responsible for the above reversal in patterns.

- 5) Over the 1974-1976 period, current dollar sales growth rate of seven companies - Allied Chemical (24.4%) American Cyanamid (26.7%), DuPont (20.9%), FMC (24.3%), TRW (28.6%) and Union Carbide (22.4%) exceeded current dollar GNP growth rate (20.8%). On a constant dollar basis however, only three companies - American Cyanamid (4.7%), 3M (6.7%) and TRW (10.9%) outpaced GNP (4.6%).

In summary, the above analysis reveals certain conflicting results with respect to the two methods of evaluation of the performance of a company. In the initial period, 1965-1968, there is only a slight difference between the performance of a company when measured by the company's rate of sales growth relative to the rate of growth of GNP in current dollars and when it is measured by the company's rate of sales growth relative to the rate of growth of GNP in constant dollars. However, in the later periods the two performance measures differed quite significantly. More specifically, because of depressed chemical prices during the second period, 1968-1972, current dollar measure of growth companies. Conversely, because of rapidly climbing chemical prices during the last two periods, 1972-1974 and 1974-1976, current dollar measure of growth rate grossly overstated the real performance of most of the chemical companies.

Current and Constant Dollar Rank Differences

Because product mixes are different among companies and change within a company over time, the divergence between estimated sales growth in current dollars and in constant dollars can be expected to vary among companies'

as well as over time for a specific company. Hence, when the ten companies' estimated sales growth in current dollars are ranked and compared with the corresponding rank in constant dollar sales growth for each period, we find substantial differences in the ranking period, we find substantial differences in the ranking patterns. Derived from Table 13 of the previous chapter, Table 22 below shows the current and constant dollar sales growth rate rank of the ten companies for the periods 1965-1968, 1968-1972, 1972-1974, 1974-1976, and 1965-1976.

Company rank in rate of sales growth in current dollars with rank in rate of sales growth in constant dollars for each company, we note that in the first period 1965-1968, the number of rank changes and the magnitude of each change are small by comparison to the later periods. A rank correlation was computed for each period and the results were: for 1965-1968, $r = .958$ for 1968-1972, $r = .782$; for 1972-1974, $r = .440$ and for 1974-1976, $r = .867$. Consequently, one would do very well predicting real growth rate rank from nominal growth rate rank is lowest for the 1972-1974 period and somewhat better for the 1968-1972 and 1974-1976 periods.

Comparing rank ordering of rate of sales growth in current dollars with rank ordering of rate of sales growth in constant dollars, we note that the ranks of four companies in the current dollar ordering are the same as their ranks in the constant dollar ordering. W. R. Grace, FMC, DuPont and B. F. Goodrich ranked 1, 2, 6 and 9th respectively whether sales growth is measured in current dollars or constant dollars. For the remaining six companies, the rank of rate of sales growth for each company in current dollars differed somewhat from its

TABLE 22

**RANK OF RATE OF SALES GROWTH IN CURRENT AND CONSTANT DOLLARS,
FOR THE PERIOD: 1965-68, 1968-72, 1972-74, 1974-76 and 1965-76**

	<u>1965-68</u>	<u>1968-72</u>	<u>1972-74</u>	<u>1974-76</u>	<u>1965-76</u>
<u>Allied Chemical</u>					
Current Dollars	10	7	1	4	4
Constant Dollars	8	3	7	5	8
<u>American Cyanamid</u>					
Current Dollars	7	1	5	2	3
Constant Dollars	7	1	6	3	4
<u>DuPont</u>					
Current Dollars	9	2	4	7	6
Constant Dollars	9	2	1	4	6
<u>FMC</u>					
Current Dollars	2	4	8	5	2
Constant Dollars	2	6	10	8	2
<u>General Electric</u>					
Current Dollars	4	6	10	9	10
Constant Dollars	3	8	8	9	7
<u>W. R. Grace</u>					
Current Dollars	1	4	2	10	1
Constant Dollars	1	4	2.5	10	1
<u>B. F. Goodrich</u>					
Current Dollars	5	5	6	8	9
Constant Dollars	5	7	9	7	9
<u>3M</u>					
Current Dollars	6	3	7	3	7
Constant Dollars	6	5	5	2	5
<u>TRW</u>					
Current Dollars	3	8	9	1	5
Constant Dollars	4	10	4	1	3
<u>Union Carbide</u>					
Current Dollars	8	9	3	6	8
Constant Dollars	9	9	2.5	6	10

its rank of rate of sales growth in constant dollars. TRW moved from 5th in current dollars rate of sales growth rank to 3rd in constant dollar rank, American Cyanamid moved from 3rd to 4th, 3M moved fomr 7th to 5th, General Electric moved fomr 10th to 7th, Allied Chemical moved form 4th to 8th and Union Carbide moved form 8th to 10th. This pattern of rank changes the greater rise in prices of chemical products over the 1965-1976 period as compared to the rise in prices of other industries. As the pattern shows, the rank of sales growth in constant dollars is lower than its corresponding rank of sales growth in current dollar for three chemcial companies. For three nonchemical companies, the reverse is true. Putting this another way, while four of the six chemical companies ranked in the top half of the current dollar sales growth ordering scheme, only three of the six ranked in the top half under the constant dollar sales growth ordering scheme. In connection with the three chemical companies that ranked in the top half of both, the current dollar scheme and the constant dollar scheme, is the fact that they had participated actively in mergers and acqisitions over the 1965-1976 period (see Case Studies -W. R. Grace, FMC and American Cyanamid). The two remaining slots in the top half of the constant dollar sales growth ranking scheme, are also occupied by merging companies - 3M and TRW.

Measures of the Degree of Diversification Share of Principal Product

From the estimated value of shipments by 4-digit SIC industries for each year, we calculated the percentage of total value shipments of company's principal 2-digit product (Table 23). For every company except B. F. Goodrich, the principal 2-digit product had a large share of company sales and had the

same 2-digit principal product for every year. Allied Chemical, American Cyanamid, DuPont, FMC, W. R. Grace and Union Carbide produced products that were predominantly classified in the chemical and allied products industry (SIC 28). General Electric and TRW produced products that were predominantly classified in the electrical and electronic equipment industry (SIC 36) and 3M produced products that were predominantly classified in the paper and allied products industry (SIC 26). B. F. Goodrich's principal 2-digit industry was rubber products (SIC 30) for 1965, 1968, 1972 and 1974. In 1976, the percentage of estimated sales in rubber dropped to 42.4% of total while the percentage of estimated sales in chemical and allied products (SIC 28) increased to 43.6%.

The effects of varying price patterns extend also to the measurement of proportion of sales contributed by the firm's principal product line. That is, the proportion of sales of any product line when measured could very well differ from its proportion of sales of any product line when measured could very well differ from its proportion of sales when measured in constant dollars.¹⁷ Presented in Table 23 are the percentages of estimated value of shipments in constant dollars of each company's principal 2-digit product line.¹⁸ B. F. Goodrich's principal 2-digit industry in 1976 measured in constant dollars is rubber products (SIC 30) as opposed to chemical and allied products (SIC 28) when measured in current dollars. This apparent contradiction occurred because of the small difference in the percentages of the two products to total estimated sales through time whether measured in current dollars or constant dollars. When chemical prices climbed rapidly in 1974, the effect was to increase chemical products current dollar share to a level above rubber products share of total estimated sales.

TABLE 23
CURRENT AND CONSTANT DOLLAR SHARES OF PRINCIPAL 2-DIGIT SIC
 (Numbers in parenthesis are ranks)

	PRINC. 2-Dig. SIC, 1965	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
<u>Allied Chemical</u>	28					
Current Dollars		.823(3)	.833(3)	.837(3)	.807(3)	.790(3)
Constant Dollars		.822(3)	.838(3)	.865(3)	.863(3)	.827(3)
<u>American Cyanamid</u>	28					
Current Dollars		.835(2)	.848(2)	.904(2)	.911(1)	.900(1)
Constant Dollars		.834(2)	.852(2)	.911(2)	.910(1)	.895(1)
<u>DuPont</u>	28					
Current Dollars		.944(1)	.932(1)	.930(1)	.899(2)	.893(2)
Constant Dollars	28	.942(1)	.933(1)	.931(1)	.888(2)	.880(2)
<u>FMC</u>	28					
Current Dollars		.518(10)	.519(9)	.463(8)	.491(7)	.478(7)
Constant Dollars		.504(10)	.535(8)	.513(7)	.499(7)	.482(8)
<u>General Electric</u>	36					
Current Dollars		.536(8)	.547(6)	.567(5)	.593(6)	.624(5)
Constant Dollars		.535(9)	.549(7)	.582(6)	.618(5)	.653(5)
<u>W. R. Grace</u>	28					
Current Dollars		.770(4)	.542(7)	.571(4)	.622(4)	.716(4)
Constant Dollars		.767(4)	.552(6)	.631(4)	.652(4)	.728(4)
<u>B. F. Goodrich</u>	30					
Current Dollars		.590(5)	.590(4)	.505(7)	.463(8)	.424(10)
Constant Dollars		.603(5)	.585(4)	.493(9)	.475(8)	.439(9)
<u>3M</u>	26					
Current Dollars		.530(9)	.466(10)	.442(10)	.443(8)	.426(9)
Constant Dollars		.536(8)	.468(10)	.431(10)	.414(10)	.400(10)
<u>TRW</u>	36					
Current Dollars		.545(7)	.521(8)	.461(9)	.427(10)	.428(8)
Constant Dollars		.544(6)	.526(9)	.486(8)	.467(9)	.489(7)
<u>Union Carbide</u>						
Current Dollars		.548(6)	.567(5)	.566(6)	.596(5)	.612(6)
Constant Dollars	28	.538(7)	.573(5)	.608(5)	.600(6)	.622(6)

Comparisons of Current and Constant Dollar Measures of Principal Product

When these percentages in current and constant dollars are ranked and compared, we find that the two ranks are identical for Allied Chemical, American Cyanamid and DuPont for all five years. Allied Chemical consistently ranked third. American Cyanamid ranked second and DuPont ranked first for the three years 1965, 1968 and 1972. From 1974 to 1976, American Cyanamid displaced DuPont for first place in having the higher percentage of estimated sales (in current or constant dollars) contributed by its principal product. Although the current dollar rank ordering of the of the seven companies changed frequently from period to period, these changes are also reflected in a parallel fashion in the constant dollar ordering system.

Trend in Current and Constant Dollar Measures of Pricipal Product

Comparing the trend in current and constant dollar measures of share of prinicpal product, we note that over the 1965-1976 period, the current dollar measure of share of principal product decreased for seven of the ten companies - Allied Chemical, DuPont, FMC, W. R. Grace, B. F. Goodrich, 3M and TRW. This indicates a decrease in specialization or an increase in diversification. The constant dollar measure of share of principal product however, indicates that over the 1965-1976 period, specialization decreased for six of the ten companies - DuPont, FMC, W. R. Grace, B. F. Goodrich, 3M and TRW. This indicates a decrease or an increase in diversification. The constant dollar measure of share of principal product however, indicates that over the 1965-1976 period, specialization decreased for six of the ten companies -DuPont, FMC, W. R. Grace, B. F. Goodrich, 3M, and TRW. For Allied Chemical what appeared in current dollars, to be decreased in specialization, was actually an increase in constant dollars.

To examine the extent and change in diversification in greater detail, Table 24 presents the constant dollar share of the largest two- three- and four-digit industries outside of the firm's principal two-digit industry and the share of the largest three- and four-digit industries within the firm's principal two-digit industry for the years 1965 and 1976. These figures are self explanatory.

A More Detailed Measure of the Degree of Diversification, The Berry Index

There are several methods one can employ to measure the degree of product diversification of a firm. The most common have been 1) the ratio of a firm's sales in its primary industry to its total sales¹⁹ 2) by the number of industries necessary to account for some fraction - say 50 percent - of the firm's sales and 3) Berry's diversification index²⁰. The Berry index is an application of the Herfindahl Summary Index of Industrial Concentration. Berry's index appears to fit the concept of diversification more comprehensively than the other two in that it takes into account not only the number of industries in which a firm is active, but also the distribution of sales among these industries.

If a firm is equally active in 10 industries, Berry's diversification index would be $1 - 1/10$, or $9/10$. If the firm is equally active in two industries, the diversification index would be $1 - 1/2$, or $1/2$ and if the firm is a fully specialized company, the diversification index would be zero. Thus, diversification is zero when a firm is active in a single industry and approaches unity when the firm produces equally in a large number of industries. A convenient property of this index is that the index reduces to $1 - 1/n$ (where n is the number of industries in

TABLE 24
Constant Dollar Share of The Largest Two-, Three-, and Four-Digit Industries Outside of The Firm's Principal Two-Digit Industry and The Share of the Largest Three- and Four-Digit Industries Within The Firm's Principal Two-Digit Industry, 1965 and 1976

	Outside of Primary 2-Digit						Within Primary 2-Digit			
	2-Digit		3-Digit		4-Digit		3-Digit		4-Digit	
	SIC	Share	SIC	Share	SIC	Share	SIC	Share	SIC	Share
<u>Allied Chemical</u>										
1965	29	13.1%	291	10.7%	2911	10.7%	281	30.5%	2865	17.0%
1976	29	9.0	291	9.0	2911	9.0	281	41.9	2812	20.5
<u>American Cyanamid</u>										
1965	30	10.5	307	10.5	3079	10.5	286	27.8	2865	17.1
1976	30	6.0	307	6.0	3079	6.0	286	23.8	2844	17.0
<u>DuPont</u>										
1965	30	2.9	307	2.9	3079	2.9	282	48.4	2824	31.0
1976	34	4.2	348	4.2	3861	2.8	282	55.0	2824	36.6
<u>FMC</u>										
1965	35	31.1	356	12.7	3795	9.5	281	24.2	2823	17.8
1976	35	32.8	353	12.5	3795	7.2	282	26.7	2823	13.1
<u>General Electric</u>										
1965	37	18.6	372	10.7	3724	8.3	363	15.9	3621	6.4
1976	37	12.0	372	11.7	3724	9.5	363	18.7	3651	7.4
<u>W. R. Grace</u>										
1965	26	7.0	264	6.4	2643	5.5	286	19.7	2869	19.7
1976	20	8.9	264	5.5	2643	5.1	287	18.7	2869	14.8
<u>B. F. Goodrich</u>										
1965	28	23.0	282	17.2	2821	17.2	301	42.6	3011	42.6
1976	28	40.3	282	34.0	2821	25.4	301	38.4	3011	38.4
<u>3M</u>										
1965	38	13.2	386	13.2	3861	13.2	264	53.6	2641	50.3
1976	28	25.9	386	13.6	3861	13.6	264	40.0	2641	37.4
<u>TRW</u>										
1965	37	23.0	371	17.1	3714	17.1	366	39.6	3662	39.6
1976	37	22.8	371	15.4	3714	15.4	366	24.0	3662	24.0
<u>Union Carbide</u>										
1965	33	21.7	331	14.6	3313	14.6	286	34.4	2869	34.4
1976	36	17.4	331	9.4	3313	9.4	286	36.1	2869	36.1

which the firm is active) when a firm is equally active in each of several industries.²¹ That is, a diversification index of 0.2, which can be obtained in various ways, can be interpreted as a firm producing equally in 1.25 industries. Similarly, a diversification index of 0.2, which can be obtained in various ways, can be interpreted as a firm producing equally in 1.25 industries. Similarly, a diversification index of 0.3, 0.4, 0.5, 0.6, ..., can be interpreted as a firm producing equally in 1.43, 1.67, 2.00, 2.50, ..., industries.

In Berry's study of the effect of diversification on corporate growth, diversification indexes were calculated for 460 companies in Fortune's list of 500 largest industrial corporations for the years 1960 and 1965. This was done using 4-, 3- and 2-digit levels of product classification detail. The basic data used in calculating the indexes came from the 1961 and 1966 editions of the Plant and Product Directory prepared by Fortune Magazine. The directories contain a listing of plant by 5-digit product codes and by employment codes for the 500 largest U.S. industrial corporations. The Fortune Plant and Product Directories describes employment size by means of code letter:

<u>Employment Code</u>	<u>Employment Size Class Interval</u>
A	under 100
B	100-499
C	500-999
D	1000-4999
E	5000- and over

For individual plants, Berry employed the following weights which "approximately correspond to the mean employment of all manufacturing establishments within the employment category shown." As seen, the

employment codes correspond to wide class intervals and thus limit the accuracy of the computations.

<u>Employment Class</u>	<u>Plant Weight</u>
under 100	60
100-499	200
500-999	600
1000-4999	1600
over 4999	5300
unkown	440

Berry's Index vs. Our Estimated Index - For 1965

Given the availability of data for estimating value of shipments by 4-digit SIC industries in the present study, it is possible to apply Berry's diversification formula to our data and in this way measure the degree of diversification for the ten companies. Berry's equation can be used on either the 4-digit, 3-digit or 2-digit product levels. In addition, since we have also estimated value of shipments by 4-digit SIC industries in constant dollars, the degree of diversification in constant dollars on the 4-, 3- and 2-digit levels can be calculated.

In Table-25, a comparison is made between the diversification index as calculated with Berry's formula using our current dollar data and the diversification index developed by Berry for the ten companies average (unweighted) .9148, .8620 and .6374 respectively. These averages are equivalent to each company producing equally in 11.7, 7.2 and 2.8 4-, 3-, and 2-digit industries respectively. Applying Berry's diversification formula to our current dollar data on the ten companies for 1965, the 4-, 3- and 2-digit estimated diversification index averaged (unweighted) .8466, .8030 and .4876 respectively.

These averages correspond approximately to each company producing equally in 6.5, 5.1 and 2.0, 4-, 3- and 2-digit industries respectively. Thus our data indicate a lower average level of diversification than does Berry's, at each of the three levels of detail.

On a company-by-company basis, there is a high degree of correspondence between Berry's measures and our measures of diversification on the 4- and 3-digit level. The unweighted average discrepancy over the ten companies on the 4-digit level is 7.5%, and on the 3-digit level it is 6.7%. The ratios of our measure of diversification to Berry's on the 2-digit level averaged .741 (a discrepancy of 25.9%) and ranged from a high of 1.0494 (General Electric) to a low of .3216 (DuPont). Berry's index indicated a higher degree of diversification than our measure for all ten companies at the three-digit level and nine of the ten at the 2-digit level.

Analysis of the Discrepancies

There are several explanations for the greater discrepancy on the 2-digit level. The most important is the fact that Berry's indexes include the mining sector (SIC 10-14), the government sector (SIC 93, 95 and 99)²² as well as the manufacturing sector while our data covers the manufacturing sector only. Comparing the number of 2-digit industries as reported by MEI for 1965 (see Table 26), we find that Fortune reported an average of 10.6 2-digit industries for the ten companies while MEI reported an average of 7.2 2-digit industries for the ten companies.

TABLE 25
 RATIO OF ESTIMATED TO BERRY'S DIVERSIFICATION INDEX-1965
 (NUMBERS IN PARENTHESIS ARE RANKS)

	<u>4-Digit</u>	<u>Ratio</u>	<u>3-Digit</u>	<u>Ratio</u>	<u>2-Digit</u>	<u>Ratio</u>
<u>Allied Chemical</u>						
Estimated	.8782(5)	.9937	.7963(6)	1.0280	.3051(8)	.5282
Berry's	.8838(9)		.7746(10)		.5776(8)	
<u>American Cyanamid</u>						
Estimated	.9056(3)	.9831	.8500(4)	1.0101	.2897(9)	.7025
Berry's	.9212(5)		.8415(7)		.4124(9)	
<u>DuPont</u>						
Estimated	.8280(6)	.9096	.6747(10)	.8641	.1079(10)	.3216
Berry's	.9103(8)		.7808(9)		.3355(10)	
<u>FMC</u>						
Estimated	.9081(2)	.9687	.8647(3)	.9890	.6284(3)	.8770
Berry's	.9374(2)		.8743(5)		.7165(4)	
<u>General Electric</u>						
Estimated	.9587(1)	.9945	.9245(1)	.9914	.6521(2)	1.0494.
Berry's	.9640(1)		.9325(1)		.6214(6)	
<u>B. F. Goodrich</u>						
Estimated	.7557(9)	.8999	.7557(8)	.9047	.5716(6)	.9759
Berry's	.8398(10)		.8353(8)		.5857(7)	
<u>W. R. Grace</u>						
Estimated	.8993(4)	.9854	.8784(2)	.9839	.3962(7)	.5576
Berry's	.9126(7)		.8928(4)		.7105(5)	
<u>3M</u>						
Estimated	.7195(10)	.7698	.6835(9)	.7443	.6686(1)	.7791
Berry's	.9346(3)		.9183(2)		.8582(1)	
<u>TRW</u>						
Estimated	.7889(8)	.8617	.7830(7)	.8601	.6282(5)	.7841
Berry's	.9155(6)		.9104(3)		.8013(2)	
<u>Union Carbide</u>						
Estimated	.8242(7)	.8874	.8194(5)	.9533	.6282(4)	.8325
Berry's	.9288(4)		.8595(6)		.7546(3)	
<u>Unweighted Average:</u>		.9254		.9329		.7408
Estimated	.8466		.8030		.4876	
Berry's	.9148		.8620		.6374	

TABLE 26

LIST OF TWO-DIGIT SIC BY COMPANY AS REPORTED BY
MEI AND FORTUNE'S PLANT AND PRODUCT DIRECTORY
FOR 1965

<u>Allied Chemical</u>	
MEI (6)	26,28,29,30,32,33
Fortune (7)	13,24,26,28,29,30,32
<u>American Cyanamid</u>	
MEI (5)	28,29,30,34, ,38
Fortune (11)	10,14,20,24,25,27,28, ,30,34,38
<u>DuPont</u>	
MEI (6)	22, 28, ,30, 35, 38,39
Fortune (13)	10,14,22,26,27,28,29,30,33,35,36,38,39
<u>FMC</u>	
MEI(5)	,28, ,34,35, ,37
Fortune (15)	14,19,22,24,25,26,28,30,32,33,34,35,36,37,99
<u>General Electric</u>	
MEI (10)	,27,28,30,32,33,34,35,36,37,38
Fortune (14)	19,25,27,28,30,32,33,34,34,36,37,38,39,99
<u>W. R. Grace</u>	
MEI (8)	,20,22,26,28, ,30,32,33,35
Fortune (5)	10,14,20,22,26,28,29,30,32, ,35
<u>B. F. Goodrich</u>	
MEI (9)	22,23,28,30,32,37
Fortune (5)	22, 28,30,32,37
<u>3M</u>	
MEI (9)	,26, 28,30,32,34,35,36,38,39
Fortune (10)	14,22,26,27,28,30,32, 35,36,38, ,
<u>TRW</u>	
MEI (8)	,30, 33,34,35,36,37,38,39
Fortune (11)	19,28,30,32,33,34,35,36,37,38, ,99
<u>Union Carbide</u>	
MEI (9)	,22,25,26,28,30, 33,34,35,36,
Fortune (10)	10, , ,26,28,30,32,33,34,35,38,38

In addition to the conclusion of the mining and government sectors in Berry's analysis, there are several other factors responsible for the greater number of 2-digit industries reported by Fortune. One factor is that Fortune's Plant and Product Directory -1966 classifies plants according to the revised SIC codes adopted in 1963 while our data uses the 1972 SIC codes. A number of reclassifications have occurred between 1963 and 1972. These changes account for some of the higher number of two-digit industries reported by Fortune. For example, Ordnance and accessories major group 19, found in the 1963 classification system was eliminated in 1972 and reclassified into four-digit codes in either the 34, 37 or 38 major groups. Another factor is that Fortune includes plants with less than 100 employees while MEI does not. Thus, if a company has several small plants (less than 100 employees) in several new two-digit industries, Fortune's count of the number of two-digit industries for the company would exceed MEI's count by that amount. In connection with this last point, Fortune lists all products (by SIC codes) produced by a given plant while MEI (following the Census procedure) lists only its primary product.

Having made up the product list of each plant, Berry then takes the employment code and distributes the corresponding employment weight equally among the various products. This procedure not only has the potential for overstating the degree of diversification ²³ but also can account for the higher number of two-digit industries reported by Fortune. That is, given a multi-product (on the two-digit level) plant with 100 employees and devoting 90 percent of its resources to the production of a single product, Berry's procedure would distribute the 100 employees equally among the various products and thereby overstate the diversification of the plant and possibly overcount the number of two-digit industries (relative to MEI's count).

When nonmanufacturing industries and small plants (employment code A) were eliminated from Fortune's list of plants and when adjustments were made for the 1972 SIC reclassification (major group 19), the average number of two-digit industries fell more in line with the average number of two-digit industries reported MEI (MEI: 7.2 vs. Fortune: 8.7) When plants with unknown employment figures were eliminated, the average number of two-digit industries reported by Fortune for these ten companies dropped to 7.8 (see Table 27). The remaining discrepancy is most probably due to Berry's procedure of distributing the number of employees equally among the various products of a plant.

Overall, Berry's indexes suggest a higher degree of diversification for the Ten companies than do our measures. As mentioned above, this is most probably due to the larger number of two-digit industries reported by Fortune. That is, it necessarily follows that the four-digit index is greater than or equal to the three-digit index which in turn is greater than or equal to the two-digit index because part of the four-digit diversification is due to diversification in the three-digit and two-digit industries. In addition to the factors already discussed pertaining to the higher count of the number of two-digit industries by Fortune and the consequently larger measures of diversification as compared to our estimated measures, there are two other important factors that should be acknowledged. The first is that the large class interval associated with each employment code in Fortune's Plant and Product Directory tends to bias Berry's diversification index upward and the second is that Berry's procedure assumes

TABLE 27

**Two-Digit Industries Eliminated From Fortune's Lists
(by Company for 1965)**

	<u>non manufacturing</u>	<u>SIC reclassi- fication</u>	<u>small plants</u>	<u>no employment data</u>
Allied Chemical	13			24
American Cyanamid	10, 14		20, 27, 35	
DuPont	10, 14			26, 27, 29, 33, 36
FMC	14, 99	19		
General Electric	99	19		25, 39
W. R. Grace	10, 14			29
B. F. Goodrich				
3M	14			
TRW		19	32	
Union Carbide	10			
<u>Total number of two-digit industries eliminated</u>	<u>12</u>	<u>3</u>	<u>4</u>	<u>9</u>

Total number of two digit industries after eliminations: 78

that plant production in all industries is proportionate to employment. This assumption ignores variations in output per employee among industries which, if taken into account, could yield a more disparate set of plant outputs and a lower degree of diversification.

Estimated Diversification Indexes - Current vs. Constant Dollars

Presented in Tables 28, 29 and 30 are diversification indexes as calculated by applying Berry's formula on our current and constant dollar data for each of the ten companies and for each year under observation. On a current dollars basis, the average (unweighted) diversification of the ten companies increased by 2.1% from 1965 to 1976 on the four-digit level, by 0.9% on the three digit level and by 3.9% on the two-digit level. On a constant dollar basis, the average (unweighted) diversification of the ten companies increased 2.2% from 1965 to 1976 on the four-digit level. Put another way, these changes in both current and constant dollar terms are equivalent to the average number of industries each company equally produces in, increasing from 6.5, 5.1 and 2.0, four-, three- and two- digit industries respectively in 1976. Thus the average diversification, whether measured in current or constant dollars, for the ten companies as a whole increased on the four- and three-digit levels but remained essentially unchanged on the two-digit level. This pattern of changes suggest that over the 1965-1976 period, diversification by the ten companies occurred on the three- and four digit levels within their established two-digit industries.

On a company-by-company basis - however, the change in the current dollar measures of the degree of diversification differ somewhat from their

TABLE 28
Diversification Index Based on 4-Digit Product Classes in Current and Constant Dollars
(1965, 1968, 1972, 1974 and 1976)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>	<u>% Change 1965-76</u>
<u>Allied Chemical</u>						
Current Dollars	.87818	.86863	.87600	.86148	.86523	-1.4%
Constant Dollars	.87855	.86495	.87223	.85427	.86868	-1.1
<u>American Cyanamid</u>						
Current Dollars	.90562	.90783	.89993	.90020	.90067	-0.5
Constant Dollars	.90581	.90801	.90075	.89789	.89844	-.08
<u>DuPont</u>						
Current Dollars	.82801	.82111	.81547	.82954	.82590	-0.3
Constant Dollars	.82913	.82491	.82448	.82955	.81032	-2.3
<u>FMC</u>						
Current Dollars	.90813	.91213	.93726	.93237	.93280	3.3
Constant Dollars	.91026	.91134	.93481	.93174	.93585	2.8
<u>General Electric</u>						
Current Dollars	.95866	.95721	.95357	.94780	.95242	-0.6
Constant Dollars	.95901	.95715	.95428	.94740	.95225	-0.7
<u>B. F. Goodrich</u>						
Current Dollars	.75568	.75540	.76131	.75615	.75506	-0.1
Constant Dollars	.75087	.75595	.76465	.75458	.75811	1.0
<u>W. R. Grace</u>						
Current Dollars	.89925	.92994	.93396	.92796	.91591	1.9
Constant Dollars	.89983	.92947	.92927	.92724	.91897	2.1
<u>3M</u>						
Current Dollars	.71949	.77061	.78718	.79020	.80299	11.6
Constant Dollars	.71485	.76906	.79109	.80243	.81785	14.4
<u>TRW</u>						
Current Dollars	.78887	.82905	.87023	.87934	.88140	11.7
Constant Dollars	.78925	.82844	.86923	.87364	.87431	10.8
<u>Union Carbide</u>						
Current Dollars	.82423	.82597	.82995	.81424	.81223	-1.5
Constant Dollars	.82869	.82766	.82391	.82105	.81847	-1.2
<u>Average (Unweighted)</u>						
Current Dollars	.84661	.85779	.86649	.86393	.86446	+2.1
Constant Dollars	.84663	.85769	.86647	.86398	.86533	+2.2

TABLE 29
DIVERSIFICATION INDEX BASED ON 3-DIGIT PRODUCT CLASSES AND CONSTANT DOLLARS
(1965, 1968, 1972, 1974 and 1976)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>	<u>% Change 1965-76</u>
<u>Allied Chemical</u>						
Current Dollars	.79625	.77580	.78644	.75755	.74996	-5.8%
Constant Dollars	.79701	.76780	.77203	.73744	.75058	-5.8
<u>American Cyanamid</u>						
Current Dollars	.84997	.85356	.84598	.84335	.84661	-0.4
Constant Dollars	.85096	.95367	.84768	.85067	.85546	0.5
<u>DuPont</u>						
Current Dollars	.67469	.65706	.64758	.67108	.66898	-0.8
Constant Dollars	.67698	.66159	.65755	.67248	.65447	-3.3
<u>FMC</u>						
Current Dollars	.86473	.85608	.87647	.87022	.87053	0.7
Constant Dollars	.86727	.85283	.86448	.87076	.86138	-0.7
<u>General Electric</u>						
Current Dollars	.92446	.91715	.91960	.91404	.91367	-1.3
Constant Dollars	.92552	.91674	.91834	.90608	.91000	-1.7
<u>B. F. Goodrich</u>						
Current Dollars	.75568	.75540	.73036	.71455	.70931	-6.1
Constant Dollars	.75087	.75595	.72824	.71291	.71416	-4.9
<u>W. R. Grace</u>						
Current Dollars	.87836	.91735	.91160	.90333	.89050	1.4
Constant Dollars	.87887	.91651	.90560	.90131	.89913	1.2
<u>3M</u>						
Current Dollars	.68352	.73435	.76201	.76049	.77592	13.5
Constant Dollars	.67826	.73270	.7626	.77740	.79483	17.2
<u>TRW</u>						
Current Dollars	.78297	.82331	.86162	.87220	.873666	11.6
Constant Dollars	.78375	.82240	.85908	.96438	.96272	10.1
<u>Union Carbide</u>						
Current Dollars	.81938	.81966	.82467	.80814	.80476	-1.8
Constant Dollars	.82398	.82023	.816.30	.814.24	.81148	-1.5
<u>Average (Weighted)</u>	.80300	.81097	.81663	.81150	.81039	+0.9%
Current Dollars	.80335	.81004	.81366	.81077	.81142	+1.0%

TABLE 30
DIVERSIFICATION INDEX BASED ON 2-DIGIT PRODUCT CLASSES IN CURRENT AND CONSTANT DOLLARS
(1965, 1968, 1972, 1974 and 1976)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>	<u>% Change 1965-76</u>
<u>Allied Chemical</u>						
Current Dollars	.30508	.28949	.28483	.32619	.35440	16.2%
Constant Dollars	.30634	.28148	.24167	.24526	.30540	-0.3
<u>American Cyanamid</u>						
Current Dollars	.28966	.27216	.17830	.16685	.18654	-35.6
Constant Dollars	.29188	.26682	.16631	.16708	.19451	-33.4
<u>DuPont</u>						
Current Dollars	.10788	.12901	.13261	.18949	.20005	85.4
Constant Dollars	.11052	.12811	.13123	.20881	.22286	101.6
<u>FMC</u>						
Current Dollars	.62844	.63275	.64567	.62819	.64168	2.1
Constant Dollars	.63536	.62219	.62321	.62686	.64353	1.3
<u>General Electric</u>						
Current Dollars	.65207	.64204	.61849	.60423	.57929	-11.8
Constant Dollars	.65374	.633922	.60619	.57806	.54382	-16.8
<u>B. F. Goodrich</u>						
Current Dollars	.57164	.56747	.60876	.61261	.61676	7.9
Constant Dollars	.56163	.57080	.61310	.61367	.62788	11.8
<u>W. R. Grace</u>						
Current Dollars	.39620	.60524	.59853	.55872	.46818	18.2
Constant Dollars	.40053	.59879	.55029	.53759	.45587	13.8
<u>3M</u>						
Current Dollars	.66858	.71128	.73454	.72338	.71490	6.9
Constant Dollars	.66342	.71000	.73914	.74255	.74126	11.7
<u>TRW</u>						
Current Dollars	.62815	.65670	.69658	.72128	.71966	14.6
Constant Dollars	.63220	.65270	.68155	.69443	.68276	8.0
<u>Union Carbide</u>						
Current Dollars	.62822	.61855	.62317	.59502	.58222	-7.3
Constant Dollars	.63697	.61257	.58489	.59156	.56995	-10.5
<u>Average (Unweighted)</u>						
Current Dollars	.48759	.51229	.51215	.51260	.50637	+3.9%
Constant Dollars	.48926	.50827	.49376	.50059	.49878	+1.9%

change in constant dollar counterparts. While changes in both the current dollar measure of diversification and the constant dollar measure of diversification reflect entries (or exits) into new industries and/or changes in the existing product mix of a company, the constant dollar measure analyzes the change in product mix as quantities changes only.

Over the 1965-1976 period, the 4-digit degree of diversification in current dollars of 6 companies - Allied Chemical, American Cyanamid, DuPont, General Electric, B. F. Goodrich and Union Carbide decreased, while in constant dollars, 5 companies - the same six except for B. F. Goodrich, showed a decrease in diversification. The decreases in diversification however, were small, ranging from - 1.5% (Union Carbide) to -0.1% (B. F. Goodrich) in current dollars and from 2.3% (DuPont) to -0.7% (General Electric) in constant dollars. By contrast, the increases in diversification (four-digit level) from 1965 to 1976; 11.6% and 11.7% respectively in current dollars and 14.4% and 10.8% respectively in constant dollars.

On the 3-digit level, the degree of diversification in current dollars decreased for six companies - Allied Chemical, American Cyanamid, DuPont, General Electric, B. F. Goodrich and Union Carbide. The largest decrease was recorded by B. F. Goodrich (-6.1%). When the 3-digit diversification index is calculated in constant dollar terms, decreases over the 1965-1976 period occurred for Allied Chemical, DuPont, FMC, General Electric, B. F. Goodrich and Union Carbide. Allied Chemical exhibited the greatest decrease under the constant dollar terms (-5.8%). 3M and TRW again registered the greatest percentage increase in diversification, 13.5% and 11.6% in current dollars respectively and 17.2% and 10.1% respectively in constant dollars.

The 2-digit diversification index shows a decrease in the degree of diversification over the 1965-1976 period for three companies - American Cyanamid (-35.6%), General Electric (-11.8) and Union Carbide (-7.3%) in current dollars and shows a decrease for four companies - Allied Chemical (-0.3%), American Cyanamid (-33.4%), General Electric (-16.8%) and Union Carbide (10.5%) in constant dollars. The greatest increase in the 2-digit degree of diversification over this period was registered by DuPont, 85.4% in current dollars and 101.6% in constant dollars and 11.7% and 8.0% respectively in constant dollars.

When these diversification indexes are ranked according to degrees of diversification (Table 31) we find that:

1. there are minor differences between current and constant dollar rank ordering.
2. there are minor differences between the 3-digit and 4-digit diversification rank ordering and ²⁴
3. there are major differences between the 3-digit and 4-digit rank ordering with the 2 digit diversification rank ordering.^{25, 26}

On the current and constant dollar rank ordering comparisons, of the 150 company-year comparisons, there are only five changes in the four-digit diversification rank patterns, six in the three-digit diversification rank patterns and eight in the two-digit diversification rank patterns. The five changes in the four-digit diversification rank patterns involved three companies- DuPont,

TABLE 31

Four-, Three- and Two-Digit Diversification Rank in Current and Constant Dollars

(1965, 1968, 1972, 1974 and 1976)

	1965			1968			1972			1974			1976		
	4- Dig.	3- Dig.	2- Dig.	4- Dig.	3- Dig.	2- Dig.	4- Dig.	3- Dig.	2- Dig.	4- Dig.	3- Dig.	2- Dig.	4- Dig.	3- Dig.	2- Dig.
<u>Allied Chemical</u>															
Current Dollars	5	6	8	5	7	8	5	7	8	6	8	8	6	8	8
Constant Dollars	5	6	8	5	7	8	5	7	8	6	8	8	6	8	8
<u>American Cyanamid</u>															
Current Dollars	3	4	9	4	4	9	4	5	9	4	5	10	4	5	10
Constant Dollars	3	4	9	4	3	9	4	5	9	4	5	10	4	5	10
<u>DuPont</u>															
Current Dollars	6	10	10	8	10	10	8	10	10	7	10	9	7	10	9
Constant Dollars	6	10	10	8	10	10	7	10	10	7	10	9	9	10	9
<u>FMC</u>															
Current Dollars	2	3	3	3	3	4	2	3	3	2	4	3	2	4	3
Constant Dollars	2	3	4	3	4	4	2	3	3	2	3	3	2	4	3
<u>General Electric</u>															
Current Dollars	1	1	2	1	2	3	1	1	5	1	1	5	1	1	6
Constant Dollars	1	1	2	1	1	3	1	1	5	1	1	6	1	1	6
<u>B. F. Goodrich</u>															
Current Dollars	9	8	6	10	8	7	10	9	6	10	9	4	10	9	-
Constant Dollars	9	8	6	10	8	7	10	9	4	10	9	4	10	9	-
<u>W. R. Grace</u>															
Current Dollars	4	2	7	2	1	6	3	2	7	3	2	7	3	2	-
<u>3M</u>															
Current Dollars	10	9	1	9	9	1	9	8	1	9	7	1	9	7	2
Constant Dollars	10	9	1	9	9	1	9	8	1	9	7	1	8	7	1
<u>TRW</u>															
Current Dollars	8	7	5	6	5	2	6	4	2	5	3	2	5	3	1
Constant Dollars	8	7	5	6	5	2	6	4	2	5	4	2	5	3	2
<u>Union Carbide</u>															
Current Dollars	7	5	4	7	6	5	7	6	4	8	6	6	8	6	5
Constant Dollars	7	5	3	7	6	5	8	6	6	8	6	5	7	6	5

Union Carbide and 3M. The six changes in the three-digit diversification rank patterns involved five companies - American Cyanamid, FMC, General Electric, W. R. Grace and TRW. The eight changes in the two-digit diversification rank patterns involved six companies - FMC, General Electric, B. F. Goodrich, 3M, TRW and Union Carbide. The obvious conclusion here is that over time, the price component of the product mix variable has little affect on the ranks of diversification of these ten companies.

With respect to the latter two findings, one can predict fairly accurately the degree of diversification on the four-digit level given the degree of diversification on the three-digit level, or vice-a-versa. However, given the two digit degree of diversification one can say very little about the three- or four-digit diversification. As an example, the five most diversified companies in 1976 (constant dollars) on the two-digit level were 3M, TRW, FMC, B. F. Goodrich and Union Carbide. Of these, only two were among the most diversified at the three-digit level. By contrast, the same five companies, General Electric, W. R. Grace, TRW, FMC and American Cyanamid were the most diversified using both the three-digit and four digit measures of diversification.

CHAPTER IV
CURRENT AND CONSTANT DOLLAR ANALYSES OF
GROWTH AND DIVERSIFICATION

Introduction

In the previous chapter we described some of the basic characteristics of the ten companies examined in this study. This chapter aims at a more detailed analysis of the effects of several factors on the rate of sales growth of a firm. Specifically, the questions asked are:

- 1) Do merger-oriented corporations generally achieve more rapid growth than do corporations less oriented toward mergers?
- 2) Do more diversified companies grow faster than less diversified ones?
- 3) What is the relationship between firms' growth rates and those of their primary industries?
- 4) Is there any evidence that certain types of diversification are more conducive to grow than others?

With respect to these questions, hypotheses are formulated and tested. These tests are performed using both the current dollar data and the constant dollar data developed in this study and the results are compared. These comparisons should provide some insight into the degree and direction of the potential errors causing current dollar data as opposed to constant dollar data in the analysis of growth.

Non-Parametric Techniques

Since the small sample size ($n=10$) does not permit valid parametric analyses, nonparametric test are the only one meaningful alternative. The

basic characteristic of a nonparametric test is that it makes no assumptions about the distribution of the population. This type of testing is, therefore, very useful when the sample size is small, as in the present case. The two nonparametric statistical tests used here are 1) the Mann-Whitney U test and 2) the test of the significance of the Spearman rank correlation coefficient.

The Mann-Whitney U Test

In applying these two tests, the only requirement is that the data be measured in at least an ordinal manner. The Mann-Whitney U test is used primarily to test whether two independent groups have been drawn from the same population. This test is a useful alternative to the parametric t-test when the researcher cannot rely upon the t-test's assumptions. The efficiency of the Mann-Whitney U test when computed with the t-test, is about 95.5 percent as N increases, and is close to 95 percent even for moderate-sized samples. The main advantage of this test is that it does not have the restrictive assumptions and requirements associated with the t-test. In applying the Mann-Whitney U test to test whether two independent groups have been drawn from the same population, we first combine the observations from both groups and rank them in order of increasing size. Then, selecting one of the groups, say the group with n_1 cases, the value of U (the statistic used in this test) is given by the number of times that a score in the group with n_2 cases precedes a score in the group with n_1 cases in the ranking. When n_1 and n_2 increase in size, the sampling distribution with:

$$\text{Mean} = \mu_u = \frac{n_1 n_2}{2}$$

$$\text{and Standard Deviation} = \sigma_u = \sqrt{\frac{n_1 \cdot n_2 (n_1 + n_2 + 1)}{12}}$$

The Spearman Rank Correlation Coefficient Test

The Spearman rank correlation coefficient is a measure of association which requires only that the objects under study be ranked in two ordered series. This test is a useful alternative to the parametric Pearson coefficient when the researcher cannot assume a bivariate normal distribution. The efficiency of the Spearman rank coefficient when compared with the Pearson Coefficient, is about 91 percent. That is, when the Spearman rank coefficient is used with a sample test for the existence of an association in the population, and when the assumptions and requirements underlying the proper use of the Pearson coefficient are met, then the Spearman rank coefficient is 91 percent as efficient as the Pearson coefficient in rejecting the null hypothesis. If a correlation between X and Y exists in that population, with the 100 cases the Spearman rank coefficient will reveal that correlation at the same level of significance which the Pearson coefficient attains with 91 cases.

I. Preliminary Analyses

On the first of analysis, the Mann-Whitney U test was used to test several hypotheses with respect to two of the above four questions. In particular, this section attempts to shed some preliminary light on 1) the relationship between merger activity and sales growth and 2) the relationship between firm's overall rate of sales growth and the growth rate of its primary industry. We then present additional tests using the Spearman rank correlation coefficient to examine the growth rate-primary industry relationship. The Spearman rank

correlation is then used on several sets of variables pertaining to the diversified-non-diversified growth rate analysis and to the type of diversification analysis.

a) Mergers and Growth

Virtually every study of the relationship between merger activity and sales growth, including Samuel R. Reid²⁷ - Mergers, Managers, and the Economy, J. Fred Weston and S. K. Mansinghka - "Tests of the Efficiency Performance of Conglomerate Firms" and Baruch Lev and Gershon Mandelker²⁹ - "The Microeconomic Consequences of Corporate Mergers" has found that merger-oriented corporations have generally achieved more rapid sales growth. Moreover, studies that have attempted to isolate growth through merger per se from the greater ongoing growth capability that the mergers may have created also showed that the more rapid growth resulted from the once-and-for-all addition of the acquired companies' sales and not from any addition of the acquired companies' sales and not from any change in the acquired companies' base growth rates.³⁰

However, in every one of these studies, current dollar measures of sales growth were used, as we saw earlier, varying price patterns can distort the measures of relative growth. While on a current dollar basis Allied Chemical (a non-merging company) grew (168.6%) faster than TRW (a merging company)-168.6% vs. 167.9% over the 1965-1976 period, the reverse is true when sales are measured in constant dollars (TRW-62.9% vs. Allied Chemical - 38.9%).

Given the five merging companies and five non-merging companies of our sample, the Mann-Whitney U test can be used to test the null hypothesis that there was no difference in the 1965-1976 sales growth rates of merging companies and non-merging companies against the alternative hypotheses that the sales growth rates of merging companies were greater than the sales rates of non-merging companies. This test was performed on both our current and constant dollar data and the results are presented in Table 32.

Using the level of significance, $\alpha = .05$, the null hypothesis is to be rejected if the value of P (the probability corresponding to a given value of n_1 , n_2 and U for a one-tailed test)³¹ is $\leq .05$. The value of P for our current dollar data is .028 and the value of P for our constant dollar data is .004. Therefore, the null hypothesis is rejected in favor of the alternative hypothesis in both cases. The tests here thus support the finding of previous studies that merger-oriented corporations tend to achieve a more rapid sales growth rate.

The more interesting empirical question on the effect of mergers is whether there is any evidence of synergy. Attempts to answer this question do not lead to a single view. In the majority of the studies that have attempted to distinguish growth through merger per se from internal growth, a comparison was made between a sample of acquiring firms and a control group. Ideally, to examine synergy in mergers and acquisitions, the performance of the combined companies should be compared with the performance of the individual companies had the merger not taken place. The data developed in this study do not permit us to employ this approach and therefore the question is not directly addressed.

In passing, it is interesting to note that over the 1965-1976 period only three of the five merging companies in our sample moved up in sales rank in Fortune's lists of the 500 largest industrials. Four of the five non-merging companies moved down while one non-merging company's rank remained unchanged. If synergy played a significant role in the growth of merging companies one would expect all five merging companies to move up in sales rank or at least to maintain their sales rank. That is, in addition to the growth contribution of the synergy effect of the acquired companies' sales push up sales rank.

Primary Industry Growth and Overall Firm Growth

Reflecting the changing composition of the economy, some industries grow faster than others. A firm producing products in a rapidly growing industry can be expected to grow faster than a firm producing products in a slowly growing industry (holding everything else constant). Similarly, a firm with a large share of its output in a rapidly growing industry can be expected to grow faster than a firm with a large share of its output in a slowly growing industry (holding everything else constant).

TABLE 32
MANN-WHITNEY U TEST ON FOUR NULL HYPOTHESIS
 (2 = .05, one-tailed test)

		N₁, N₂	U	P	DECISION		
1	HO: Sales growth rates of merging companies = Sales growth rates of non-merging companies	n ₁ =5	Current dollar data:	3	.028	Reject	HO
	HA: Sales growth rates of merging companies Sales growth rates of non-merging companies	n ₂ =5	Constant dollars data	0	.004	Reject	HO
2	HO: Sales growth rates of chemical companies = Sales growth rates of non-chemical companies	n ₁ =4	Current dollar data:	3	.033	Reject	HO
	HA Sales growth rates of chemical companies Sales growth rates of non-chemical companies	n ₂ =6	Constant dollar data:	10	.381	Accept	HO
3	HO: Given merging companies, Sales growth rates of chemical companies = Sales growth rates of non-chemical companies	n ₁ =2	Current dollar data:	0	.100	Accept	HO
	HA: Given merging companies, sales growth rates of chemical companies Sales growth rates of non-chemical companies	n ₂ =3	Constant dollar data:	1	.200	Accept	HO
4	HO: Given Chemical companies, sales growth rate of merging companies = Sales growth rates of non-merging companies	n ₁ =3	Current dollar data:	0	.05	Reject	HO
	HA: Given chemical companies, sales growth rate of merging companies Sales growth rates of non-merging companies	n ₂ =3	Constant dollar data:	0	.05	Reject	HO

Over the 1965-1976 period, the chemical industry was among the more rapidly growing industries. During this period, the chemical industry has been among the largest investors in research and development. These expenditures have resulted in a flow of new products and processes which has contributed significantly to the above average growth of the chemical industry and to major changes in its product mix. While manufacturing production index increased 44.4% over the 1965-1976 period, the chemical products production index increased some 92.0% over the same period.³² Of the six chemical companies in our study, four of them had a faster rate of current dollar sales growth than the most rapidly growing of the four non-chemical companies (TRW) over the 1965-1976 period. On a constant dollar basis, however, TRW's rate of sales growth was exceeded by only two chemical companies. This comparison points out again the importance of differential price trends in assessing a real growth patterns.

The null hypothesis to be tested here is: that there was no difference in the 1965-1976 sales growth rates of the six chemical companies and the four non-chemical companies. The Mann-Whitney U test was used on both our current and constant dollar data and the results are presented in Table 32. performing the test with $\alpha = .05$ using our current dollar data, we rejected the null hypothesis that the sales growth rates of chemical companies were equal to the sales growth rates of non-chemical companies. However, when the test was performed using our constant dollar data, the result was to accept the null hypothesis that there was no difference in the sales rates between chemical companies. This contradiction in results brings to light the importance of differential price changes and the potential for errors when current dollar data are used in comparisons of growth.

Retest for Two Subperiods

To carry this analysis further, we performed the same test using our current and constant dollar data for two separate periods, 1965-1972 and 1972-1976. The intention here is to determine whether the chemical price explosion and the shortage of raw materials beginning in late 1973 might not have adversely affected the chemical industry and thereby subjected our constant dollar finding to misinterpretation. By splitting the 1965-1976 period into two subperiods, we should be able to test the null hypothesis that there was no difference in the sales growth between chemical companies and non-chemical companies (for the earlier subperiod) without the negative impact of the shortage of raw materials (that had occurred in the latter subperiod).

The decision to accept the null hypothesis (see Table 33), using our constant dollar data for both subperiods, support our earlier finding that there was no difference in the sales growth rates between chemical companies and non-chemical companies. In general, the tests here failed to extend any support to the notion that the chemical companies should have grown more rapidly than the other companies (at least not the chemical companies selected for this study) by virtue of its faster industry rate of growth.

TABLE 33

RETEST OF CHEMICAL VS. NON-CHEMICAL COMPANIES FOR TWO SUBPERIODS

Using $\alpha = .05$ (one-tailed test) the results are:

HO: Sales growth rates of chemical companies =
Sales growth rates of non-chemical companies

HA: Sales growth rates of chemical companies
Sales growth rates of non-chemical companies

$$n_1 = 4, n_2 = 6$$

	<u>Period</u>	<u>U</u>	<u>P</u>	<u>Decision</u>
Current Dollar Data	1965-1972	8	.238	Accept HO
	1972-1976	2	.019	Reject HO
Constant Dollar Data	1965-1972	12	.545	Accept HO
	1972-1976	11	.457	Accept HO

c) The Non-Mutual-exclusivity of Merging Companies and Chemical Companies - A Problem?

Although three of the six chemical companies in our sample are also companies that had participated actively in mergers and acquisitions, the results of the tests performed in the above subsections remain valid. A problem similar to multicollinearity (in regression analysis) would exist if both the merging variable and the chemical industry variable were positively related to sales growth. Since this was not the case, the results described in the above subsections are more reliable. As further confirmation, the following null hypotheses were tested:

- 1) given the set of merging companies - that there was no difference in the 1965-1976 sales growth rates of chemical companies and non-chemical companies and
- 2) given the set of chemical companies - that there was no difference in the 1965-1976 sales growth rates of merging companies and non-merging companies.

The results of these tests support our previous findings (see Table 1).

In summary, these preliminary tests support the findings of previous studies that merger-oriented companies tend to achieve a more rapid sales growth. They failed, however, to extend any support to the notion that the chemical companies should have grown more rapidly than the other companies.

Nethertheless, the importance of primary (two-digit) activity in determining firm's growth performance cannot be dismissed. Such activity constitutes, by definition, the largest part of a firm's total production. As indicated by the figures in Table 34 there is a high degree of correspondence between the rank ordering pattern of the rates of growth of the four 2-digit industries (26, 28, 30, 36) that are of concern here and the rank ordering pattern of the estimated rates of growth of the ten companies into these industries. According to ranks of industry growth rates in current and constant dollars, the rubber company (B. F. Goodrich) should have been the chemical companies. The third fastest should have been the paper and pulp company (3M) and the slowest should have been the two electrical and equipment companies (General Electric and TRW).

According to our estimated growth rates in current and constant dollars, the rank ordering patterns are quite similar to the above pattern. In current dollars, the average rate of growth of the six chemical companies recorded the fastest growth over the 1965-1976 period. 3M's growth was the second fastest. B. F. Goodrich was the third fastest and the average of the two electrical and equipment companies recorded the slowest growth. The only difference between this rank ordering pattern and the above industry rank ordering pattern is of 3M and B. F. Goodrich. According to its primary industry, the rubber company should have grown the fastest.

A similar difference occurred when these rates in constant dollars are ranked. The average rate of growth of the six chemical companies in constant dollars recorded the fastest growth for the 1965-1976 period. The second

TABLE 34

A Comparison of the Four Two-Digit Industries' Growth Rates with Estimated Rates of Growth of the Ten companies Grouped into these Industries

<u>Industry</u>	<u>SIC</u>	<u>1965-1976 Growth Rates*</u>			
		<u>Current Dollars</u>	<u>Rank</u>	<u>Constant Dollars</u>	<u>Rank</u>
Paper & Pulp	26	161.6	3	40.3	3
Chemical & Allied	28	178.7	2	47.4	2
Rubber	30	193.7	1	77.0	1
Electrical & Equip.	36	110.1	4	15.4	4
 <u>Average (unweighted) Rate</u>					
3M		161.5	2	57.3	2
Six Chemical Companies		199.9	1	63.7	1
B. F. Goodrich		145.8	3	37.2	4
Two Elect. & Equip.		144.4	4	51.1	3

*Industries' growth rates were obtained from U.S. Department of Commerce Statistical Abstract.

fastest was recorded by 3M. The third fastest was recorded by the average of the two electrical and equipment companies and the slowest was recorded by B. F. Goodrich. Again, B. F. Goodrich registered the only inconsistent rank.

II. A model of Corporate Growth

For the corporations with unchanging mix of products the growth of corporations would be simply and directly related to the growth of their primary industry. The sum of the outputs of all firms in the industry would exactly equal the output of the industry. Thus, the average firm would grow at the same rate as its primary industry and an individual firm would only grow faster or slower than the primary industry if its share of total industry's activity rose or fell.

Suppose that during a period of time, a firm in an economy without change in industry mix grew at a rate G . This rate would be equal to the rate of growth of its primary industry I , only if there is no change in the firm's relative share of the market, a . Change in the relative share of the market can come about in many ways - in a change in the number of firms during the period of measurement, a change in the cost structure of a particular firm or set of firms relative to the industry, etc. Thus,

$$(1) G = I \text{ if } \frac{\Delta a}{a} = 0 \text{ otherwise}$$

$$(2) G = \left[I + \frac{\Delta a}{a} \cdot \frac{T_2}{T_1} \right] \text{ where } \frac{T_2 - T_1}{T_1} = I, T_1 = \text{total industry}$$

output in the first period and $T_2 =$ total industry output in the second period.

When diversification is introduced, the picture changes. Individual firm's growth can now be achieved by expanding into other industries as well as by maintaining or increasing its share of its primary industry. With sufficient expansion in other industries, a firm may be able to combine a higher than average overall rate of growth with a stagnant or even declining primary market. Under this situation, equation (2) then becomes:

$$(3) \quad G = W_1 \left[I + \frac{\Delta d}{\alpha_1} \cdot \frac{T_2}{T_1} \right] + W_2 I^0$$

where I^0 is the weighted average growth rate of the firm's other products, W_1 is the proportion of the firm's sales in its primary industry and W_2 is the proportion of the firm's sales in other industries ($W_1 + W_2 = 1$). It is clear that G and I will be close to each other (firm's growth rate would be constrained by its primary industry's growth) only if $\frac{\Delta d}{\alpha_1}$ and $W_2 I^0$ are small. This however, as the figures in Table 35 below show, is not the case. On the contrary our estimated value of shipments data show that five of the ten companies' growth rates in current dollars (leaving signs aside) over the 1965-1976 period diverged by more than ten percentage points from their primary 2-digit industry growth rates. The maximum deviation was 77.6% and was accounted for by W. R. Grace. When companies' growth rates are compared with their primary 4-digit industry growth rates, all ten companies growth rates diverged by more than ten percentage points from their primary 4-digit industry growth rates. The maximum deviation on this 4-digit level definition of primary industry was 4,165% (FMC) and the minimum deviation was - 13.2% (DuPont).

TABLE 35

Estimated Company Sales Growth,
Primary Two-Digit and Primary Four-Digit Industry*
Growth: 1965-1976, Current and Constant Dollars

	(A) Estimated Co. Sales Growth	(B) 4-Digit Primary Ind.	(C) 2-digit Primary Ind.	A-B B	A-C C
<u>Allied Chemical</u>					
Current Dollars	168.6%	96.6%	178.7%	+74.5%	-5.7%
Constant Dollars	38.9	0.6	47.4	+6,383.0	-17.9
<u>American Cyanamid</u>					
Current Dollars	173.7	243.8	178.7	-28.8	-2.8
Constant Dollars	62.3	78.9	47.4	-21.0	+31.4
<u>DuPont</u>					
Current Dollars	165.1	190.3	178.7	-13.2	-7.6
Constant Dollars	56.5	95.5	47.4	-40.8	+19.2
<u>FMC</u>					
Current Dollars	221.8	5.2	178.7	+4,165.4	+24.1
Constant Dollars	66.1	-29.2	47.4	+326.4	+39.5
<u>General Electric</u>					
Current Dollars	121.0	33.2	110.1	+264.5	+9.9
Constant Dollars	39.3	-11.8	15.4	+433.1	+55.2
<u>W. R. Grace</u>					
Current Dollars	317.4	240.5	178.7	+32.0	+77.6
Constant Dollars	57.3	33.2	40.3	+72.6	+42.2
<u>B. F. Goodrich</u>					
Current Dollars	145.8	128.2	193.7	+13.7	-24.7
Constant Dollars	37.2	32.1	77.0	+15.9	-51.7
<u>3M</u>					
Current Dollars	161.5	139.2	161.6	+16.0	-0.1
Constant Dollars	57.3	33.2	40.3	+72.6	+42.2
<u>TRW</u>					
Current Dollars	167.9	93.0	110.1	+80.5	+52.5
Constant Dollars	62.9	20.4	15.4	+208.3	+208.4
<u>Union Carbide</u>					
Current Dollars	152.8	240.5	178.7	-36.5	-14.5
Constant Dollars	32.4	77.3	47.4	-58.1	-31.6

*See Table 24 of Chapter III for listing of primary 4-digit products.

When the constant dollar growth rates are examined, all ten companies' growth rates over the 1965-1976 period diverged by more than ten percentage points not only from their primary 4-digit industry growth rates but also from their primary 2-digit industry growth rates. On the 4-digit comparisons, the maximum deviation was 6,383% (Allied Chemical) and the minimum was 15.9% (B. F. Goodrich). On the 2-digit comparisons, the maximum deviation was 208.4% (TRW) and the minimum was -17.9% (Allied Chemical).

The greater degree of divergence in the constant dollar comparisons as against the current dollar comparisons suggest that price trends over the 1965-1978 period may have tended to conceal the relationship between firm's overall growth and its growth in its principal industry. The use of current dollar data tends to exaggerate the importance of principal industry growth in the determination of firm growth.

We next turn to an examination of 1) the net effect of the firm's rate of growth of the firm's primary industry and the change in the firm's market share in that industry and 2) the rate of growth of products sold outside the firm's primary industry.

II. The Net Effect of the Rate of Growth of the Firm's Primary Industry and the Change in Market Share

Each company's primary two-digit product rate was calculated from our estimated value of shipments data. These rates and their respective industry's growth rates, in current and constant dollars are presented in columns a and b of Tabel 36. As the figures show, even in this comparison, considerable discrepancies exist. The percentage differences between firm's estimated current dollar primary product growth rates and their corresponding industry's

growth rates ranged from a high of -62.6% (B. F. Goodrich) to a low of 0.0% (TRW's primary two-digit product grew at the same rate as its industry, 110.1%. In constant dollars, the percentage differences are greater and ranged from a high of 354.5% (General Electric) to a low of -2.7% (DuPont).

As mentioned earlier, a firm's primary product growth rate would be equal to its industry's growth rate only if market share were unchanged. However, as columns (d) and (e) of Table 36 shows, market share remained unchanged for only three companies - American Cyanamid, TRW and Union Carbide.

Four Companies - Allied Chemical, DuPont, B. F. Goodrich and 3M had experienced a drop in their principal market share. These losses are translated via $\frac{\Delta d}{d_1} \cdot \frac{T_2}{T_1}$, as percentage subtractions from their respective primary industry's growth rates. The largest subtraction was registered by B. F. Goodrich, 122.5% in current dollars and 73.7% in constant dollars. The smallest subtraction was registered by Allied Chemical, 24.3% in current dollars and 12.8% in constant dollars.

The three remaining companies - FMC, General Electric and W. R. Grace had experienced a rise in their principal market share. These gains are translated as percentage additions to their primary industry growth rates. The largest addition was recorded by W. R. Grace, 83.7% in current dollars and 44.2% in constant dollars. The smallest addition was registered by FMC, 25.4% in current dollars and 13.4% in constant dollars.

Column (g) of Table 36 presents the necessary additions and subtractions to industries growth rates to account for changes in market shares. A comparison between each company's rate of primary two-digit product growth

TABLE 36
Estimated Rates of Sales Growth of Primary Product, Primary Industry's Growth Rates, Change in Market Shares:
1965-1976, Current and Constant Dollars

	Estimated Rate of Sales Growth of Primary Products	Primary Industry's Rate of Growth	(c)	Market Shares of Primary Product		(f)	(g)	(h)
	(a)	(b)		1975 (d)	1976 (e)			
Allied Chemical								
Current Dollars	158.0%	178.7%	-11.6%	2.3%	2.1%	-24.3%	154.4%	2.3%
Constant Dollars	39.7	47.4	-16.2			-12.8	34.6	14.7
American Cyanamid								
Current Dollars	194.7	178.7	9.0	1.4	1.4	-	178.7	9.0
Constant Dollars	74.2	47.4	56.6			-	47.4	56.5
DuPont								
Current Dollars	150.8	178.7	-15.6	7.0	6.3	-27.9	150.8	-
Constant Dollars	46.1	47.4	-2.7			-14.7	32.7	41.0
FMC								
Current Dollars	196.6	178.7	10.0	1.1	1.2	25.4	203.8	-3.5
Constant Dollars	59.0	47.4	24.5			13.4	60.8	-3.0
General Electric								
Current Dollars	157.3	110.1	42.9	6.7	8.2	47.0	157.1	0.1
Constant Dollars	70.0	15.4	354.5			25.8	41.2	69.9
W. R. Grace								
Current Dollars	288.0	178.7	61.2	1.0	1.3	83.7	262.4	9.8
Constant Dollars	114.5	47.4	141.6			44.2	91.6	25.0

*Obtained by dividing the estimated value of shipments of the primary 2-digit product by the value of shipments of the industry as reported by the Annual Survey of Manufacturers.

TABLE 36 (Continued)

	<u>(a)</u>	<u>(b)</u>	<u>(c)</u>	<u>(d)</u>	<u>(e)</u>	<u>(f)</u>	<u>(g)</u>	<u>(h)</u>
<u>B. F. Goodrich</u>								
Current Dollars	72.5%	193.7%	-62.6%	3.6%	2.1%	-122.5%	71.1%	2.0%
Constant Dollars	0.1	77.0	-100.1			-73.7	3.3	-103.0
<u>3M</u>								
Current Dollars	110.4	161.6	-31.7	1.8	1.5	-43.7	117.8	-6.3
Constant Dollars	17.2	40.3	-57.3			-23.4	16.9	1.8
<u>TRW</u>								
Current Dollars	110.1	110.1	0.0	1.2	1.2	-	110.1	-
Constant Dollars	46.	15.4	201.3			-	15.4	201.3
<u>Union Carbide</u>								
Current Dollars	182.1	178.7	1.9	2.5	2.5	-	178.7	1.9
Constant Dollars	52.9	47.4	11.6			-	47.4	<u>11.6</u>
<u>Unweighted Average</u>								
Current								3.5%
Constant								52.8%

(column (a)) and its corresponding adjusted industry growth rate (column (g)) reveals that, changes in market share accounted for a significant part of the deviation between each firm's principal product growth rate and its respective industry's growth rate. The remaining discrepancies - column (h) are small and averaged 3.5% in current dollar terms. In constant dollar terms however, the remaining discrepancies averaged 52.8%. This suggests that variations in growth rates of the 4-digit components within the primary 2-digit industry for each company is smaller in current dollar terms and larger in constant dollar terms. In other words, differential price trends tended to conceal the real growth variations of the 4-digit components.

The discussion has so far been conducted in terms of the growth performance of companies as the growth of the companies' primary industry affects it. The above analysis reveals that industries' growth rates on the two-digit level in current dollars, adjusted for changes in market shares, explained a significant portion of firm's change in market share, its primary industry growth rate and its overall rate of growth was shown in equation 3 and is modified in equation 3' below to include δ , the difference due to differential rates on the 4-digit level.

$$3' G = W_1 \left(1 + \frac{\Delta \lambda}{\lambda_1} \times \frac{T_2}{T_1} + \delta \right) + (1 - W_1) (I^0)$$

A firm's growth rate would approximate closely the rate of growth of its primary industry, if it produced only that product and if its market share were unchanged. Under these conditions, W_1 of equation 3' would be unity and $\Delta \lambda$ would be zero. However, as we say earlier $\Delta \lambda$ was not zero for all firms. In addition, all ten companies had produced in at least five two-digit SIC

industries in 1965. Moreover, according to our estimated diversification indexes on the two-digit level, seven of the ten companies had experienced an increase in diversification from 1965 to 1976 on a current dollar measurement basis and six of the ten companies had experienced an increase in diversification on a constant dollar measurement basis.

Iib. Growth and/or Diversification Outside of Primary Industry

As far as the link between activity outside of its primary industry and a firm's overall rate of growth is concerned, according to equation 3' above, the relative contribution of the firm's rate of growth of its primary product to overall firm growth would be smaller, the greater is $(1-W_1)$, where $(1-W_1)$ measures the degree of the firm's outside activity. I^o, the firm's rate of growth of products outside of its primary product is calculated directly from our estimated value of shipments data and W_1 , the rate of growth of each firm's primary product accounted for over 50% of the firm's overall growth. Put another way, each firm's principal product sales accounted for over 50% of total sales (see also Table 23 of previous chapter). The difference between overall growth of a firm and the rate of growth contributed by its principal product $(G - W_1 (I + \frac{\Delta b}{\Delta t} \cdot \frac{T_2}{T_1} + \delta))$ is the company's rate of growth contributed by outside primary industry activity.

Iic. Summary and Findings of Model as Applied to the Ten Companies

Summary Table 37 presents an overall picture of the ten companies examined in this study with respect to equation 3' and their change in the degree of diversification over the 1967-1976 period, as measured by our estimated diversification indexes on the 2-, 3- and 4-digit levels. As mentioned

earlier, a firm may be able to combine, by diversifying into other industries, a higher than average overall rate of growth with a constant or even declining share of the primary industry, particularly if it is in a stagnant or declining primary market.

As the figures in Table 37 show, the direction of change of the two variables - market share and the degree of diversification appears to be consistent with the company's overall growth performance relative to its primary industry's growth rate. Take as the first example, W. R. Grace. This company's overall rate of growth in current and constant dollars exceeded its primary industry's growth rate for the period 1965-1976. This greater than primary industry growth performance was accompanied by 1) an increase in market share and (2) an increase in the degree of diversification on all three levels of detail in current and constant dollars.

For another example, take B. F. Goodrich. This company's overall rate of growth in current and constant dollars was slower than its primary industry's rate of growth for the 1965-1976 period. Accompanying this was 1) a significant decrease in the degree of diversification on the three-digit level (in current and constant dollars).

In summary, these preliminary observations suggest that changes in both market share and the degree of diversification have a positive effect on companies' overall rate of growth. The precise relationship, however, is unclear. A firm's overall growth can exceed its industry's growth rate either by an increase in its principal market share alone, or in combination with increased diversification, or by increased diversification and their attendant effects on the overall growth rate of a company is not clear. This is due primarily to the

TABLE 37

Summary Table of Equation Three

Estimated Overall Sales Growth

	<u>(a)</u>	<u>(b)</u>	<u>(c)</u>	<u>(d)</u>	<u>(e)</u>	<u>(f)</u>
<u>Allied Chemical</u>						
Current Dollars	168.6%	.823	178.7%	-24.3%	154.4%	3.6%
Constant Dollars	38.9	.814	47.4	-12.8	34.6	5.1
<u>American Cyanamid</u>						
Current Dollars	173.7	.835	178.7	-	178.7	16.0
Constant Dollars	62.3	.834	47.4	-	47.4	26.8
<u>DuPont</u>						
Current Dollars	165.1	.944	178.7	-27.9	150.8	-
Constant Dollars	56.5	.943	47.4	-14.7	32.7	13.4
<u>FMC</u>						
Current Dollars	221.8	.518	178.7	25.4	203.8	-7.2
Constant Dollars	66.1	.507	47.4	13.4	60.8	-1.8
<u>General Electric</u>						
Current Dollars	121.0	.536	110.1	47.0	157.1	0.2
Constant Dollars	39.3	.536	15.4	25.8	41.2	28.8
<u>W. R. Grace</u>						
Current Dollars	317.4	.771	178.7	83.7	262.4	25.6
Constant Dollars	126.1	.768	47.4	44.2	91.6	22.9
<u>B. F. Goodrich</u>						
Current Dollars	145.8	.558	193.7	-122.5	71.1	1.4
Constant Dollars	37.2	.603	77.0	-73.7	3.3	-3.4
<u>3M</u>						
Current Dollars	161.5	.530	161.6	-43.7	117.8	-7.4
Constant Dollars	57.3	.536	40.3	-23.4	16.9	0.3
<u>TRW</u>						
Current Dollars	167.9	.545	110.1	-	110.1	-
Constant Dollars	62.9	.543	15.4	-	15.4	31.0
<u>Union Carbide</u>						
Current Dollars	152.8	.549	178.7	-	178.7	3.4
Constant Dollars	32.4	.539	47.4	-	47.4	5.5

TABLE 37 (Continued)

	Estimated Primary Prod- uct Sales Growth (f)	$W_1(\Gamma)$ (h)	W_2 (i)	I^0 (j)	W_2I^0 (k)	Diversificat- ion Index (1965-1976) (l)
<u>Allied Chemical</u>						
Current Dollars	158.0% (5)	130.0	.177	218.1%	38.6%	16.2% (3)
Constant Dollars	39.7 (8)	32.3	.186	35.5	6.6	-0.3 (7)
<u>American Cyanamid</u>						
Current Dollars	194.7 (3)	162.6	.165	67.3	11.1	-35.6 (10)
Constant Dollars	74.2 (2)	61.9	.166	2.4	0.4	-33.4 (10)
<u>DuPont</u>						
Current Dollars	150.8 (7)	142.4	.056	405.4	22.7	85.4 (1)
Constant Dollars	46.1 (7)	43.5	.057	228.1	13.0	101.6 (1)
<u>FMC</u>						
Current Dollars	196.6 (2)	101.8	.482	247.3	119.2	2.1 (7)
Constant Dollars	59.0 (4)	29.9	.493	73.4	36.2	1.3 (6)
<u>General Electric</u>						
Current Dollars	157.3 (6)	84.3	.464	79.1	36.7	-11.8 (9)
Constant Dollars	70.0 (3)	37.5	.464	3.9	1.8	-16.8 (9)
<u>W. R. Grace</u>						
Current Dollars	288.0 (1)	222.0	.229	416.6	95.4	18.2 (2)
Constant Dollars	114.5 (1)	87.9	.232	164.7	38.2	13.8 (2)
<u>B. F. Goodrich</u>						
Current Dollars	72.5 (10)	40.5	.442	238.2	105.3	7.9 (5)
Constant Dollars	-0.1 (10)	-0.1	.397	94.0	37.3	11.8 (3)
<u>3M</u>						
Current Dollars	110.4 (8)	58.5	.470	238.2	103.0	6.9 (6)
Constant Dollars	17.2 (9)	9.2	.464	103.7	48.1	11.7 (4)
<u>TRW</u>						
Current Dollars	110.1 (9)	60.0	.455	237.1	107.9	14.6 (4)
Constant Dollars	46.4 (6)	25.2	.457	82.5	37.7	8.0 (5)
<u>Union Carbide</u>						
Current Dollars	182.1 (4)	100.0	.451	117.1	52.8	-7.3 (8)
Constant Dollars	52.9 (5)	28.5	.461	8.5	3.9	-10.5 (8)

TABLE 37 (continued)

	% Change in Diversi- fication Index		Difference Change in Diversi- fication Index (1965-1976)		
	3-digit (m)	4-digit (n)	2-digit (o)	3-digit (p)	4-digit (q)
<u>Allied Chemical</u>					
Current Dollars	-5.8% (9)	-1.4% (9)	.04932 (4)	-.04629 (9)	-.01295 (10)
Constant Dollars	-5.8 (10)	-1.1 (8)	-.00094 (7)	-.04643 (10)	-.00987 (8)
<u>American Cynamid</u>					
Current Dollars	-0.4 (5)	-0.5 (7)	-.10312 (10)	-.00336 (5)	-.00495 (7)
Constant Dollars	0.5 (4)	-0.8 (7)	-.09737 (9)	.00450 (4)	-.00737 (7)
<u>DuPont</u>					
Current Dollars	-0.8 (6)	-0.3 (6)	.09217 (1)	.00571 (6)	-.00211 (6)
Constant Dollars	-3.3 (8)	-2.3 (10)	.11234 (1)	-.02251 (8)	-.01881 (10)
<u>FMC</u>					
Current Dollars	0.7 (4)	3.3 (3)	.01324 (7)	.00580 (4)	.02467 (3)
Constant Dollars	-0.7 (5)	2.8 (3)	.00817 (6)	-.00589 (5)	.02559 (9)
<u>General Electric</u>					
Current Dollars	-1.3 (7)	-0.6 (8)	-.07278 (9)	-.01079 (7)	.00624 (8)
Constant Dollars	-1.7 (7)	-0.7 (6)	-.10992 (10)	-.01552 (7)	-.00676 (6)
<u>B. F. Goodrich</u>					
Current Dollars	-6.1 (10)	-0.1 (5)	.04512 (6)	-.04637 (10)	.00062 (5)
Constant Dollars	-4.9 (9)	1.0 (5)	.06625 (3)	-.03671 (9)	.00724 (5)
<u>3M</u>					
Current Dollars	13.5 (1)	11.6 (2)	.04632 (5)	.09240 (1)	.08350 (2)
Constant Dollars	17.2 (1)	14.4 (1)	.07784 (2)	.11657 (1)	.10300 (1)
<u>TRW</u>					
Current Dollars	11.6 (2)	11.7 (1)	.09151 (2)	.09069 (2)	.09253 (1)
Constant Dollars	10.1 (2)	10.8 (2)	.05056 (5)	.07897 (2)	.08506 (2)
<u>Union Carbide</u>					
Current Dollars	-1.8 (8)	-1.5 (10)	-.4600 (8)	-.01462 (8)	-.01200 (9)
Constant Dollars	-1.5 (6)	-1.2 (9)	-.06702 (8)	0.01250 (6)	-.01022 (9)

smallness of our sample and the unavoidable lower reliability of the nonparametric tests it has been necessary to use.

A common argument used to explain the practice of corporate diversification is that firms facing unfavorable growth opportunities within their established markets (primary markets) would be those most likely to diversify into unrelated markets.³³ Firms with substantial potential for growth within their primary market would tend, in contrast, to expand into areas closely related to those markets. This particular framework suggests 1) a positive relationship between product diversification within the firm's primary industry's set of potential products and the firm's rate of primary product sales growth and 2) a positive relationship between diversification outside of its primary industry and sales growth of products outside of its primary industry.

Test of the Relationship Between Overall Growth and Changing Diversification

In a general test of the relationship between the change in diversification and firm's overall rate of growth, the Spearman Rank Correlation coefficient was calculated for several measures of diversification change in current and constant dollars. In addition to the 2-, 3-, and 4-digit distinctions, the change in these diversification indexes were ranked in percentage terms (columns 1, m, and n of Table 37) and difference terms (columns o, p and q of same Table.)³⁴ One other measure of diversification (also in percentage terms as well as difference terms) used here is the change in the specialization ratio. This ratio is defined as the percentage of sales of principal (2-digit) product to total sales (see Table 23, Chapter III).

Table 38 presents the value of r_s and t- ratios for the relationship between overall growth and the various measures of change in diversification. The relationship between change in the diversification indexes and firm's overall growth appears to be positive but weak on the 2 digit level and fairly strong on the 3- and 4- digit levels. This comparison is even more pronounced on the constant dollar basis than in the current dollars basis. As for the percentage change term and difference term measures, the former yields a slightly higher positive relationship with overall rate of growth.

The Spearman Rank coefficients between overall rate of growth and change in specialization ratios, in current and constant dollars, are negative and insignificant.

In summary, the constant dollars results suggest that diversification leading to overall growth has usually involved entry into 3-digit industries within the same (or established 2-digit industry groups. This finding is a familiar one. Having analyzed the effect of various factors such as size and earnings on the growth of 460 large U.S. industrial corporations, C.H. Berry had this to say about the role of diversification and growth: "Corporate growth, within this group of 460, is positively associated with increasing diversification, regardless of the level at which diversification is measured"³⁵ More importantly, his comment on the relative virtue of increasing diversification in established and new secondary industries is as follows: "Diversification leading to corporate growth has involved entry to 4-digit industries related to (within the same 2-digit industry group as) those 4-digit industries within which the corporation in question has experienced past success".³⁶ In a footnote, Berry claimed that "Essentially similar results are obtained if changing diversification

TABLE 38

Spearman Rank Coefficients and t-Values, Between Percent Increase in Overall Sales and Change (Percent and Difference) of 2-, 3-, and 4-Digit Diversification Indexes and Specialization Ratio, 1965-1976, Current and Constant Dollars.

A. Overall Rate of growth and Change in Diversification Indexes:

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>two-digit</u>				
%	+.273	+.802	+.224	+.651
	+.236	+.688	+.164	+.469
<u>three-digit</u>				
%	+.442	+1.395	+.673	+2.572**
	+.442	+1.395	+.673	+2.572**
<u>four-digit</u>				
%	+.297	+.880	+.576	+1.992
	+.248	+.726	+.576	+1.992

B. Overall Rate of Growth and Change in Specialization Ratios:

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
%	-.127	-.362	-.176	-.506
	-.030	-0.085	-.139	.397

* Significant at 2=.10 with 8 degrees of freedom (two-tailed test)

**Significant at 2=.05 with 8 degrees of freedom (two-tailed test)

is measured at the 3- rather than the 4-digit level".³⁷ Thus, it appears that there is a substantial similarity between Berry's results and the evidence presented here for the ten conglomerates.

Test of the Relationship Between Interindustry Growth and Changing Diversification

When the firm's component of growth contributed by expansion outside of its primary product (column k of Table 37) is examined an interesting relationship between diversification and the rate of interindustry growth can be made. Presented in Table 39 are the Spearman Rank correlation coefficients and their corresponding t-values for the relationships between I^O (column j of Table 37 and W_2I^O (column k of Table 37) and the various measures of changing diversification in current and constant dollars.

The results shown in Table 39 indicate 1) a positive relationship between the change in diversification and the rate of growth of products sold outside of firm's primary industry and 2) a positive relationship between the change in diversification and the growth in the relative contribution to overall firm growth of products sold outside the firm's primary industry. The Spearman Rank coefficients are positive and significant ($\alpha = .05$) for the change (in percentage change terms and in difference terms) in the 2-digit diversification indexes in current and constant dollars and the rate of growth of products sold outside of firm's primary indexes and relative contribution to overall firm growth, the Spearman Rank coefficients are positive and significant ($\alpha = .05$) for the 2-digit diversification index change in constant dollars and the 4-digit diversification index change in current and constant dollars.

Several important implications may be drawn from these findings. In the constant dollar findings, the more extreme diversifications reflected at the 2-digit level has led not only to increased sales growth of products outside the firm's primary industry but also to increased relative contribution to overall growth. In contrast, the current dollar findings suggest that diversification at the more extreme 2-digit level has led only to increased sales growth of products of the firm's primary industry. Diversification on the less extreme 4-digit level has led to increased relative contribution to overall growth of products sold outside the firm's primary industry (in current and constant dollars).

The findings, however, are tentative and subject to qualifications. The diversification indexes used here are not directly comparable to I^0 (and W_2I_0) - which is, as described above, the rate of growth of products sold outside the firm's primary industry. The 2-, 3- and 4- digit diversification indexes, on the other hand, contain the effects of diversification within the firm's primary 2-digit industry as well as diversification into other 2-, 3- or 4-digit industries. That is, any change in the sales proportion of the firm's primary 2-digit industry relative to total sales, whether through new expansion on the 4- or 3-digit level or simply through expansion of existing 4- or 3- digit level, are reflected in these indexes. This type of expansion, as equation 3' shows, is already reflected in $W_1(I + t_2/T_1 +)$. Thus a high correlation between the 2-3- and/or 4-digit diversification indexes and I^0 (or W_2I^0) may reflect the firm's active expansion within its primary 2-digit industry relative to its expansion into other 2-digit industries.

TABLE 39

Spearman Rank Coefficients and t-Values, Between Percent Increase in Sales of Products Outside of Primary (2-digit) Industry (I^0), Percent Increase in Relative Contribution to Overall Growth of Sales of Products Outside of Primary (2-digit) Industry (W_2I^0) and change (Percent and Difference) of 2-, 3-, and 4-Digit₂ Diversification Indexes, 1965-1976, Current and Constant Dollars.

A. I^0 and Change in Diversification Indexes:

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>two-digit</u>				
%	+ .782	+3.549**	+ .988	+18.093**
	+ .733	+3.048**	+ .952	+8.797**
<u>Three-digit</u>				
%	+ .248	+ .724	+ .139	+ .397
	+ .248	+ .724	+ .139	+ .397
<u>Four-digit</u>				
%	+ .539	+1.810*	+ .224	+ .650
	+ .527	+1.752*	+ .224	+ .650

B. W_2I^0 and change in Diversification Indexes:

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>Two-digit</u>				
%	+ .139	+ .397	+ .758	+3.287**
	+ .224	+ .650	+ .770	+3.413**
<u>Three-digit</u>				
%	+ .309	+ .919	+ .473	+1.518*
	+ .309	+ .919	+ .473	+1.518*
<u>Four-digit</u>				
%	+ .685	+2.659**	+ .721	+2.943**
	+ .697	+2.749**	+ .721	+2.943**

*Significant at $\alpha=0.20$ with 8 degrees of freedom (two-tailed test)

**Significant at $\alpha=0.05$ with 8 degrees of freedom (two-tailed test)

Presented in Table 40 are the numbers of 3- and 4-digit industries within each firm's primary 2-digit industry and the numbers of 2-, 3- and 4-digit industries outside of the firm's primary 2-digit industry for 1965 and 1976. As the figures show, changes in both sets of numbers occurred for the majority of the companies. Within the primary 2-digit industry, two companies increased and two companies decreased the number of 3-digit operations and five companies increased and three companies decreased the number of 4-digit operations. For industries outside of the firm's primary 2-digit industry, three companies increased and two companies decreased the number of 2-digit operations and six companies increased and four companies decreased the number of 3- and 4-digit operations.

Given this admixture of changes within and without two-digit categories, it is difficult to accurately test whether firms facing unfavorable growth opportunities within their primary market would more likely diversify into unrelated markets. It is also difficult to test whether firms facing substantial potential for growth within their primary market would tend, instead, to expand into areas closely related to those markets. To perform a more powerful test, a different set of diversification indexes must be employed. Such indexes for diversification outside of the firm's primary industry. For this, two sets of indexes are necessary for each company - one for diversification on the 3- and 4-digit levels within the firm's primary 2-digit industry and the second set for diversification on the 2-, 3- and 4-digit levels exclusive of the firm's primary 2-digit industry. These two sets of diversification indexes for the years 1965 and 1976 are calculated from our current and constant dollar data and are presented in Table 41.

TABLE 40

Numbers of 3- and 4- Digit Industries Within
Firm's Priary 2-digit Industry and Numbers
of 2-, 3- and 4-Digit Industries Outside of
Primary 2-digit, 1965 nd 1976

	<u>Within Primary 2-Digit</u>				<u>Outside of Primary 2-Digit</u>					
	<u>3-Digit</u>		<u>4-Digit</u>		<u>2-Digit</u>		<u>3-Digit</u>		<u>4-Digit</u>	
	<u>1965</u>	<u>1976</u>	<u>1965</u>	<u>1976</u>	<u>1965</u>	<u>1976</u>	<u>1965</u>	<u>1976</u>	<u>1965</u>	<u>1976</u>
<u>Allied Chemical</u>	4	4	9	10	5	5	7	5	8	5
<u>American Cynamid</u>	7	7	12	11	4	4	4	5	4	5
<u>DuPont</u>	5	6	9	11	5	8	5	12	5	13
<u>FMC</u>	4	4	6	7	4	7	8	15	16	28
<u>General Electric</u>	8	8	21	22	9	9	22	21	31	30
<u>W. R. Grace</u>	6	6	10	10	7	8	8	15	10	20
<u>B. F. Goodrich</u>	4	3	4	3	5	4	7	5	7	6
<u>Minn. Mining & Mfg. Co.</u>	1	1	2	2	8	8	15	17	17	21
<u>TRW</u>	4	5	5	7	7	7	13	15	13	19
<u>Union Carbide</u>	4	3	5	4	8	6	13	10	15	12

Test of the Relationship Between Diversification Within Primary Two-Digit Industry and Sales Growth of Primary Product

Presented in Table 42 are the Spearman Rank Correlation coefficient and their corresponding t-values for 1) the relationship between primary product growth and changing diversification on the 3- and 4-digit levels within the firm's primary 2-digit industry and 2) the relationship between the rate of growth of relative contribution of primary products to overall firm growth and changing diversifications on the 3- and 4-digit levels within the firm's primary 2-digit industry. In each of the tests, using various measures of changing diversification, r_s was small and insignificant. That is, the rate of growth of primary product was not correlated with either 3- or 4-digit (within primary 2-digit) diversification changes.

Tests of the Relationship Between Diversification Outside of Primary Industry and Sales Growth of Products Outside of Primary Industry

Similar results were also obtained for (see Table 43) 1) the relationship between diversification outside the firm's primary industry and sales growth of products outside of the firm's primary industry and 2) the relationship between the rate of growth of relative contribution of these products to overall firm growth and changing diversification on the 2-, 3- and 4-digit levels outside of the firm's primary 2-digit industry.

the evidence here thus fails to support the argument that firms will diversify within and outside of their primary industry when substantial growth potential exists in both markets. Neither does the evidence support the argument that they will diversify in only one market when substantial potentials exist there only.

TABLE 41
Diversification Indexes, Within and Outside of Primary 2-Digit Industry, 1965 and 1976

	Within Primary				Outside Primary 2-Digit Industry					
	3-Digit		4-Digit		2-Digit	3-Digit		4-Digit		
	1965	1976	1965	1976		1965	1976	1965	1976	
<u>Allied Chemical</u>										
Current Dollars	.7181	.6334	.8389	.8179	.4287	.5214	.5895	.5214	.5948	.5214
Constant Dollars	.7188	.6517	.8392	.8246	.4325	.6178	.5903	.6178	.5953	.6178
<u>American Cyanamid</u>										
Current Dollars	.8027	.8155	.8824	.8823	.5455	.5806	.5455	.5928	.5455	.5928
Constant Dollars	.8040	.8251	.8828	.8788	.5398	.5819	.5319	.5398	.5945	.5944
<u>DuPont</u>										
Current Dollars	.6363	.5880	.8084	.7840	.5749	.7486	.5749	.7710	.5749	.8301
Constant Dollars	.6379	.5575	.8092	.7580	.5755	.7506	.5755	.7763	.5755	.8297
<u>FMC</u>										
Current Dollars	.6368	.6172	.7540	.8096	.5563	.5230	.8375	.8456	.8889	.9327
Constant Dollars	.6363	.5763	.7542	.7993	.5500	.5377	.8359	.8504	.8890	.9348
<u>General Electric</u>										
Current Dollars	.8198	.8357	.9210	.9244	.7198	.7529	.8898	.8349	.9134	.8717
Constant Dollars	.8210	.8378	.9211	.9250	.7240	.7567	.8927	.8273	.9150	.8692
<u>W. R. Grace</u>										
Current Dollars	.8111	.8080	.8430	.8548	.8062	.7637	.8201	.8642	.8566	.8802
Constant Dollars	.8110	.8074	.8431	.8611	.8040	.8050	.8184	.8808	.8561	.8994
<u>B. F. Goodrich</u>										
Current Dollars	.4614	.2279	.4614	.2279	.5248	.3866	.6629	.5421	.6628	.6798
Constant Dollars	.4606	.2266	.4606	.2266	.5239	.4297	.6628	.5651	.6628	.7046
<u>Minn. Mining & Mfg. Co.</u>										
Current Dollars	.0000	.0000	.1142	.1205	.7707	.6859	.8383	.8712	.8559	.8870
Constant Dollars	.0000	.0000	.2242	.1205	.7713	.7251	.8403	.8737	.8580	.8842
<u>TRW</u>										
Current Dollars	.4125	.5878	.4323	.6170	.6404	.7028	.7957	.8445	.7957	.8519
Constant Dollars	.4059	.5928	.4245	.6341	.6533	.7002	.8048	.8468	.8048	.8535
<u>Union Carbide</u>										
Current Dollars	.5277	.5563	.5410	.5743	.6514	.7121	.8107	.8067	.8148	.8116
Constant Dollars	.5272	.5729	.5404	.5888	.6569	.6984	.8172	.8373	.8214	.8432

TABLE 42
Spearman Rank Coefficients and t-values, Between Percent Increase in Primary Product Sales (P), Percent Increase in Relative Contribution to Overall Growth of Sales of Primary Products and Change (Percent and Difference) of 3- and 4-Digit Diversification Indexes within the Primary 2-Digit Industry, 1965-1976, Current and Constant Dollars

A. P and Change in Diversification Indexes Within Primary 2-Digit

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>three-digit</u>				
%	+.067	+.190	+.455	+1.455*
	+.067	+.190	+.455	+1.455*
<u>four-digit</u>				
%	+.236	+.687	+.309	+.919
	+.321	+.959	+.406	+1.257

B. W₁P and change in Diversification Indexes Within Primary 2-Digit

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>three-digit</u>				
%	-.091	+.258	+.018	+.051
	-.091	+.258	+.018	+.051
<u>four-digit</u>				
%	-.127	+.362	-.200	+.577
	-.030	+.085	-.103	+.293

*Significant at $\alpha = .20$ with 8 degrees of freedom (two-tailed test)

TABLE 43

Spearman Rank Coefficients and t-Values, Between Percent Increase in Products Outside of Primary 2-Digit Industry (I^0), Percent Increases in Relative Contribution to Overall Growth of Sales of Products Outside of Primary Products and Change (Percent and Difference) of 2-, 3- and 4-digit Diversification Indexes Outside of Primary 2-Digit Industry, 1965-1976, Current and Constant Dollars

A. I^0 and Change in Diversification Indexes Outside of Primary 2-Digit:

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>two-digit</u>				
%	-.127	+.362	-.248	-.724
	-.152	+.435	-.188	-.541
<u>three-digit</u>				
%	+.273	+.803	+.273	+.803
	+.273	+.803	+.418	+1.301
<u>four-digit</u>				
%	+.309	+.919	+.330	+.999
	+.370	+1.126	+.370	+1.126

B. W_2I^0 and Change in Diversification Indexes Outside of Primary 2-Digit;

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>two-digit</u>				
%	-.515	-1.699*	-.539	-1.810*
	-.467	-1.494*	-.455	-1.445*
<u>three-digit</u>				
%	-.176	-.506	-.006	-.017
	-.176	-.506	+.164	+.470
<u>four-digit</u>				
%	-.030	-.085	+.042	+.119
	+.067	.190	+.139	+.397

*Significant at $\alpha = .20$ with 8 degrees of freedom (two-tailed test)

This conclusion was also reached by Berry in his analyses of 460 companies. After redefining his diversification indexes to distinguish between new 4-digit industries within old 2-digit industries and new 4-digit industries with new 2-digit industries, his conclusion on diversification outside of firm's established markets was - "This is not the result that would be anticipated if low industry growth rates lead to diversification outside those industries".³⁸ With respect to established markets, his conclusion was - "Other things being equal, there is, apparently, a greater tendency for corporate size and growth to generate 4-digit diversification within established market areas. But the evidence is far from strong".³⁹

Corporate Growth Models - A Comparison with Berry's

Although the results of Berry's analyses here are basically similar, the processes of growth that each embodies are somewhat different. Berry's model; of corporate growth is that corporations diversify to product areas (Industries) related to their areas of past success (established markets) and that it is those corporations whose performance and potential growth have been unsatisfactory which are more likely to branch to new and unrelated areas of productive endeavor. The model used in our analyses differed slightly from Berry's. While Berry's definition of areas of past success is operations in 2-digit industries as of the year 1960, our's is the boundaries of the firm's primary industry. Defining the areas of past success the way Berry's did, one would be exposed to the possibility that one or more of the existing 2-digit industries of a firm in 1960 were recently acquired and reflect, in reality, diversification away from the

firm's diminishing primary industry's growth performance. Thus, depending on the time frame selected, this broad definition of areas of past success might yield different results.

Defining areas of past success as the boundaries of the firm's primary 2-digit industry is based on the assumption that it is an area of familiarity on economic and technological grounds. This assumption is a reasonable one and it does not open to one criticism and that is that the two-digit industry in question may be an excessively limited sector. The area of familiarity, especially with our modern-day corporations, is not limited to a single 2-digit industry. It might span two or three or more 2-digit industries. Clearly, the determination of the extent of a firm's area of familiarity is a difficult and most certainly a subjective task.

Redefining Areas of Familiarity

On the presumption that certain secondary products may play an active role within each of the ten companies' realm of familiarity, a re-examination of each firm's share of principal 2-digit product was made. As we saw earlier, for the ten companies sales of principal product on the 2-digit level in constant dollars ranged from a high of 94.2% (DuPont) to a low of 50.4% (FMC) of total firm sales in 1965 and averaged 63.3%. If certain secondary products (on the 2-digit level) were, in fact, part of the realm of firm's economic and technological familiarity in 1965, then we can expect their share of total sales to be probably significant.

An examination of shares of 2-digit secondary products to total sales for each firm revealed that for the majority of the companies, a single 2-digit

TABLE 44

Areas of Familiarity - Combined Principle 2-digit Product and Significant Secondary 2-Digit Product Share of Total 1965 Sales in Constant Dollars

	<u>Principal 2-Digit</u>	<u>Principal Share</u>	<u>Significant Secondary 2-Digit</u>	<u>Combined Share</u>
Allied Chemical	28	82.2%	none	82.2%
American Cyanamid	28	83.4	none	83.4
DuPont	28	94.2	none	94.2
FMC	28	50.4	35	81.5
General Electric	36	53.5	37	72.3
W. R. Grace	28	76.7	none	76.7
B. F. Goodrich	30	60.3	28	83.3
3M	26	53.6	28, 38	79.0
TRW	36	54.4	37	75.0
Union Carbide	28	53.8	33	75.6

secondary industry accounted for a significant amount of total sales.⁴⁰ For Allied Chemical, American Cyanamid, DuPont and W. R. Grace, whose primary products already accounted for a very high percentage of sales, there was no single secondary product with sales contributing a significant share to total sales in 1965. For FMC, General Electric, B. F. Goodrich, TRW and Union Carbide, there was a single secondary product. For 3M, there were two. Presented in Table 44 are the primary and significant secondary industries for each company along with their combined shares of total sales in constant dollars for 1965.

Retests-Using New Dimension of Areas of Familiarity

Given the revised dimension of areas of familiarity to include significant secondary 2-digit industry or industries, the various diversification indexes (Table 45) and growth rates (Table 46) were ranked and the usual test of correlation was performed. Presented in Table 47 are the Spearman Rank correlation coefficients and their t-values for 1) relationship between primary product sales growth (as revised) and changing diversification on the 3- and 4-digit levels within the firm's primary 2-digit industry or industries (as revised and 2) the relationship between the rate of growth of relative contribution of sales of primary products (as revised) to overall firm growth and changing primary 2-digit industry or industries (as revised).

Presented in Table 48 are the Spearman Rank correlation coefficients and their t-values for 1) the relationship between diversification on the 2-, 3-, and 4-digit levels outside the firm's primary industry or industries (as revised) and sales growth of products outside of the firm's primary industry or industries (as revised and 2) the relationship between the rate of growth of relative

contribution of these products to overall firm growth and changing diversification on the 2-, 3- and 4-digit levels outside the firm's primary 2-digit industry or industries (as revised).

TABLE 45

Diversification Indexes, Within and Outside of Areas of Familiarity, 1965 and 1976

	Within Primary 2-Digit Industry or Industries				Outside Primary 2-Digit Industry or Industries						
	3-Digit		4-Digit		2-Digit		3-Digit		4-Digit		
	1965	1976	1965	1976	1965	1976	1965	1976	1965	1976	
<u>Allied Chemical</u>											
Current Dollars	.7181	.6334	.8389	.8179	.4287	.5214	.5895	.5214	.5948	.5214	
Constant Dollars	.7188	.6517	.8392	.8246	.4325	.6178	.5903	.6178	.5953	.6178	
<u>American Cyanamid</u>											
Current Dollars	.8027	.8155	.8824	.8823	.5455	.5806	.5455	.5928	.5455	.5928	
Constant Dollars	.8040	.8251	.8828	.8788	.5398	.5819	.5398	.5945	.5398	.5944	
<u>Dupont</u>											
Current Dollars	.6363	.5880	.8084	.7840	.5749	.7486	.5749	.7710	.5749	.8301	
Constant Dollars	.6379	.5575	.8092	.7580	.5755	.7506	.5755	.7763	.5755	.8297	
<u>FMC</u>											
Current Dollars	.8162	.8208	.8811	.9193	.5991	.4967	.6272	.6862	.6272	.7588	
Constant Dollars	.8196	.8048	.8843	.9141	.5958	.5396	.6236	.7056	.6236	.7836	
<u>General Electric</u>											
Current Dollars	.8728	.8603	.9359	.9299	.6834	.6862	.8908	.8468	.9009	.8656	
Constant Dollars	.8736	.8615	.9363	.9305	.6822	.7112	.8902	.8606	.9002	.8795	
<u>W. R. Grace</u>											
Current Dollars	.8111	.8080	.8430	.8548	.8062	.7637	.8201	.8642	.8565	.8802	
Constant Dollars	.8110	.8074	.8431	.8611	.8040	.8050	.8184	.8808	.8561	.8994	
<u>B. F. Goodrich</u>											
Current Dollars	.6743	.6250	.6743	.6869	.2052	.1382	.2770	.3182	.2770	.3182	
Constant Dollars	.6699	.6209	.6699	.6829	.2063	.3110	.2787	.3110	.2787	.3110	
<u>3M</u>											
Current Dollars	.5070	.6778	.5632	.7168	.6188	.7310	.7976	.8632	.8192	.8782	
Constant Dollars	.4987	.6885	.5558	.7241	.6161	.6904	.8001	.8259	.8214	.8360	
<u>TRW</u>											
Current Dollars	.6584	.7546	.6680	.7664	.6279	.6578	.8492	.8626	.8492	.8855	
Constant Dollars	.6522	.7536	.6614	.7728	.6252	.6703	.8463	.8654	.8463	.8871	
<u>Union Carbide</u>											
Current Dollars	.7124	.6683	.7192	.6805	.5731	.6046	.7924	.8217	.8080	.8329	
Constant Dollars	.7139	.6602	.7206	.6722	.5671	.5755	.7897	.8209	.8045	.8314	

TABLE 46
GROWTH RATES OF PRODUCTS WITHIN AND OUTSIDE OF AREAS OF FAMILIARITY
1965-1976

	<u>WITHIN AREAS OF FAMILIARITY</u>		<u>OUTSIDE AREAS OF FAMILIARITY</u>	
	<u>Growth Rate</u>	<u>Rank</u>	<u>Growth Rate</u>	<u>Rank</u>
<u>Allied Chemical</u>				
Current Dollars	158.0	5	218.1	5
Constant Dollars	39.7	8	35.5	7
<u>American Cyanamid</u>				
Current Dollars	194.7	3	67.3	10
Constant Dollars	74.2	2	2.4	10
<u>DuPont</u>				
Current Dollars	150.8	6	405.4	2
Constant Dollars	46.1	7	228.1	1
<u>FMC</u>				
Current Dollars	220.0	2	229.6	4
Constant Dollars	65.0	3	71.1	4
<u>General Electric</u>				
Current Dollars	125.7	10	108.5	8
Constant Dollars	49.0	6	13.9	9
<u>W. R. Grace</u>				
Current Dollars	288.0	1	416.6	1
Constant Dollars	114.5	1	164.7	2
<u>B. F. Goodrich</u>				
Current Dollars	150.0	7	94.4	9
Constant Dollars	38.7	9	30.0	8
<u>3M</u>				
Current Dollars	173.6	4	116.2	7
Constant Dollars	58.7	4	51.9	6
<u>TRW</u>				
Current Dollars	130.7	9	303.0	3
Constant Dollars	50.8	5	104.4	3
<u>Union Carbide</u>				
Current Dollars	145.0	8	178.5	6
Constant Dollars	25.3	10	54.2	5

TABLE 47

Spearman Rank Coefficients and t-Values, Between Percent Increase in Sales of Products in Realm of Familiarity, Percent Increase in Relative Contribution to Overall Growth of Sales of Those Products and Change (Percent and Difference) of 3- and 4-Digit Diversification Indexes Within Realm of Familiarity Industries, 1965-1976, Current and Constant Dollars

A. r and Change in Diversification Indexes

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>three-digit</u>				
%	+.212	+.614	+.661	+2.492**
	+.236	+.687	+.661	+2.492**
<u>four-digit</u>				
%	+.327	+.979	+.515	+1.699*
	+.327	+.979	+.530	+1.768*

B. W_1r and Change in Diversification Indexes

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>three-digit</u>				
%	+.127	+.362	+.500	+.633*
	+.176	+.506	+.500	+.633*
<u>four-digit</u>				
%	+.139	+.397	+.410	+1.271
	+.139	+.397	+.400	+1.234

*Significant at $\alpha = .20$ with 8 degrees of freedom (two-tailed test)

**Significant at $\alpha = .05$ with 8 degrees of freedom (two-tailed test)

TABLE 48

Spearman Rank Coefficients and t-Values, Between Percent Increase in Sales of Products Outside the Realm of Familiarity, Percent Increase in Relative Contribution to Overall Growth of Sales of Those Products and Change (Percent and Difference) of 2-, 3- and 4-Digit Diversification Indexes Outside the Realm of Familiarity Industries, 1965-1976, Current and Constant Dollars

A. I^0 and Change in Diversification Indexes

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>two-digit</u>				
%	-.321	-.957	-.297	-.880
	-.261	-.765	-.115	-.327
<u>three-digit</u>				
%	-.018	-.051	+.370	+1.126
	+.261	+.765	+.467	+1.494*

B. W_2I^0 and Change in Diversification Indexes

	<u>Current Dollars</u>		<u>Constant Dollars</u>	
	<u>r_s</u>	<u>t</u>	<u>r_s</u>	<u>t</u>
<u>two-digit</u>				
%	-.721	-2.943**	-.527	-1.754*
	-.733	-3.048**	-.412	-1.279
<u>three-digit</u>				
%	-.467	-1.494*	+.091	+.258
	-.188	-.541	+.236	+.687
<u>four-digit</u>				
%	-.382	-1.169	+.103	+.293
	-.333	-.999	+.394	+1.212

*Significant at $\alpha = .10$ with 8 degrees of freedom (two-tailed test)

**Significant at $\alpha = .02$ with 8 degrees of freedom (two-tailed test)

Conclusion

The test results indicate that there is 1) a high and significant positive correlation between changing diversification on the 3-digit level within the firm's areas of familiarity and rate of sales growth of those products, particularly on a constant dollar basis. Also indicated was 2) a high and significant negative correlation between changing diversification on the 2-digit level outside the firm's area of familiarity and rate of relative contribution to overall sales growth of those products, particularly on a current dollar basis. All other correlation measures were small and insignificant.

The results suggest that the route to corporate growth in real terms is through diversification within the firm's realm of familiarity on the 3-digit level. Although less reliable statistically, diversification on the 2-digit level into areas outside of the firm's realm of familiarity yields a smaller relative contribution to overall growth.

The findings presented here tend to conflict with one of the secondary findings of Berry's study. While Berry concluded that the relationship between diversification within established markets and the rate of growth of these products is weak, the evidence here suggests the contrary. Using realm of familiarity instead of established industries and using constant dollar measures of growth and diversification instead of current dollar measures, we found that efforts to increase its diversification by investing in activity areas more familiar than those available outside the immediate economic and technological environment can be expected to reward the firm with a faster growth rate.

FOOTNOTES

¹C. H. Berry, Corporate Growth and Diversification, Princeton University Press, 1975.

²An example of the general interpretation of the requirements is as follows: During the foregoing periods, generally the _____ group, the _____ group and the _____ group contributed to the company's pro forma profits in substantially the same proportions as their contributions to aggregate proforma sales; the _____ group and the _____ group contributed less proportionately to profits than to sales; and the _____ group contributed proportionately more to profits than to sales.

³Required in Form S-1, pertaining to public distributions of securities and Form S-10, the comprehensive form for registering securities.

⁴For further discussion on this see Hearings Pursuant to S. Res. 40 Before the Subcommittee on Antitrust and Monopoly of the Senate Committee on the Judiciary, 89th Congress., 1st Session, pt. 5 (1966) (testimony of Dr. Willard Mueller, pgs. 1877-78).

⁵Ibid., (testimony of Yura Arkus-Duntov, pg. 1705).

⁶R. Mautz, Financial Reporting by Diversified Companies (1968). A study sponsored by the Financial Executives Institute, an organization of financial executives.

⁷SEC, Disclosure to Investors, A Reappraisal of Federal Administrative Policies Under the '33 and '34 Acts 353 (CCH ed. 1969)

⁸1968 Presidential Task Force on Antitrust Policy, 115 Cong. Rec. 5642.

⁹The line of business information supplied to the FTC is more detailed (the Standard Industrial Classification System is used to classify products) and is required on special FTC forms which need not be completely consistent with 10K categories. Where discrepancies exist, a reconciliation is required. Because of the non-disclosure rule which inhibits government statistical compendiums, this information is not available for public usage.

¹⁰See description of, in Appendix A of this chapter.

¹¹The trend toward more disclosure, while in the right direction, still draws charges of inadequate revaluation by security analysis, investors, and economists across a wide spectrum of concern about pension obligations, tax obligations, foreign currency translation, and the effect of inflation on corporate assets and earnings.

¹²Although the BLS also publishes industry-sector price indexes (ISPI), the availability of indexes for 4-digit SIC industries are very limited at this time (145 4-digit SIC manufacturing industries) and for the majority of the available ones, the indexes do not go back to 1965, the relevant base year of our analysis.

¹³Companywide sales includes non-manufacturing sales and sales results from foreign operations.

¹⁴Although the Census provides sufficient data to permit calculations of shipments per employee ratios for several different employment size classes of plants in each industry, which would enable us to capture some systematic differences in economies of scale and/or technology among plants in the same industry, this refinement will not be made. The difficulties involved with rounding, as cited above would make this refinement questionable.

¹⁵Let S_{jt} = current dollar sales in j th SIC year t

$$= \sum_{i=1}^{n_j} P_{ijt} X_{ijt} \quad \text{where } P = \text{Price} \quad X = \text{output}$$

$$j = 1, \dots, m \quad i = 1, \dots, n_j$$

and n_j = number of goods in j th SIC

$$\text{Since Laspeyres Price Index} = L_{jt} = \frac{\sum_{i=1}^{n_j} P_{ijt} X_{ijo}}{\sum_{i=1}^{n_j} P_{ijo} X_{ijo}}$$

$$\text{Then Constant Dollars Sales} = \hat{S}_{jt} = S_{jt} / L_{jt}$$

14 (Continued)

$$\text{or } \hat{S}_{jt} = \frac{\sum_{i=1}^{n_j} P_{ijt} X_{ijt}}{\left[\frac{\sum_{i=1}^{n_j} P_{ijt} X_{ijo}}{\sum_{i=1}^{n_j} P_{ijo} X_{ijo}} \right]}$$

$$\text{or } \hat{S}_{jt} = \left[\frac{\sum_{i=1}^{n_j} P_{ijt} X_{ijt}}{\sum_{i=1}^{n_j} P_{ijt} X_{ijo}} \right] \sum_{i=1}^{n_j} P_{ijo} X_{ijo}$$

$$\text{but } \hat{S}_{j0} = S_{j0} = \sum_{i=1}^{n_j} P_{ijo} X_{ijo}$$

$$\text{therefore } \hat{S}_{jt} = \left[\frac{\sum_{i=1}^{n_j} P_{ijt} X_{ijt}}{\sum_{i=1}^{n_j} P_{ijt} X_{ijo}} \right] \hat{S}_{j0}$$

$$\text{or } \frac{\hat{S}_{jt}}{\hat{S}_{j0}} \equiv Q_{jt} = \frac{\sum_{i=1}^{n_j} P_{ijt} X_{ijt}}{\sum_{i=1}^{n_j} P_{ijt} X_{ijo}}$$

Where Q_{jt} is a Paasche Quantity Index and the weights are Current Year Prices.

Now let $\hat{S}_t = \sum_{j=1}^M \hat{S}_{jt} =$ total constant dollar sales in year t (summed over all SICs)

$$\text{then } \hat{S}_t = \sum_{j=1}^M Q_{jt} \hat{S}_{j0}$$

$$\text{and } \frac{\hat{S}_t}{\hat{S}_0} = \sum_{j=1}^M Q_{jt} \frac{\hat{S}_{j0}}{\hat{S}_0} \quad \text{where } \hat{S}_0 = S_0 = \sum_{j=1}^M S_{j0}$$

$$\text{and } S_0 = \sum_{j=1}^m \sum_{l=1}^{n_j} P_{ljo} X_{ljo}$$

Define $\frac{S_{j0}}{S_0} = K_{j0}$ = fraction of base sales accounted for by the jth SIC (Note: $\sum_{j=1}^m K_{j0} = 1$)

Then $\frac{\hat{S}_t}{\hat{S}_0} = \sum_{j=1}^M Q_{jt} K_{j0}$. Thus the constant dollar sales index is a weighted average of SIC - Specific Paasche (quantity indexes, where the weight are the fractions of base period sales accounted for by each SIC.

¹⁵1975 U.S. Industrial Outlook, U.S. Dept. of Commerce, pp, 89.

¹⁶Ibid, pp. 90

¹⁷In the two product case, holding quantities constant and allowing for price changes we have:

$$R = X_1 P_1 + X_2 P_2, S_1 = \frac{X_1 P_1}{R}, S_2 = \frac{X_2 P_2}{R}$$

$$dS_1 = \frac{\partial S_1}{\partial P_1} dP_1 + \frac{\partial S_1}{\partial P_2} dP_2 \quad \text{where } \frac{\partial S_1}{\partial P_1} = \frac{X_1}{R} - \frac{S_1 X_1}{R} \text{ and}$$

$$\frac{\partial S_1}{\partial P_2} = -\frac{S_1 X_2}{R} \quad \text{or} \quad dS_1 = S_1 S_2 \left[\frac{dP_1}{P_1} - \frac{dP_2}{P_2} \right]$$

That is, the only time the proportion of sales in current dollars would equal the proportion of sales in constant dollars is when percentage change in prices are equal.

¹⁸Clearly this discussion on the determination of principal product in constant dollars is relative to the price patterns of the various products with 1967 as the base year. If a different base year were used, say 1974, then B. F. Goodrich's principal product would be Chemical & Allied Products for 1974 and 1976.

¹⁹This section of the study relies heavily on Charles H. Berry, Corporate Growth and Diversification, (Princeton University Press, 1975).

²⁰See Michael Gort, Diversification and Integration in American Industry, (Princeton University Press, 1960).

²¹ $D + 1 - P^2$ where P_i is the ratio of the firm's sales in the i th industry to the firm's total sales in n industry.

²²This property has been discussed in detail by M. A. Adelman in Comment on the 'H' Concentration Measure as a Numbers-Equivalent. Review of Economics and Statistics, Vol 51, February 1969.

²³These SIC correspond to government-owned business-type establishments.

²⁴In A Problem of Measurement, From Plants to Enterprises in the Analysis of Diversification: A Note, (Journal of Industrial Economics, March 1980), Paul K. Gorecki concluded in his study of leading enterprises in the Canadian food processing sector that the rectangular approximation (Berry's procedure of allocating plant employment to the various products) and the geometric approximation (weighting rank of plant in geometric progression) overstates the degree of diversification while the primary approximation (the Census procedure) typically understates the degree of diversification.

²⁵That is, given a company with two plants, one with 500 employees and the other with 900 employees. Fortune's Plant and Product Directory would classify both plants under a single employment code and Berry's diversification index would be 0.50. A computation however using the actual employment sizes would yield a lower index of diversification - 0.46 Using MEI's more detailed size-class groupings, yields a diversification index of 0.46 also.

²⁷The rank correlation between the four- and three-digit diversification indexes are as follow:

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Current Dollars	.818	.903	.891	.806	.806
Constant Dollars	.818	.903	.842	.842	.891

²⁸The rank correlation between the four- and two-digit and between the three- and two-digit diversification indexes are as follows:

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
<u>4-digit vs. 2-digit</u>					
Current Dollars	-.091	.079	-.170	-.255	-.188
Constant Dollars	-.152	.079	-.291	-.339	-.091
<u>3-digit vs 2-digit</u>					
Current Dollars	.224	.224	.248	.213	.200
Constant Dollars	.200	.200	.176	.139	.061

²⁸The rank correlation between Berry's four- and three-digit diversification indexes, four- and two-digit diversification indexes and three- and two-digit diversification indexes for the ten companies (1965) are as follows:

4-digit vs. 3-digit: .745
 4-digit vs. 2-digit: .491
 3-digit vs. 2-digit: .709

The single most important factor for the higher rank correlation between Berry's four-digit and two-digit diversification indexes and between Berry's four-digit and tow-digit diversification indexes as compared to our's, can most likely be attributable to the use of two different SIC classification systems. This point raises the important question of the effect of the classification system on measures of diversification and will be discussed in the next chapter.

²⁹Samuel R. Reid, Mergers, Managers, and the Economy (New York: McGraw-Hill, 1968), pp. 153-264.

³⁰J. Fred Weston and S.K. Mansinghka, "Test of the Efficiency Performance of Conglomerate Firms", *Journal of Finance* 26 (September 1971) pp. 919-936.

³¹Baruch Lev and Gershon Mandelker, "The Microeconomic Consequences of Corporate Mergers", *Journal of Business* 45 (January 1972) pp. 85-104.

³²For a review of this, see Steiner, Mergers, pp. 189-195 and Scherer, Industrial Market Structure and Economic Performance, 1st Edition pp. 120.

³³See Sidney Siegel, Nonparametric Statistics, McGraw-Hill, New York, 1956. The critical values utilized for the statistical tests in this chapter were obtained from Table J.

³⁴Federal Reserve Board's indexes of industrial production.

³⁵See Edith T. Penrose, The Theory of the Growth of Firms, (Oxford: Blackwell, 1959). See also Robin Morris, "A Model of the Managerial Enterprise," Quarterly Journal of Economics, Vol. 77, May 1963, pp. 185-209.

³⁶Although there is a high positive correlation between the two measures of change in diversification, the distinction was deemed appropriate because of the limited range (between 0 and 1) of the diversification indexes.

³⁷C. H. Berry, Corporate Growth and Diversification, Princeton University press 1975, pp. 70.

³⁸*Ibid.*, pp. 71

³⁹*Ibid.*, pp. 69.

⁴⁰*Ibid.*, pp. 104.

⁴¹*Ibid.*, pp. 105.

⁴²Significant secondary 2-digit product is defined arbitrarily as those products contributing approximately twenty-percent or more to total sales in constant dollars for the year 1965. For 3M, there were no such products. However, the combined shares of the two largest 2-digit secondary industries (28 and 38) contributed 25.4% to total sales.

ALLIED CHEMICAL

In 1976 Allied Chemical ranked as the eighth largest chemical company in the U.S. with sales of \$2.63 billion. In 1965 sales were \$1.12 billion and measured in current dollars have grown at an annual compound rate of 8.1%. Allied's three major product groups are chemicals, energy and fibers and fabricated products. Over the 1965-1976 period, chemicals accounted for between 53 and 58% of sales, energy for between 22 and 25% and fibers and fabricated products for between 19 and 25% of total sales. The yearly sales for the three product groups for the years 1965 through 1976 are presented in Table 49. It is evident from the table that sales growth was relatively slow from 1965 through 1973. In 1974 chemical industry prices rose rapidly. Allied Chemical sales increase 33% that year as sales of its chemical and energy groups leaped 38% and 42%, respectively. Specific causes of this quantum increase are described below.

Product Description - Chemical Group

Allied Chemical is a leading producer of heavy chemicals such as the acids, alkalies and other inorganics that are basic to both the chemical and other process industries. These chemical products are sold principally to other manufacturers for use in the production of their own products. The principal chemical product subgroups are:

- (1) inorganics - principal products of this subgroup include sulfuric, hydrochloric, hydrofluoric and nitric acids. Also included here are aluminum sulfate, soda ash and ammonium chloride.

TABLE 49
ALLIED CHEMICAL SALES BY PRODUCT LINE

	<u>Energy</u>		<u>Fibers and Fabricated Products</u>		<u>Chemicals</u>		<u>Total</u>
1965							1,121
1966							1,246
1967	278	(23%)	239	(19%)	718	(58%)	1,235
1968	283	(22%)	246	(20%)	734	(58%)	1,263
1969	311	(24%)	259	(20%)	746	(56%)	1,316
1970	309	(25%)	229	(18%)	710	(57%)	1,248
1971	316	(25%)	273	(21%)	737	(55%)	1,326
1972	338	(23%)	353	(24%)	810	(53%)	1,501
1973	360	(22%)	417	(25%)	888	(53%)	1,665
1974	511	(23%)	484	(22%)	1,221	(55%)	2,216
1975	581	(25%)	504	(22%)	1,248	(53%)	2,333
1976	626	(25%)	591	(22%)	1,413	(54%)	2,630

- (2) plastics - principal products of this subgroup include polyethylene waxes for floor polishes, rubber compounding and molding. Inks, paper coatings and thermo-setting resins are also produced by this subgroup for packaging closures, dinnerware and for electronic components. For the five-year period 1968 through 1972, this subgroup also produced and sold polyvinyl chloride resins for pipe, building materials, upholstery, gloves and boots.
- (3) organic chemicals - principal products included here are dyes, pigments, vinyl chloride monomer and ethylene dichloride.
- (4) agricultural chemicals - principal products here include anhydrous ammonia, ammonia sulfate and other ammonia based products. These products are used principally for the manufacture of mixed and direct application fertilizer. Other products in this subgroup include feed supplements and pesticides (which was phased out in 1976).

Contributions of each subgroup to dollar sales of the chemical group are listed in Table 50 for the years 1967 to 1976. The share in total chemicals of the agricultural chemical subgroup increased from approximately 14% in the early years to 19% in 1974. It further increased to 21% in 1975 but then dropped to 16% in 1976. Sales of agricultural chemicals rose from \$123 million in 1973 to \$235 million in 1974, a 91% increase, while plastics, inorganics and organics had increases of 39%, 28% and 27%, respectively. Thus, the 38% increase in chemical sales was fueled principally by the 91% increase in dollar sales of its agricultural products in 1974.

The phenomenal growth in sales can be traced back to the shortage/inflation psychology of 1974-1975. Manufacturer and government predictions of a severe shortfall in supplies of natural gas (the raw material for nitrogen fertilizers) caused forced-draft demand from distributors and dealers and a soaring price structure through the spring shipping season of 1975. These inflated prices greatly reduced the normal crop-yield economic incentive for fertilizer and many farmers cut back their use. Since fertilizer production was not, in fact, significantly inhibited by gas curtailments, there was a sharp increase in inventories of all fertilizer materials and a rapid erosion of selling prices. Table 51 describes what happened to prices of key types of ammonia-based fertilizers at the farm level.

Product Description - Energy Group

The principal products of this group include oil, gas, coal, coke and nuclear fuel. Allied Chemical's involvement in the petroleum business dates back to the 1962 acquisition of Union Texas Natural Gas Corp. (now the Union Texas Petroleum division) which held moderately sized natural gas reserves and small oil reserves, in both cases primarily in the U.S.. This group also gathers and processes casingheads gas from refiners and removes liquids from natural gas supplied by others. Union Texas is also involved in the retail distribution of LPG's, particularly bottled propane fuel gas.

The coal and coke division mines metallurgical coal, mostly for use in its own coke operations. Coke operations are divided into two sectors: 1) furnace-grade material produced for iron and steel manufacture and 2) foundry coke used in production of iron castings. The energy group also supplies nuclear fuel (UF_6) to nuclear power plants.

TABLE 50
ALLIED CHEMICAL
CHEMICAL GROUP

	<u>Inorganic</u>		<u>Plastics</u>		<u>Organic</u>		<u>Agricultural</u>		<u>Total</u> <u>Chemical</u>
1967	307	(43%)	86	(12%)	219	(30%)	106	(15%)	718
1968	310	(42%)	95	(13%)	227	(31%)	102	(14%)	734
1969	321	(42%)	100	(13%)	230	(31%)	95	(13%)	746
1970	298	(42%)	99	(14%)	219	(31%)	94	(13%)	710
1971	308	(42%)	98	(13%)	232	(32%)	99	(13%)	737
1972	335	(41%)	118	(15%)	249	(31%)	108	(13%)	810
1973	366	(41%)	119	(13%)	280	(32%)	123	(14%)	888
1974	464	(38%)	165	(14%)	357	(29%)	235	(19%)	1,221
1975	497	(40%)	154	(12%)	331	(27%)	266	(21%)	1,248
1976			(1,189)				224	(16%)	1,413

TABLE 51
ALLIED CHEMICAL
FERTILIZER PRICES PAID BY FARMERS(a)
(Per Ton)

	<u>1974</u>		<u>1975</u>		<u>1976</u>
	<u>Apr 15</u>	<u>Sept 15</u>	<u>Apr 15</u>	<u>Sept 15</u>	<u>Apr 15</u>
Ammonia Sulfate	\$110	\$ 137	\$148	\$125	\$ 98
Anhydrous Ammonia	183	229	265	219	191
Urea	183	232	244	203	166
Nitrogen Solutions (30%)	111	136	153	126	113

(a) At beginning of spring and fall fertilizer seasons each year.
Source: Crop Reporting Board, USDA.

Of the major kinds of materials in the table, all but anhydrous ammonia are important to Allied Chemical.

The relative contributions to dollar sales of the energy group by its two principal divisions are listed in table 52 for the years 1967 to 1976. The tabulation of sales reveals a moderate annual average increase of 4.5% from 1967 to 1973. From 1973 to 1974, dollar sales for the group increased by 42% and is attributable to increases in the petroleum and coal, coke, UF₆ divisions of 44% and 37%, respectively.

Allied Chemical's position as a seller of energy enabled the company to weather the energy crisis during the 1973-1974 period quite easily. As with every chemical producer, Allied Chemical's costs of gas, hydrocarbon, feeds and purchased power rose sharply, shortly after the oil embargo in 1973. However, this increase was more than offset by corresponding rise in selling price, both at Union Texas and in some important chemical sectors, especially in the very large ammonia operations which represent Allied Chemical's major internal user of natural gas. It is significant, that with little increase in its own production, Union Texas showed a 15% advance in revenues during the first half of 1973.¹

Product Description

Fibers and Fabricated Products Groups

The fibers and fabricated products group with about 20-25% of total sales consists mainly of nylon and polyester yarns for the tire industry and seat belts and harnesses for the automobile industry. Allied Chemical's output of these products closely parallels the automobile industry sales trend. The 1967 acquisition of Jim Robbins Seatbelt Company resulted in the complete integration of this line, starting from nylon production, then to the webbing itself and finally to the belts and related hardware. In 1971 the FTC forced Allied Chemical to divest itself of its webbing operations.

TABLE 52
ALLIED CHEMICAL
ENERGY GROUP
(In Millions of Dollars)

	<u>Petroleum</u>	<u>Coal, Coke, UF₆</u>	<u>Total</u>
1967	\$ 194	\$ 84	\$ 278
1968	181	102	283
1969	186	125	311
1970	189	120	309
1971	198	118	316
1972	204	134	338
1973	241	119	360
1974	348	163	511
1975	373	208	581
1976	430	196	626

Foreign Sales

Allied Chemical's principal foreign manufacturing operations are in Canada. Automotive seatbelts and shoulder harnesses are produced and marketed in Western Europe. However, total non-U.S. business is regarded as small (3-6% of total sales) and is not reported separately.

Estimated Sales Versus Reported Sales

Our estimates of sales are based on employment data for domestic manufacturing plants with 100 or more employees. In concept, it is equivalent to domestic manufacturing production. This includes products for domestic sales, plus net exports. Because foreign sales are small and dollar figures are not available, our estimates of sales can only be compared with total sales as reported by the company. Our estimates of sales by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section.

In total, Allied Chemical had manufacturing operations in 17 4-digit SIC industries during 1965, 15 during 1968 and 1972, 16 during 1974 and 15 during 1976. The decrease in the number of 4-digit SIC industries from 17 in 1965 to 15 in 1968 is attributable to the divestiture in 1967 of the Barrett-Smith division, an asphalt and roofing manufacturer. The increase in 1974 to 16 4-digit SIC industries from 15 in 1972 is attributable to internal expansion of a plant to the point where MEI would capture its significance (100 or more employees). In 1976, the plant either had been divested or had fewer than 100 employees, thus returning total number of 4-digit SIC industries to 15.

The ratios of our estimated to reported sales are as follows:

<u>Sales</u>	<u>Estimated</u> (In Millions of Dollars)	<u>Rep. Total</u>	<u>Ratio</u>
1965	\$ 1,040.0	\$1,121.0	.93
1968	1,131.1	1,263.0	.90
1972	1,390.3	1,501.0	.93
1974	2,246.3	2,216.0	1.01
1976	2,793.8	2,630.0	1.06

The ratios of estimated sales to reported sales averaged .97 for the five years. For 1965, 1968 and 1972, our estimates are below reported sales. For 1974 and 1976, our estimates are above reported total sales.

Discrepancies Between Estimated and Reported - An Explanation

Since our estimated sales are based on the average value of the shipments of domestic manufacturing plants, all non-manufacturing sales of foreign manufacturing subsidiaries to customers abroad as well as to the domestic market should be netted out of total reported sales. Only in this way can fully equivalent comparisons be made. Unfortunately, as mentioned earlier, foreign sales are not reported separately and could not be subtracted from total sales. This imparted a downward bias on the ratio of estimated sales to reported sales.²

The degree and direction in which foreign manufacturing activities affect the discrepancies between our estimated sales and the company's reported sales are offset by other factors such as inefficient plant operations and plant elimination. These two factors have the effect of increasing the ratio of our estimates to reported sales.

Recall that our estimated sales are based on: 1) the data as set forth in MEI and 2) the assumption implicit in our estimating procedure, namely that each plant operates at its respective industry's average value of shipments per employee. Our estimates then apply to a firm possessing typical plants in various industries (as classified by MEI for the five years under analysis) with each operating at its industry's average value of shipments per employee and not each subject to a typical problem, such as strikes, start-up problems, etc., associated with its industry. Consequently, if a company experiences greater difficulties and/or operates below industry's average value of shipments then we can expect our estimates to exceed reported domestic sales.

During the period of analysis, Allied Chemical's growth potential was limited by a number of formidable problems. Among these were the uncertainties of environmental protection regulations and related lawsuits that affected a large portion of Allied Chemical's business. These problems had particular effect on its coke operations, fluorocarbon propellants, synthetic food colors and synthetic soda ash.

Another major set of problems was related to widespread production difficulties. These difficulties led to inefficient operations and production losses. These problems suggest that its plants were not operating at the industry average and as a result we can expect our estimated sales to exceed the sales reported by the company.

Allied Chemical's response to the above problems was a widespread program of divestiture that management had begun in 1968. During the late 1960's the early 1970's, Allied's management had undergone a complete turnover and this is reflected by the dispositions of 23 businesses and/or plants. These divestitures produced some \$300 million in cash and tax credits.

Among the discontinued activities are Allied's coke oven construction business, PVC resin manufacture, a vast array of small volume batch produced dyestuffs, the Barrett asphalt roofing operations and a small Texas condensate refinery and gasoline station chain. As management explained in its Annual Reports to Stockholders, this widespread divestiture program was undertaken for a number of reasons:

- (1) many plants were old, others were of uncompetitive scale,
- (2) some important production processes were obsolescent and
- (3) pollution control problems were enormous.

One reason for the company's high average age of plants, noncompetitive small scale and obsolescent production processes was deficient capital spending and spending on research and developments. As shown in Table 53, Allied Chemical's R&D spending is the smallest of the large chemical companies, with research expense remaining in the \$28-\$30 million range from 1965 to the present.

From 1965 through 1972, Allied Chemical's capital outlays averaged only 5% per year on beginning gross plant, a level considered to be one of the industry's lowest. It was not until 1973, that Allied Chemical embarked on an ambitious capital spending program (Table 54).

Allied Chemical has many old plants located in the densely populated northeast quadrant of the country and production is heavily oriented toward dyestuff and such inorganics as chlorine, synthetic soda ash, chromium compounds and hydrofluoric and sulfuric acids. All of these have been identified as problem materials by environmental regulators. Despite this, Allied Chemical's outlays for pollution control were \$ 40 million or 1.5% of total sales and about in line with the ratio of other large chemical producers (See Table 54).

The increase in spending for pollution control reflects the activities of the environmental regulatory bodies. It is reflected in a count of environmental actions (EPA orders, court cases, fines, etc.) reported by the company. Without having made a detailed comparative study, we note that the number of actions reported by Allied Chemical since the beginning of 1974 was 21. This compares to 15 during the same period for DuPont—a company three times Allied Chemical's size and one which also had many old plants.

Allied Chemical's old facilities and its attendant technical and environmental difficulties affected a large portion of its business. Described below are two specific incidents that had set back production and adversely affected productivity. The incidents involved two large segments of the company: its coke operations in the energy group and its soda ash operations in the chemical group.

In its coke operations, the difficulties in which Allied Chemical found itself are fundamentally of its own making, exacerbated by rising standards of pollution control and union/OSHA confrontation on employee health and safety. Allied Chemical has long been a leader in coke sales and production technology; yet just eight years after modernizing two large oven batteries, Allied Chemical had to divert \$90 million to re-modernize. Ordinarily, coke batteries have useful lives of about 30 years, but because of over-heating during start-up in 1968, premature aging and deterioration of the linings restricted efficiencies and limited the life spans of the batteries. Finally, in March 1976, for environmental and safety reasons, Allied Chemical closed its largest coke battery for refurbishing; an act which led to a non-performance law suit by Armeo, Inc., its largest customer.

TABLE 53

ALLIED CHEMICAL

SELECTED COMPARISONS FOR FOUR QUARTERS ENDING JUNE 1976

	<u>Allied</u>	<u>Celanese</u>	<u>Dow</u>	<u>DuPont</u>	<u>Monsanto</u>	<u>Carbide</u>
Sales	\$2,532	\$2,186	\$5,319	\$8,078	\$4,153	\$5,992
R & D Expense	37	67	175	350	150	129
% of Sales	1.5%	3.1%	3.3%	4.3%	4.7%	2.1%
Pollution Control Exp.	\$ 40	\$ 30	\$ 75	\$ 150	\$ 85	80
% of Gross Plant (12/31/75)	1.5%	1.3%	1.5%	1.7%	2.3%	1.3%

TABLE 54**ALLIED CHEMICAL****CAPITAL EXPENDITURE BREAKDOWN**
(In Millions of Dollars)

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
Energy						
Capitalized Explora- tion & Development	\$ 19	\$ 28	\$ 50	\$ 85	\$ 123	\$ 180
Other	31	20	23	23	24	35
Fibers & Fabricated Products	27	23	34	71	59	43
Chemicals	<u>55</u>	<u>57</u>	<u>78</u>	<u>127</u>	<u>99</u>	<u>132</u>
Total	\$ 132	\$ 128	\$ 185	\$ 306	\$ 305	\$ 390
Beginning Gross Plant	\$2,156	\$ 2,236	\$ 2,250	\$ 2,360	\$ 2,563	\$ 2,752
Total Expenditures as %	6.1%	5.7%	8.2%	13.0%	11.9%	14.2%
Pollution Control, Inc. Above	\$ 10	\$ 21	\$ 25	\$ 28	\$	\$ 40

In 1968 Allied Chemical began the transition from its aged synthetic soda ash plants to natural soda ash. The newest of its synthetic soda ash plants was built in 1934. The switch-over to trona-based (natural soda) ash had been going on throughout the industry, and Allied Chemical's part of this effort was beset by difficulties. The 1973 Annual Report to Stockholders mentioned "substantial start-up" costs of the natural ash facilities. The 1974 Annual Report to Stockholders stated that "after a period of losses during price controls and plant expansion periods, we now expect this to become a profitable business." However, its 10-Q report for the third quarter 1975 revealed that "after-tax losses in the company's soda ash business... have averaged \$1 million per month over the last year and a half" (i.e., roughly \$18 million from the second quarter of 1974 through the third quarter of 1975). The 1975 Annual Report disclosed that the pretax losses in 1975 were \$27.9 million versus \$24.8 million in 1974. In 1976, soda ash losses were reduced significantly and the "business moved into the black during the second quarter for the first time in 13 quarters."³

These losses related to the entire soda ash business, including the established synthetic ash plants, not just to its new natural ash plant. The exact nature of the problems was not revealed by management, although at various times, strikes, reduced demand, price controls, skilled labor shortages, and the catch-all, "start-up costs", have all been mentioned. In sum, it appears that production was below the industry's average in terms of efficiency.

TABLE 55

ALLIED CHEMICAL

ESTIMATED SALES IN CURRENT AND CONSTANT DOLLARS

(In Millions of Dollars)

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$1,040.0	\$1,131.1	\$1,390.3	\$2,246.3	\$2,793.8
(a) Index					
(1965=100)	100	109	134	216	269
In Constant Dollars	\$1,051.1	\$1,161.8	\$1,414.8	\$1,439.4	\$1,460.5
(b) Index					
(1965=100)	100	111	135	137	139
(c) = (a) / (b)	100	98	99	158	194

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of sales of a "typical" firm with characteristics basically similar to Allied Chemical's domestic manufacturing activities in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in Table 55.

Line (a) is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the price index for Allied Chemical's (or our "typical" firm's domestic manufacturing activities. The pattern for Allied Chemical is typical for the chemical industry in that during the early years, up to Federal Phase IV price controls, the divergence between the two growth patterns is small reflecting an essentially flat pattern of price changes. Beginning in 1974, the double effect of the oil embargo and the expiration of Federal price controls boosted chemical product prices to an all time high. This had the effect of exaggerating nominal growth, especially for the chemical industry, with its high dependence on fuel and organic chemical raw materials.

The real growth pattern can be described in two ways: (1) our estimated of real growth—line (b) of Table 55, and (2) the company's current dollar reported total sales deflated by our implicit company price index—line (c) of Table 55. In Table 56, Allied Chemical's reported sales are deflated by our estimated price index.

Line (a) is the growth pattern of reported total sales in current dollars. Line (b) is Allied Chemical's total sales growth subjected to domestic manufacturing price changes as experienced by our "typical" firm.

TABLE 56

ALLIED CHEMICAL

REPORTED TOTAL SALES IN CURRENT AND CONSTANT DOLLARS
(In Millions of Dollars)

<u>Reported Total Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$1,121.0	\$1,263.0	\$1,501.0	\$2,216.0	\$2,630.0
(a) Index (1965=100)	100	113	134	198	235
In Constant Dollars	\$1,121.0	\$1,288.8	\$1,516.0	\$1,402.5	\$1,355.7
(Using Estimated Price Index) (b) Index (1965=100)	100	115	135	125	121

TABLE 57

ALLIED CHEMICAL

COMPARISON OF ESTIMATED REAL SALES TO REPORTED REAL SALES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	111	135	137	139
B) Index of Reported Real Sales (b)	100	115	135	135	121

(As deflated by our implicit price index)

(a) from line (b) of Table 55

(b) from line (b) of Table 56

To facilitate comparison, the two real growth series are presented in Table 57.

Line (A) of Table 57 shows that real sales grew 11%, 35%, 37% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period, respectively. Line (B) on the other hand, shows that real sales grew 15%, 35%, 25% and 21% over the 1965-1968 period, 1965-1972 period, 1965-1976 period, respectively. The discrepancies between line (a) and line (b) can be attributed to differences between our estimated sales and reported sales. That is, if estimated sales equal reported sales for every year in our analysis, the two real growth patterns—line (A) and line (B) would be identical.

Referring back to Table 56, if we now make the assumption that our implicit price index accurately reflects the company's actual composite selling price trend for all of its products included in total sales, then the following statement can be made. Whereas reported sales on a current dollar basis grew 135% over the 1965-1976 period, physical volume or sales adjusted for inflation rose only 21%.

AMERICAN CYANAMID

American Cyanamid is a diversified chemical and pharmaceutical concern. With 1976 sales of \$2.09 billion, it was ranked 107th in sales volumes among leading American corporations by Fortune Magazine. In 1965 sales were \$863 million and measured in current dollars have grown at an annual compound rate of 8.4%. American Cyanamid has four main product groups: (1) chemical products, (2) medical products, (3) consumer and building products and (4) agricultural products. Chemical products have accounted for between 27 and 35 percent, consumer and building products for between 21 and 33 percent and agricultural products for between 18 and 27 percent of total sales.

In its annual reports to stockholders, American Cyanamid has maintained a somewhat consistent set of definitions for its product categories for over the 12 year period ending in 1976. There were no new categories added or deleted and only one small reclassification involved the transfer of its acrylite sheet business, about \$13 million in sales, from its consumers and building group to its chemical group in 1968. Table 58 summarizes the distribution of sales as reported by the company from 1965 to 1976. Sales growth was relatively slow from 1965 through 1973. In 1974, chemical industry prices and agricultural product prices rose rapidly. American Cyanamid's total sales jumped 21 percent that year as sales of its chemical and agricultural groups leaped 26 and 47 percent, respectively. An analytical description of each group, presented below, should provide some insights into the factors in this and other changes.

TABLE 58

AMERICAN CYANAMID

DISTRIBUTION OF SALES
(In Millions of Dollars)

	<u>Chemicals</u>	<u>Medical</u>	<u>Building & Consumers</u>	<u>Agricultural Products</u>	<u>World-Wide Sales</u>
1965	\$ 302	\$ 216	\$ 181	\$ 164	\$ 863
1966	337	216	207	193	953
1967	324	207	216	190	937
1968	369	218	247	189	1,023
1969	382	231	278	196	1,087
1970	372	243	314	229	1,158
1971	372	256	427	228	1,283
1972	388	273	442	256	1,359
1973	419	309	455	289	1,472
1974	530	351	474	425	1,780
1975	512	400	492	524	1,928
1976	610	426	572	486	2,094

Product Description - Chemical Group

The chemical group produces a diversity of intermediate chemicals for use by a wide range of industries including the paint, paper, petroleum, plastic, rubber, steel, and textile industries. Some of the major products of this group include: pigments, textile and intermediate chemicals, polymers, titanium dioxide, water treatments and mining chemicals, resins and adhesives, thermosetting molding compounds, refinery chemicals, and catalysts, acrylamide, sulfuric acid, alum, acrylonitrile, aircraft adhesive, polyester resins and industrial ammonia.

The annual rate of growth of chemical products sales from 1965 through 1976 averaged 7.3% per year. In 1970 sales declined \$10 million from 1969 level of \$382 million, representing a 3 percent drop in percentage share of total sales. In 1971, sales of the chemical product group remained at the 1970 level of \$372 million. The drop in sales was attributed by Amercian Cyanamid in its 1970 Annual Report to Stockholders to a "broad softening in demand accompanied by relatively stable prices for the entire chemical industry". flood conditions caused by tropical storm Doria at several of the company's chemical plant sites and continuing sluggish performance of the U.S. economy explained the zero growth situation between 1970 and 1971. Toward the latter half of 1971, management had begun to focus greater attention on this group. Certain unprofitable businesses and plants were divested and construction of new chemical production facilities were started. Among the discontinued activities were: dynamite and blasting caps. Farmer Electric Products Co., Inc., and Control Print Corporation.

In 1974 chemical sales grew 26 percent to \$530 million from 1973 sales of \$419 million. This significant increase was attributed to two factors according

to management. First customers demand were strong despite higher prices, and second, introduction of new products during 1974 were met with better than expected results. Finally, the drop in sales from \$530 million to \$512 million in 1975 was attributed by American Cyanamid to a sharp drop in demand during the early part of the year, reflecting the recession of 1974-1975.

Product Description - Medical Group

The company's medical business is carried on within the Lederle Laboratories Division and the Davis & Geck Department. Lederle is a producer of a broad line of pharmaceuticals in which antibiotics are its most important class of products. Davis & Geck is a producer of sterile sutures and other disposable operating room specialties.

Medical sales growth was relatively slow and averaged 3.4 percent per year from 1965 through 1972. From 1973 to 1976 medical sales growth averaged 12 percent per year. The rise in growth rate was due in part to (1) unusually high incidence of tuberculosis abroad and (2) as an active participant in a cooperative program coordinated by the U.S. Public Health Services Center for Disease Control to counteract the declining level of childhood immunizations in the U.S.

Despite considerable research and development expenditures, American Cyanamid's progress has been below that of the drug industry leaders, as can be seen in Table 59. Eli Lilly & Company, Merck & Co., Inc. and Pfizer, Inc., had annual sales growth of 9.9, 14.9 and 13.5 percent respectively from 1973 to 1976. The slower growth exhibited by American Cyanamid, particularly in the years, can be attributed to a number of factors. First the company had been slow in changing the focus of this exploratory efforts away from antibiotics and in the direction of new chemical entities. Second, expenditures on research and

TABLE 59
 AMERICAN CYANAMID
COMPARITIVE DRUG COMPANY PERFORMANCE (a)
 (In Millions of Dollars)

	<u>American Cyanamid</u>			<u>Eli Lilly & Company</u>			<u>Merck & Co., Inc.</u>			<u>Pfizer, Inc.</u>		
	<u>Sales</u>	<u>R&D</u>	<u>%</u>	<u>Sales</u>	<u>R&D</u>	<u>%</u>	<u>Sales</u>	<u>R&D</u>	<u>%</u>	<u>Sales</u>	<u>R&D</u>	<u>%</u>
1965	\$216	21	9.7									
1966	216	20	9.3									
1967	207	19	9.2									
1968	218	20	9.2									
1969	231	21	9.1									
1970	243	20	8.2									
1971	256	19	7.4									
1972	273	22	8.1	517	59	11.4	583	64	11.0	558	35	6.3
1973	309	24	7.8	581	66	11.4	665	73	11.0	644	45	7.0
1974	351	32	9.1	634	74	11.7	755	82	10.9	740	54	7.3
1975	400	35	8.8	690	83	12.0	885	101	11.4	833	63	7.6
1976	426	42	9.9	761	90	11.8	1,010	109	10.8	925	70	7.6

(a) All data are for pharmaceutical and related operations only.

and developments have remained essentially constant between 1965 and 1973. As Table 59 shows, research and development expenditures since 1972 have been doubled, the 1976 level of \$42 million being almost twice the 1972 level of \$22 million. One important outcome of this is that American Cyanamid failed to introduce significant new pharmaceutical products and to compete more effectively. Finally, as occurs from time to time in the drug industry, one of American Cyanamid's more important products was taken off the market by FDA in 1971, and this seriously affected sales.

Product Description - Building and Consumers Group

Principal products of this group include high pressure laminates (Formica), vinyl coated wall coverings and synthetic fibers. Synthetic fibers production went from predominantly carpet fibers to predominantly textile fibers in 1969. Also, production of rayon staple and natural filament lines were discontinued at the end of 1972 while production of polyester tire yarn was increased.

Direct consumer business consists of J.H. Breck, Shulton and the household product lines. Breck is primarily a producer and marketer of female hair care products such as shampoos and hair sprays. Shulton markets cosmetics, toiletry and fragrance items, most of which it also manufactures. Household products consist of two principal lines — floor waxes and liquid cleaners.

For the 12 year period from 1965 to 1976, the building and consumers group experienced an annual average sales growth of 11 percent per year, which range from a high of 36 percent from 1970 to 1971 to a low of 3 percent from 1972 to 1973. The variation in sales growth can be attributed principally to significant acquisitions made during the period. In 1968, the company entered the vinyl coated cloth-backed wall covering business with the acquisition of

Standard Coated Products, Inc. In 1971, Shulton, Inc. and IRC Fibers, Inc. were added with annual sales at acquisition of approximately \$104 million and \$40 million respectively.

Group sales advanced slowly during the 1973-1975 period. Group sales as a percentage of total sales declined from 31 percent in 1973 to 26 percent in 1974 and 1975. The economic downturn of the period slowed dollar sales advances of the group of \$19 million between 1973 and 1974 and \$18 million between 1974 and 1975. According to the company's Annual Reports to Stockholders, higher selling prices were largely responsible for the increases in group sales.

Product Description - Agricultural Products Group

The agricultural products group can be subdivided into two distinct components: agricultural chemicals and plant foods. Agricultural chemicals consist mainly of pesticides and animal health care products such as animal feed supplements, feed phosphates and dewarmer for cattle and swine. Plant foods consists of fertilizers, ammonia and phosphates. In addition, the company had operated retail farm service centers which sold its own agricultural products as well as products manufactured by other companies to farmers. This unit contributed approximately \$41 million to group sales before it was sold in 1972.

Agricultural products sales growth was relatively slow from 1965 through 1973. In 1974, agricultural products sales increased 47 percent from \$289 million in 1973 to \$425 million in 1974. This huge jump also reflects the price explosion of the chemical industry that occurred that year.

In general, it appears that the products marketed by American Cyanamid are sensitive to both the general state of the economy and weather conditions. Its agricultural and medical products are most sensitive to weather conditions as evidenced by very strong sales of antibiotics and weak sales of fertilizers and pesticides whenever winters are severe. As expected, its consumer products are sensitive to the state of the economy as evidenced by relatively poor sales during recession.

Foreign Sales

The financial statements, as reported by the company in its Annual Reports to stockholders, distinguish between foreign and domestic sales but do not carry the separation through the industrial distribution of sales. American Cyanamid's foreign revenues in relation to total sales are shown in Table 60. Foreign sales data include sales by foreign subsidiaries as well as export sales from U.S. to customers abroad (except for Canada, which American Cyanamid includes as part of domestic sales). Foreign revenues as a percentage of total sales rose from a low of 18 percent in 1965 to a high of 40 percent in 1975. According to the company's Annual Reports, drugs constitute about half of volume outside the U.S. and exports, primarily of phosphate rock and derivatives, and chemical specialties, constitute about one-tenth of overseas sales.

Estimated Sales versus Reported Sales

Our estimates of sales are based on domestic manufacturing plants with 100 or more employees and corresponds closely to domestic manufacturing production. This can be defined as domestic manufacturing sales plus net exports. Because dollar figures on net exports are not available, our estimates of sales must be compared with domestic sales as reported by the company

TABLE 60
AMERICAN CYANAMID
DOMESTIC AND FOREIGN SALES
(In Millions of Dollars)

	<u>Domestic Sales (A)</u>	<u>Foreign Sales (B)</u>	<u>Total Sales</u>
1965	\$ 709	\$ 154	\$ 863
1966	785	168	953
1967	759	178	937
1968	825	198	1,023
1969	881	206	1,087
1970	929	229	1,158
1971	1,012	271	1,283
1972	974	385	1,359
1973	996	476	1,472
1974	1,149	631	1,780
1975	1,157	771	1,928
1976	1,361	733	2,094

(Column A of Table 60). Our estimates of value of shipments by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. In total, American Cyanamid had operations in 16 4-digit SIC industries during 1965, 17 during 1968, 17 during 1972, and 16 during 1974 and 1976. The increase from 16 4-digit SIC industries in 1965 to 17 in 1968 is due to the acquisition of Standard Coated Products, Inc. in 1968. Between 1968 and 1972, American Cyanamid had discontinued its dynamite and blasting caps division and sold two wholly-owned subsidiaries - Farmers Electric Co. and Control Print Corporation, which were acquired in 1970 and 1969 respectively. During the same period, American Cyanamid had acquired Glendale Optical Co. (1968) and IRC Fubers, Inc. (1969). These two actions served to counter one another, thereby leaving the number of 4-digit SIC industries unchanged from 1968 to 1972. Between 1972 and 1974, American Cyanamid had either closed a wax and polish plant or the number of employees for that particular plant had dropped below 100 (recall that MEI lists only plants with 100 or more employees), in either case, the effect was a reduction in the number of 4-digit SIC industries to 16 for 1974 and 1976.

The ratios of our estimates to reported domestic sales are as follows:

(Column A of Table 60). Our estimates of value of shipments by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. In total, American Cyanamid had operations in 16 4-digit SIC industries during 1965, 17 during 1968, 17 during 1972, and 16 during 1974 and 1976. The increase from 16 4-digit SIC industries in 1965 to 17 in 1968 is due to the acquisition of Standard Coated Products, Inc. in 1968. Between 1968 and 1972, American Cyanamid had discontinued its dynamite and blasting caps division and sold two wholly-owned subsidiaries - Farmers Electric Co. and Control Print Corporation, which were acquired in 1970 and 1969 respectively. During the same period, American Cyanamid had acquired Glendale Optical Co. (1968) and IRC Fubers, Inc. (1969). These two actions served to counter one another, thereby leaving the number of 4-digit SIC industries unchanged from 1968 to 1972. Between 1972 and 1974, American Cyanamid had either closed a wax and polish plant or the number of employees for that particular plant had dropped below 100 (recall that MEI lists only plants with 100 or more employees), in either case, the effect was a reduction in the number of 4-digit SIC industries to 16 for 1974 and 1976.

The ratios of our estimates to reported domestic sales are as follows:

<u>Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
Estimated	\$611.5	\$ 724.3	\$978.7	\$1,321.5	\$1,673.8
Reported Domestic	\$709.0	\$ 825.0	\$974.0	\$1,149.0	\$1,361.0
Ratio	.86	.88	1.00	1.15	1.23

The ratios of estimated sales to reported sales averaged 1.02 for the 5 years and ranged from a low of .86 for 1965 to a high of 1.23 for 1976. For 1965 and 1968 our estimates are below reported domestic sales. For 1972 our estimate is slightly above reported domestic sales. For 1974 and 1976 our estimates are above reported domestic sales. An explanation of this increasing trend is attempted below.

Discrepancy Between Estimated and Reported - An Explanation

Since our estimated sales are based on manufacturing activities of domestic plants, our estimates should be compared with sales of domestic manufactured products to the domestic market as well as to foreign markets. Sales of domestic manufactured products abroad however, were not included along with domestic sales in the ratio above. As a result of this, an upward bias is imparted on the ratios. Moreover, if a positive correlation exists between net exports and foreign sales, the increasing share of foreign sales through time would then suggest an increasing upward bias on the ratios. This of course would partly explain the rising ratio of estimates to reported domestic sales through time.

Two other factors that were not adjusted for in the comparison of our estimated sales to reported domestic sales are: 1) American Cyanamid's non-

manufacturing activities (which includes distribution of cosmetic items manufactured by American Cyanamid and other companies and retail farm service centers) and 2) the inclusion of Canada in the company's definition of domestic sales. The lack of dollar sales figures on these two factors prevented us from adjusting reported domestic sales data to reflect domestic manufacturing activities only. The effect, in both cases, is to impart a downward bias on the ratios.

In addition to the restriction imposed by the above three accounting difficulties on the appropriate basis of comparison, there are several other contributors to the discrepancies between estimated sales and reported domestic sales. As part of its strategy of becoming a diversified and multi-national corporation, American Cyanamid had acquired and divested certain businesses to establish a broad but selected product mix for its global markets. The main thrust of its acquisition program occurred in the late 1960's and early 1970's, the key acquisitions of which are listed in Table 61. To preserve its basic product mix, American Cyanamid had divested its molten sale division in 1968, spandex yarn division in 1970, farm service division in 1973, and real estate development division in 1974. These and other divestitures, and acquisitions of other companies often occur during the year (as opposed to the beginning) and as a result will distort the relationship between our estimated sales and reported domestic sales because our estimates are based on full year operations.

Other factors contributing to the discrepancies between our estimated sales and reported sales are focused on in the following critical review of American Cyanamid's development. American Cyanamid's growth potential was limited by a number of factors despite its seemingly excellent roster of businesses. Although research and development expenditures have averaged about 3.5 percent of total sales for the 5 year period ending 1976, and exceeded

\$83 million in 1976 the company failed to maintain an adequate flow of new products. This was especially important in the medical division. For many years, American Cyanamid was complacent with its leading position in the antibiotics business and failed to devote sufficient attention to other lines or to the need for development of new classes of products within the medical division itself. From the late 1950's to early 1970's, American Cyanamid had failed to develop more than a handful of successful new products. These new products, however, were centered around the antibiotic field and as such have faced similar price attrition that will inevitably occur when a product reaches commodity status. As mentioned earlier, beginning in 1972, substantial research and development expenditures were re-directed to anti-infective, cardio vascular, selected metabolic and central nervous system areas and away from antibiotics. However, the full benefit from this new approach remains to be realized.

From 1967 to 1973, American Cyanamid's capital outlays averaged 7.2% per year on beginning gross plant; this rose to 11.5%, 15.5% and 15.6% in 1974, 1975 and 1976 respectively (see Table 62). A substantial part of the increase in capital expenditures was directed to modernize and increase the capacity of existing plants. However, many of these plants encountered start-up problems, delaying for some time the beneficial effects of these newer plants.

In addition, American Cyanamid's diverse product lines are subject to constantly increasing government regulation. In the medical area, a victim of the Food and Drug Administration's (FDA) crackdown on pharmaceutical

TABLE 61
 AMERICAN CYANAMID
SIGNIFICANT ACQUISITIONS, 1963-1976

<u>Date</u>	<u>Company</u>	<u>Business</u>	<u>Approximate Sales (In Millions)</u>
5/63	J. H. Breck, Inc.	Hair Care Products	\$ 28.1
2/63	Dumas Milner Corp.	Household Cleaners	9.0
3/64	Fiat Metal Mfg. co.	Shower Stalls & Floors	8.8
5/65	Preen Company	Floor Cleaners & Waxes Mfg.	N/A
10/65	Rainbow Chemicals, Ltd.	Liquid & Dry Fertilizers & Pesticides (Service Concern)	N/A
2/68	Stamford Rubber Supply	"Fattice" Rubber Chem	N/A
9/68	Glendale Optical Co.	Safety Glasses	20.0
9/68	Laboratories Novalis	French Drug Formulator	N/A
9/68	Standard Coated Products, Inc.	Vinyl-Coated Wall Covering	N/A
12/68	Bird-Archer Co.	Formulates Water Treat. Chem.	N/A
6/69	Control Print Corp.	Codemarking & Pkg. Equip.	N/A
7/69	Sargent Calcium Co.	Feed-Grade Calcium	N/A
12/69	IRC Fibers Division	Rayon, Polyester Fibers	40.0
6/70	Farmer Electric Product Co.	Photo-Electric Controls	2.0
9/70	Ervin Co.	Residential Developer	N/A
12/70	Sunstate Builders	Residential Developer	39.5

TABLE 61 (Continued)

<u>Date</u>	<u>Company</u>	<u>Business</u>	<u>Approximate Sales (In Millions)</u>
11/70	Chem. Lab. Corp.	Clinical & Diag. Labs	N/A
4/71	Shulton, Inc.	Men's Toiletries	\$104.0
6/71	MacGregor Lead Co.	Heat Stabilizers for P.V.C.	2.0
11/71	Edmund J. Bennett Assoc., Inc.	Residential Developer	N/A
12/71	Croyder, Irvin & Co., Inc.	Residential Developer	N/A
5/72	Greenbrier Nursery Farms		N/A
8/75	Les Engrais Ideal, Ltd.	Fertilizers & Related Products	N/A

TABLE 62
AMERICAN CYANAMID
CAPITAL EXPENDITURES
(In Millions of Dollars)

	<u>Beginning Gross Plant</u>	<u>Capital Expenditure</u>	<u>%</u>
1965	\$ 761	\$129.4	17.0%
1966	862	108.4	12.6
1967	926	51.8	5.6
1968	941	60.0	5.3
1969	961	93.3	9.6
1970	1,024	89.2	8.7
1971	1,121	109.2	9.7
1972	1,157	70.2	6.1
1973	1,176	64.0	5.4
1974	1,199	138.3	11.5
1975	1,311.1	203.8	15.5
1976	1,488.4	232.7	15.6

combination products, Lederle's "Achrocidin", an antibiotic-antihistamine, was removed from the U.S. market in December 1971. Loss of this profitable product was primarily responsible for keeping Lederle's 1972 earnings at their 1971 level despite a 7 percent sales gain. In the agricultural area, the FDA in 1973 required additional research to demonstrate the effect on organisms, found in animals that may be transmitted to man, of certain of American Cyanamid's products used in livestock and poultry feed. Government regulation has also been increasing in environmental matters. Laws, regulation and court decisions have imposed increasingly stringent requirements for the prevention and control of pollution. American Cyanamid's compliance with these requirements has involved substantial capital outlays and temporary shutdown of facilities.

These factors suggest that American Cyanamid's production, especially during the mid 1970's was not an optimum level. Due to various governmental requirements, the production processes of some plants were either interrupted or discontinued. In view of this, our estimates of sales, which are based on the average value of shipments per employee for all plants in the industry, might be expected to exceed reported domestic sales.

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of sales of a "typical firm with characteristics basically similar to American Cyanamid's domestic manufacturing activities in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in Table 63.

TABLE 63

AMERICAN CYANAMID ESTIMATED SALES AND GROWTH OF SALES

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
In Current Dollars	\$611.5	\$724.2	\$978.7	\$1,321.7	\$1,673.8
(a) Index of (1965=100)	100	118	160	216	274
In Constant Dollars	\$623.7	\$720.5	\$950.0	\$ 966.8	\$1,012.5
(b) Index of (1965=100)	100	116	152	155	162
(c) = (a) / (b)	100	102	105	139	169

Line (a) is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the price index for American Cyanamid's for our "typical" firm's) domestic manufacturing activities. Typical of the chemical industry, during the early years American Cyanamid had experienced an essentially flat pattern of price changes. This is reflected in the small divergence between the two growth patterns. Beginning in 1974, the double effect of the oil embargo and the expiration of Federal price controls boosted chemical product prices to an all time high. This had the effect of exaggerating nominal growth, especially for the chemical industry, with its high dependence on fuel and organic chemical raw materials.

The real growth pattern can be described in two ways: (1) our estimate of real growth - line (b) of Table 63 and (2) the company's current dollar reported domestic sales deflated by our estimated company price index - line (c) of Table 63. In Table 64, American Cyanamid's reported domestic sales are deflated by our estimated price index.

TABLE 64

AMERICAN CYANAMID REPORTED DOMESTIC SALES

Reported Domestic Sales	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$709.0	\$825.0	\$974.0	\$1,149.0	\$1,361.0
(a) Index of (1965=100)	100	116	137	162	192
In Constant Dollars (Using estimated price index)	\$709.0	\$808.8	\$927.6	\$ 826.6	\$ 805.3
(b) Index of (1965=100)	100	114	131	117	114

Line (a) is the growth pattern of reported domestic sales in current dollars.

Line (b) is American Cyanamid's reported domestic sales growth deflated by domestic manufacturing price changes as experienced by our "typical" firm.

To facilitate comparison, the two real growth patterns are presented together in Table 65.

TABLE 65
AMERICAN CYANAMID REAL GROWTH PATTERNS

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	116	152	155	162
B) Index of Reported Real Domestic Sales (Deflated with implicit price index)	100	114	131	117	114

(a) from line (b) of Table 63

(b) from line (b) of Table 64

Line (A) of Table 65 shows that real sales increased 16%, 52%, 55% and 62% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. Line (B), on the other hand shows that real sales increased 14%, 31%, 17% and 14% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. The discrepancies between Line (A) and Line (B) can be attributed to differences between our estimated sales and reported domestic sales. That is, if estimated sales equal reported domestic sales for each of the 5-years, then the two real growth patterns would be exactly identical.

Referring back to Table 64, if we make the assumption that our implicit price index accurately reflects American Cyanamid's actual composite selling price changes of all products included in its reported domestic sales, then the following statement can be made: Whereas reported domestic sales on a current dollar basis grew 92% over the 1965-1976 period, physical volume or sales adjusted for inflation rose only 14% over the same period.

DUPONT

Dupont was ranked as the 6th largest industrial corporation in the U.S. with 1976 sales of \$8.4 billion. In 1965, DuPont had worldwide sales of \$3.0 billion and measured in current dollars grew at an arithmetic average rate of 10.1% per year over the next 11 years. DuPont began in 1802 as a one-product black powder explosive producer and remained almost wholly an explosive manufacturer for the next 110 years. In 1912 an antitrust decree split the company into three parts. This prompted the company to diversify into other markets. Largely through acquisitions and strong commitment to research and development, DuPont became a worldwide producer of a variety of chemicals, fibers and plastics.

Dupont's acquisition program during the period of our analysis was small by comparison to its earlier activity. In 1969, the company merged with Endo Laboratories, Inc., a small pharmaceutical concern (about \$23 million in sales during 1969) which augmented its small internally developed antiviral drug line. In 1970 the company purchased Bell & Howell's analytical instruments division which manufactures mass spectrometers, moisture monitors and leak detectors. Both businesses were further complemented with the 1973 acquisitions of Berg Electronics, Inc., and Ivan Sorvall, Inc. The first is a manufacturer of precision electrical and electronic components, and the second, a manufacturer of biomedical laboratory equipment.

DuPont's products can be classified into 4 major groups: Fibers, Plastic Materials and Synthetics, Industrial Chemicals, and Specialty Products. From 1969 to 1976 (data for earlier years were not available) the Fibers group accounted for between 33 and 39% of worldwide sales, the Plastic Materials and

Synthetics group accounted for between 18 and 22% and the Specialty Products group for between 20 and 26% of worldwide sales. Presented in Table 66 is DuPont's historical consolidated sales broken-down into these 4 groups.

As Table 66 reveals, total reported worldwide sales showed positive year-to-year growth for 10 of the 12 years between 1965 and 1976. In 1967, sales dropped 2.5% from \$3,159 million in 1966 to \$3,079 million. This drop was attributed to excessive customer's inventories at the beginning of 1967 which had reduced new order, and to lower selling prices for man-made fibers and plastics, brought on by keen competition. In 1970, sales dropped slightly from \$3,632 million in 1969 to \$3,618 million. This was attributed to lower selling prices in several product lines and to the slow-down in the domestic economy. Between 1972 and 1976, reported current dollar sales advanced rapidly, recording a 13.5% jump in 1972, a 20.9% jump in 1973, a 31.0% jump in 1974, a slight 4.5% jump in 1975 and 15.8% jump in 1976. The huge jump in 1974 partially reflects reporting changes that occurred that year which consolidated the sales of 4 subsidiaries: DuPont of Canada, Remington Arms Company, Ducilo (an Argentine subsidiary) and Polidura (a Brazilian subsidiary). These changes and factors affecting them are examined more closely in the following product description.

Product Description - Fibers Group

DuPont is the largest fiber producer in the world and enjoys a commanding lead in its principal U.S. markets. The company produces all three of the major noncellulosic fibers and is the dominant factor not only in each broad fiber type but also in most of the varieties of each designed for specific end markets. The noncellulosics are: 1) Nylon-textile yarn, 2) Polyester-

TABLE 66

DUPONT

DISTRIBUTION OF SALES
(In Millions of Dollars)

	<u>Worldwide Sales</u>	<u>Fibers</u>	<u>Plastic Materials & Synthetics</u>	<u>Industrial Chemicals</u>	<u>Specialty Products</u>
1965	\$2,999	\$ N.A.	\$ N.A.	\$ N.A.	\$ N.A.
1966	3,159	N.A.	N.A.	N.A.	N.A.
1967	3,079	N.A.	N.A.	N.A.	N.A.
1968	3,455	N.A.	N.A.	N.A.	N.A.
1969	3,632	1,308	799	799	726
1970	3,618	1,302	760	760	796
1971	3,848	1,462	770	770	846
1972	4,366	1,703	917	830	916
1973	5,276	2,058	1,108	950	1,160
1974	6,910	2,440	1,485	1,308	1,677
1975	7,222	2,557	1,397	1,381	1,887
1976	8,361	2,764	1,798	1,625	2,174

textile yarn and 3) Acrylic staple. These noncellulosic products account for about 98% of DuPont's fibers business (acetate yarn - a cellulosic man-made fiber account for the other 2%) and serve textile markets in apparel, home furnishings (especially carpeting), automotive, rubber goods and other industries.

Sales growth for this group averaged 11.5% per year between 1969 and 1976 and was above the company's average sales growth of 10.1% over the same period. The group experienced positive year-to-year gains for every year except 1970. In 1970, group sales dropped slightly from \$1,308 million in 1969 to \$1,302 million and reflect two important factors: 1) the textile recession of 1969-70, which greatly reduced the growth rate in the use of man-made fibers and 2) lower selling prices.

During much of the period between 1965 and 1976, non-cellulosic fiber prices declined an average of 6 to 7¢ per year. As shown in Table 67, DuPont's fibers sales price index recorded a downward trend from 1967 to 1973 and a less pronounced upward trend from 1973 to 1977.

TABLE 67
DUPONT'S FIBERS SALES PRICE INDEX

<u>Year</u>	<u>Price Index</u>	<u>Percent Change</u>
1967	100.0	
1968	98.4	(1.6%)
1969	92.6	(5.9)
1970	85.7	(7.5)
1971	80.5	(6.1)
1972	74.7	(7.2)
1973	74.2	(0.7)
1974	82.3	10.9
1975	85.8	4.3
1976	89.0	3.7
1977	90.0	1.1

The downward movement in prices reflects a combination of the impact of expansion programs begun by U.S. producers in the boom year of 1968 and by increasing imports of fibers and apparel. During the decade 1967-73, domestic consumption of noncellulosic fibers increased almost 20% a year. Comparable growth occurred in Europe. Rising living standards and favorable demographic influences increased overall textile demand. At the same time, noncellulosics benefitted from the relatively low cost of petroleum-based raw materials and gradually increased its market share at the expense of rayon, cotton and wool.

The rapid growth in demand for noncellulosic fibers had attracted many new entrants and resulted in severe price cutting. In 1973, fiber selling prices

reversed their long downtrend, primarily as a result of the oil embargo and the subsequent tripling of the price of imported crude oil.

Despite new entrants during the early years, DuPont, because of its policy of stressing the development of propriety products, was able to maintain positive physical sales growth. The company not only spends more than twice as many dollars each year as its nearest rival for research and development, it allocates to research a larger percentage of sales than any other diversified chemical company. As Table 68 shows, the difference between DuPont's R&D expenditure level and a typical competitor's rate of spending is about 3.0% of sales.

It should also be noted that in recent years, DuPont's R&D expenditures have been declining relative to sales. The ratios reached its high point in 1968 and was further cutback in the 1970-71 belt-tightening program. However, when DuPont's overall employee census declined by 11%, R&D professionals were reduced by only 8% from 5,000 in 1970 to 4,600 in 1972. This cut-back was accomplished via a thorough going reappraisal of the potential value of the research being conducted in each major area of emphasis. In this connection, Senior Vice President E. A. Gee was quoted in Fortune (January 1973) as stating, "We're directing a large proportion of our work into markets we know a lot about, and we're using less time to convert an idea into a useful product. We used to take as much as ten years, now we're aiming at three to five".

Product Description - Plastic Materials and Synthetics Group

This group comprises 3 divisions and contributed 22% to the company's 1976 consolidated sales. In the 1969-1976 period, group sales growth averaged

TABLE 68
DUPONT COMPARATIVE RESEARCH
AND DEVELOPMENT EXPENDITURES
(In Millions of Dollars)

	<u>DuPont</u>		<u>Monsanto</u>		<u>Dow (a)</u>	
	<u>R&D Amount</u>	<u>% of Sales</u>	<u>R&D Amount</u>	<u>% of Sales</u>	<u>Amount</u>	<u>Sales</u>
1966	\$246	7.8%	\$ 76	4.7%	\$ 71	5.4%
1967	246	8.0	94	5.1	77	5.6
1968	250	7.2	86	4.6	84	5.1
1969	255	7.0	102	5.2	87	4.9
1970	265	7.3	98	5.0	92	4.8
1971	250	6.5	87	4.2	95	4.6
1972	255	5.8	92	4.1	105	4.4
1973		5.2	100	3.9	115	3.9
1974	344	5.0				
1975	336	4.7				
1976	353	4.2				

Sources: Annual Reports to Stockholders.

13.3% per year and registered positive year-to-year sales growth for five of the seven years in the period. Sales declined 5% in 1970 and 1975. The declines are attributable to the domestic recessions in those years.

In the Plastics Division, DuPont is a large producer of high and low density polyethelenes and acrylics, acetal resins, nylon plastics, fluorocarbon resins and ionomers. This division also produces and markets a variety of polymers and copolymers for adhesives and coatings, as well as a number of fabricated plastic products such as polyvinyl butyral safety glass sheeting and polyethelene pipe.

In the Film Division, products include cellophane, polyester, shrink and polyimide films as well as film for packaging and individual application. These films are used in magnetic tape, reproduction systems, electrical insulating systems and food packaging as well as coverings for building materials and automotive trimmings. In the Elastomer Division, products include a variety of rubbers for industrial applications such as wire coating, adhesives, upholstery, sealants, hoses, drive belts and automotive bumper systems.

The products of this group serve a wide range of markets in the packaging automotive, electronic, housing and other industries and are heavily dependent on petrochemical feedstocks as a basic raw material. Although DuPont does not provide a separate selling price index for the products of this group, according to its 1972 Annual Report, "The price index for these products declined slightly, following the gradual downward trend that has prevailed in recent years". The 1973 Annual Report states - "The domestic selling price index for plastics remained relatively stable during 1973, with a slight upward trend". Group sales jumped 34.0% from \$1,108 million in 1972 to \$1,485 million

in 1974 and reflects both higher demand and higher selling prices. In 1975 group sales followed the general cyclical pattern in the economy with marked recovery in the last half and continued growth during 1976. However, the sharply higher cost of energy and the elimination of Federal price controls have contributed to persistently higher selling prices to 1976.

Product Description - Industrial Chemicals Group

The products of this group are handled by three division and contributed 19.0% to consolidated sales during 1976. In the Organic Chemicals division, the major products include dyestuffs, of which DuPont is the leading U.S. producer, flourochemicals and antiknock compounds used by refineries to increase the octane of gasoline. This division also manufactures and markets permeators for the company's reverse osmosis technique for water purification.

In the Pigments Division, DuPont produces a variety of inorganic and organic color pigments and inorganic fibers. The largest product sales in the division are of DuPont's titanium dioxide, made entirely using the company's proprietary chloride process.

In the Industrial Chemical Division, products range from heavy chemicals such as nitric and sulfuric acids through amines and cyanides, to methanol and formaldehyde, hydrogen peroxide, silicates and tetrahydrofuran. Specialty chemicals include catalysts, chrome complexes, colloidal silica, electroplating chemicals and flame retardants.

Sales growth for this group averaged 11.3% per year from 1969 to 1976. year-to-year sales gain was achieved in every year except 1970, when the domestic recession and lower selling prices reduced revenue from \$799 million in 1969 to \$760 million in 1970. The greatest gain in group sales

occurred in 1974 when sales jumped 37.6% from \$950 million in 1973 to \$1,308 million in 1974. Demand was strong throughout 1974 for most major products despite sharply higher selling prices in the second half of the year (reflecting higher costs of raw materials and energy).

Product Description - Specialty Products Group

This last group is a catch-all and consists of a diverse set of products serving many markets. Included are sales to the agriculture, automotive, health care printing, electronics and the mining industries. These products accounted for 20.0% of DuPont's consolidated sales in 1969 and partially due to the acquisitions made in 1970 and 1973, its relative share increased to 26.0% in 1976.

The products of this group fall into 7 divisions:

- (1) Instruments division - this division manufactures and markets thermal analysis instruments, liquid chromatographs, pollution monitoring instruments and biomedical instruments such as clinical analyzers, high speed refrigerated centrifuges and ultramicrotomes, the latter product reflecting the 1973 acquisition of Ivan Sorvall, Inc.
- (2) Photo Products division - the products here are X-ray, graphic arts and engineering reproduction films, as well as related chemicals and processing equipment. The division is also a producer of plastic printing plates, photo-resist polymers and pre-press proofing systems used primarily in the printing industry.

- (3) Electronic products division - this division consists solely of electronic connectors manufactured by Berg Electronics, Inc. which was acquired in 1973.
- (4) Agricultural Chemical division - products of this division consists principally of proprietary crop protection chemicals. These chemicals include fungicides, which control fungus disease in a wide range of crops and weed killers.
- (5) Pharmaceuticals division - the products of this division consist largely of the drug business of Endo Laboratories, acquired in late 1969 in part to provide marketing and management expertise to the company's internally developed antiviral line.
- (6) Finishes division - products here include industrial coatings, consumer paints and maintenance finishes. Dominant lines embrace acrylic, alkyd and fluorocarbon paints and finishes, as well as acrylic and epoxy resin coating for electrical and structural use.
- (7) Polymer Intermediates division - this division comprises DuPont's explosive products such as blasting caps, underwater gels and dynamite as well as intermediate chemicals such as acrylonitrile (for acrylic fibers), adipic acid (for nylon resins) and dimethylterephthalate (for polyester fiber and film).

The sales growth for this group averaged 17.5% per year from 1969 to 1976. Positive year-to-year sales gain was achieved in every year with the greatest gain occurring in 1974 when sales jumped 44.5% from \$1,160 million in 1973 to \$1,677 million in 1974. This increase is due largely to the consolidation of four wholly-owned subsidiaries that had occurred that year.

Foreign Sales

Table 69 below shows the historical sales trend separately for foreign sales (including exports) and domestic sales for the years 1965 through 1976. Percentage of foreign sales to worldwide sales has increased steadily from 11.1% in 1965 to a high of 27.5% in 1974. In 1975 and 1976, foreign sales accounted for 27.0% and 27.1% of total worldwide sales respectively. Foreign sales grew at a faster rate than domestic sales and averaged about 20.2% percent per year from 1965 to 1976 as compared to 8.1% per year for domestic sales during the same period. Exports of products from the U.S. to foreign markets accounted for 67.4% of foreign sales in 1965 and because of the company's stepped-up foreign investments during the period of analysis, the share of exports in foreign sales dropped to 41.2% in 1976.

Estimated Sales vs. Reported Sales

Estimated of value of shipments by 4-digit SIC industries in current and constant dollars for 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. DuPont had manufacturing operations with plants of 100 or more employees in 14 5-digit SIC industries during 1965 and 1968. The acquisitions of Endo Laboratories (1969) and the analytical instruments line of Bell & Howell (1970) increased the number of 4-digit SIC industries to 17 in 1972. Expansion of existing plants to the point (100 or more employees) where it would appear in MEI's tabulations and consolidation of the Remington Arms subsidiary increased the number of 4-digit SIC industries to 22 in 1974 and 24 in 1976.

TABLE 69
DUPONT
HISTORICAL SALES TRENDS
(In Millions of Dollars)

	(a) <u>Worldwide Sales</u>	(b) <u>Foreign Sales</u>	(c) <u>Domestic Sales</u>	(d) <u>Exports</u>	(e) <u>Domestic Manufacturing Production</u>
1965	\$2,999	\$ 334	\$2,665	\$ 225	\$2,890
1966	3,159	350	2,809	214	3,023
1967	3,079	378	2,701	239	2,940
1968	3,455	440	3,015	276	3,291
1969	3,632	543	3,089	303	3,392
1970	3,618	634	2,984	345	3,329
1971	3,848	680	3,168	342	3,510
1972	4,366	800	3,566	393	3,959
1973	5,276	1,144	4,132	571	4,703
1974	6,910	1,904	5,006	811	5,817
1975	7,222	1,950	5,272	792	6,064
1976	8,361	2,267	6,094	934	7,028

Our sales estimates, as mentioned earlier, are based on data for domestic manufacturing plants with 100 or more employees. The comparable corporate aggregate for DuPont is its domestic sales plus exports or domestic manufacturing product - presented in column (e) of Table 69.

Presented in Table 70 below are ratios of estimated sales to domestic manufacturing production.

TABLE 70

DUPONT RATIO OF ESTIMATED SALES TO DOMESTIC MANUFACTURING

<u>Sales</u> (In Millions)					
Estimated	\$2,774.4	\$3,020.2	\$3,945.5	\$6,082.9	\$7,354.9
Rptd. Dom Manufact.	\$2,890.0	\$3,291.0	\$3,959.0	\$5,817.0	\$7,028.0
Ratio	.96	.92	1.00	1.05	1.05

Estimated sales are below reported domestic manufacturing for 1965 and 1968. For 1974 and 1976, estimated sales are above reported domestic manufacturing production. The discrepancies between our estimated sales figures and reported domestic manufacturing production average are small. The ratios of estimated sales to reported domestic manufacturing production averaged .999 for the 5 years under analysis with 1968 exhibiting the greatest discrepancy of 8.0%. In its annual reports to stockholders, there were no indications such as strikes, production difficulties, etc., to suggest the direction of bias, if any, of our estimates.

Our estimated sales and growth of estimated sales for DuPont's domestic manufacturing operations in current and constant dollars for the years under analysis are presented in Table 71.

TABLE 71

DUPONT ESTIMATED SALES AND GROWTH OF ESTIMATED SALES

Estimated Sales (In Millions)	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$2,774.4	\$3,020.2	\$3,945.5	\$6,082.9	\$7,354.9
Index (1965=100) (a)	100	109	142	219	265
In Constant Dollars	\$2,799.2	\$2,981.6	\$3,703.1	\$4,241.9	\$4,381.7
Index (1965=100) (b)	100	107	132	152	157
(c)=(a)/(b)	100	102	108	144	169
(d)	100	93	84	98	119

Line (a) of Table 71 is the price index of estimated sales in current dollars and line (b) is the index of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for DuPont's domestically manufactured products. This estimated price index suggests that over the 1965-1976 period DuPont's composite selling prices increased 69.0%.

In its annual reports to stockholders, DuPont provided its own sales price index and for the relevant years it is presented in line (d) of Table 71. Contrary to our estimated sales price index, DuPont's published sales price index indicates that over the 1965-1976 period its composite selling prices rose only 19.0%.

Although there are no concrete supporting evidence, the apparent contradiction is most likely due to lower selling prices abroad. DuPont's published sales price index applies to products sold in foreign markets as well as to products sold in the domestic market. A weak evidence of lower selling prices abroad is presented in Table 72 where DuPont's published sales price index is compared with 3 BLS Producers Price series. Whereas BLS PPI for (1) All Industrial Commodities, (2) Chemicals & Allied Products and (3) Textile Products & Apparels Show increases for every year over the 1967-1976 period, DuPont's published sales price index increased only during the later years - 1974, 1975 and 1976. Over the 1967-1973 period, while foreign sales increased from 12.2% of total sales in 1967 to 21.6% in 1973, DuPont's price index declined at an annual compound rate of _____. The implication here is that DuPont was charging a lower per unit price to its foreign customers which scaled down its composite sales price index.

DuPont's real domestic manufacturing production growth can be viewed in two ways: (1) our estimate of real growth - line (b) of Table 71 and (2) DuPont's reported domestic manufacturing production deflated by our implicit price index - line (c) of Table 71. In Table 73, DuPont's reported domestic manufacturing production is deflated by our implicit price index.

TABLE 72
DUPONT
PRICE INDEXES

	<u>Textile Products & Apparel</u>	<u>Chemicals & Allied Products</u>	<u>DuPont</u>	<u>Industrial Commodities</u>
1967	100.0	100.0	100.0	100.0
1968	103.7	99.8	99.0	102.5
1969	106.0	99.9	96.0	106.0
1970	107.1	102.2	95.0	110.0
1971	108.6	104.2	92.0	114.0
1972	113.6	104.2	89.0	117.9
1973	123.8	110.0	90.0	125.9
1974	139.1	146.8	104.0	153.8
1975	137.9	181.3	119.0	171.5
1976	148.2	187.2	126.0	182.4

TABLE 73

DUPONT REPORTED DOMESTIC MANUFACTURING PRODUCTION

<u>Rptd. Dom. Production (In Millions)</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$2,890.0	\$3,291.0	\$3,959.0	\$5,817.0	\$7,028.0
Index (1965=100) (a)	100	114	137	201	243
In Constant Dollars	\$2,890.0	\$3,226.5	\$3,665.7	\$4,039.6	\$4,158.6
Index (1965=100) (b)	100	112	127	140	144

According to the second method of describing real growth - line (b) of Table 73, domestic manufacturing production grew 12.0% over the 1965-1968 period, 27.0% over the 1965-1972 period, 40.0% over the 1965-1974 period and 44.0% over the 1965-1976 period. The first method (our estimated of real growth - line (b) of Table 71) on the other hand, shows that domestic manufacturing production grew over the same respective periods 7.0%, 32.0%, 52% and 57.0%. The discrepancy between the first and second method is due to the discrepancy between estimated sales and reported domestic manufacturing in each year. That is, if estimated sales exactly equalled reported domestic manufacturing for each year, the calculation of real growth by either method would yield identical percentage changes because the same price index was used to deflate both.

If our estimated price index accurately represents DuPont's domestic manufacturing production sales price index, then according to Table 73, real domestic manufacturing grew only 44.0% over the 1965-1976 period as opposed to 143.0% when measured in current dollars.

FMC

FMC is one of the largest domestic producers of industrial machinery and inorganic chemicals and until 1976 it was also one of the leading producers of textile yarns. In 1965 FMC had worldwide sales of \$929 million. In 1976 world-wide sales were \$2.14 billion and measured in current dollars have grown at a compound annual rate of 7.9%. FMC's diverse products can be classified into 4 major groups: machinery, chemical, fibers and film, and ordnance. Machinery accounted for between 26 and 50% of sales, chemicals for between 19 and 32%, fibers and film for between 5 and 26% and ordnance for between 8 and 17% total sales over the 1965-76 period. Huge variation in percentage shares of sales is due principally to large acquisitions and divestitures of businesses and to the different cyclical patterns of a large portion of FMC's products.

The yearly sales for the 4 product groups for the years 1965 to 1976 are presented in Table 74. The table reveals that sales growth has been very erratic, dropping as low as 6% in 1970 and 1976 and advancing as high as 30% in 1967. Specific causes of these changes are detailed below following a brief description of each group.

Product Description - Machinery Group

The machinery group had its beginning in the agricultural and food processing equipment lines. Areas in which FMC is preeminent include automatic machinery for harvesting, processing and canning or freezing fruits, vegetables and other foods and specialized units for crop spraying, dusting and

FMC
TABLE 74
DISTRIBUTION OF SALES, 1965-1976
(In Millions of Dollars)

	<u>Machinery</u>	<u>Chemical</u>	<u>Fiber & Film</u>	<u>Ordnance</u>	<u>Total Sales</u>
1965	\$ 241.2	\$ 232.5	\$ 303.6	\$ 151.6	\$ 928.9
1966	288.2	255.2	312.7	153.6	1,009.7
1967	546.6	260.6	302.8	203.0	1,313.0
1968	512.2	278.9	345.0	240.1	1,376.2
1969	568.0	271.4	345.4	224.4	1,409.2
1970	556.3	288.9	313.3	172.0	1,330.5
1971	565.9	296.1	350.1	141.5	1,353.6
1972	676.4	325.4	331.6	164.3	1,497.7
1973	772.4	379.5	365.3	202.1	1,719.3
1974	954.0	520.0	430.0	171.0	2,075.0
1975	1,123.0	628.0	308.0	233.0	2,292.0
1976	1,080.2	691.7	109.7	263.1	2,144.7

Source: FMC's Annual Report to Stockholders

irrigation. Mergers and acquisitions of other companies played an important role in the development of this group Table 75 lists significant acquisitions from 1963 to 1976. Nine of the thirteen acquisitions made during this period extended or complemented the existing line of the machinery group. The largest addition to this group is its Link-Belt division which was acquired in 1967 for a total price of \$163 million and which contributed over \$240 million or approximately 44% to machinery group sales in 1967. The principal products of this division include: materials-handling machines, power transmission equipment, rectifier stacks and cells and silicon diodes, conveyors, power crane and excavating equipment. Other products of this group, by sub-categories are listed below:

Industrial - materials-handling machinery, power transmission equipment, marine and industrial pumps (sold in 1976), sewage disposal and water systems, liquid loading and unloading equipment, bulk materials processing equipment, swivel joints, valves, castings pollution control equipment, petroleum and fluid control equipment.

Construction - power cranes, excavating equipment, and mining equipment.

Transportation - railroad freight cars, barges and marine craft, truck bodies and trailers.

Food Processing - specialized machinery for sorting, processing and canning or freezing fruits and vegetables, egg sorters, milk sterilizers, and commercial kitchen equipment.

TABLE 75
FMC
ACQUISITIONS (1963-1976)

<u>Date</u>	<u>Company</u>	<u>Business</u>	<u>Approx. Sales (In Millions)</u>
1963	American Viscone Corp.	Rayon, Cellophane	\$239.8
1964	North Ordinance, Inc.	Heavy Naval Ordinance	12.0
1965	Seed Research Specialties	Vegetable Seeds	N/A
1965	Gunderson Brothers Engineering Co.	Railcars, Barges	34.9
1965	Hus-Ski, Ltd.	Snow Vehicles	N/A
1966	Dealer Associates, Inc.	Farm Implements	2.6
1966	Harry J. Ferguson Co.	Conveying Machinery	1.5
1967	Link-Belt Company	Power Transmission Equipment Construction Machinery	244.9
1968	Kilby Steel Company	Foundry	N/A
1972	Galis Manufacturing Co.	Coal Mining Machinery	N/A
1972	Wayne Manufacturing Motor Sweepers		28.4
1973	Raque Manufacturing		N/A
1973	Martin Marietta Corp.	Waste Treatment	N/A

Agricultural - crop sprayers, duster and harvesters irrigation systems, frost protection equipment, tilthens and cutters.

Packaging - machinery for making boxes and bags, flexographic printing systems, machinery for filling, weighing and sealing flexible containers.

Consumer - power gardening equipment, lawn mowers and snow blowers.

As is evident from the above description, product sales of this group are very sensitive to the general condition of the economy and to corporate capital spending in particular. Dollar sales growth of the machinery group averaged 16.9% per year from 1965 to 1976. However, excluding the 90% increase in group sales due largely to the acquisition of Link-Belt in 1967, the average growth of sales is only 9.6% per year. Sales dropped 6% in 1968, 2% in 1970 and 4% in 1976. The 1968 drop reflects the long strike that had affected the John Bean farm equipment division. The 1970 drop reflects the high interest costs, reduced profits and uncertainties about the depth and duration of the recession that began in 1969. The 1976 drop reflects the divestiture of its pump division with approximately \$62 million in sales. Significant increases in sales growth of 20%, 14%, 24% and 18% in 1972, 1973, 1974 and 1975 respectively are attributed to increased demand and to a revived acquisition program after a four-year hiatus.

Product Description -Chemical Group

The principal products of this group fall into 3 categories:

- 1) Inorganics - chlorine, caustic soda, soda ash, caustic potash, phosphates, barium and magnesium derivatives, and peroxygens.
- 2) Organics - plasticizers, intermediates, additives and glycerine.
- 3) Agricultural - insecticides, fungicides, herbicides and vegetable seeds.

Sales growth of this group was relatively slow between 1965 and 1973 and averaged 6.4% per year. In 1974, sales jumped 37% to \$520 million from \$380 in 1973. The enormous jump in sales is attributed to the chemical industry price explosion which occurred that year and to strong demand.

Product Description - Fiber & Film Group

The fibers component of this group consists of high-tenacity and regular tenacity rayon yarns; rayon staple, polyester staple and yarn, acetate yarn and polypropylene strapping. The film component consists of cellophane and polyvinyl chloride. The products of this group are used by the tire industry, textile industry and the apparel industry. FMC's involvement with fiber and film began with the acquisition of American Viscose Corporation in 1963 with approximately \$240 million in sales. Sales growth averaged 1.2% per year from 1965 to 1975. In 1976, FMC sold its Fibers division with over \$200 million in

sales and reduced this group to \$110 million in sales for its remaining fiber sales. The extremely slow sales growth of this group can be traced back to the inroads of polyester in two principal markets of FMC. Rayon yarns and staple, in which FMC enjoys a very strong position, have been losing market shares to polyester staple and polyester filament in both the tire market and the apparel market since the late 60's. The automobile companies and tire companies have shifted away from high tenacity rayon tire cord to polyester-fiberglass tire cord and the textile industry has shifted to polyester staple at the expense of both cotton and rayon. As can be seen in Table 76, daily consumption of rayon had dropped 32% in 1971 from a level of 28 million lbs a day in 1969. The fundamental difficulty affecting the competitive position of rayon in all its markets was the inexorable upward thrust in the cost of dissolving pulp and the related limited opportunity for cost reduction in rayon versus the non-cellulosic fibers. In addition to the continuing competitive inroads of polyester, FMC's rayon business had suffered through two severe textile recessions. In 1967, group sales dropped 3% while total sales increased 5%, in 1970, group sales dropped 9% while total sales dropped 6%. The severe recession that began in 1974 depressed group sales from \$430 million in 1974 to \$308 million in 1975, a drop of 28%. In 1976, FMC divested its Fibers Division and reduced sales of that group by 64% to \$110 million.

TABLE 76

FMC

DAILY AVERAGE STAPLE FIBER CONSUMPTION

(In mil. lbs., seasonally-adjusted)

	<u>Total</u>	<u>Upland Cotton</u>	<u>Cellulosics (Mainly Rayon)</u>	<u>Non- Cellulosics (Mainly Polyester)</u>
3/71	20.7	15.3	1.9	3.5
3/70	20.1	14.7	2.2	3.2
3/69	21.5	15.6	2.8	3.1
% Chng. 3/69- 3/71	-4%	-2%	-32%	+13%

Source: Census Bureau Reports

Product Description - Ordinance Group

Principal products of this group include: wheeled and tracked military vehicles; missile carriers and ground support systems; missile launching systems; naval ordnance; mortar shell casings, and recreational vehicles.

The sales growth of this group depends to a large extent on the defense budget of the Federal government and to a lesser extent on foreign governments.

Foreign Sales

Table 77 below shows the historical trend of consolidated sales broken down to domestic sales and foreign sales. Foreign sales is further broken down to foreign manufacturing and exports. Finally, domestic manufacturing is presented in the last column as the sum of domestic sales plus exports or consolidated sales minus foreign manufacturing.

Although foreign sales have grown more rapidly (20% per year) than FMC's domestic sales (6% per year) they remain a relatively small portion of the total. The proportion of foreign sales to total sales increased from 10% in 1965 to 28% in 1976. The increase in foreign sales reflects increases in foreign manufacturing of 18% per year and increases in exports of 22% per year. Between 1965 and 1976, exports accounted for an average of 55% of foreign sales, with a low of 48% in 1971 and a high of 66% in 1976. Domestic manufacturing, which is equivalent to domestic sales plus exports accounted for 96% of consolidated sales in 1965 and 90% in 1976.

TABLE 77

FMC

BREAKDOWN OF DOMESTIC AND FOREIGN SALES

	(a) <u>World-Wide Sales</u>	(b) <u>Domestic Sales</u>	(c) <u>Foreign Sales</u>	(d) <u>Foreign Manufacturing</u>	(e) <u>Exports</u>	(f) <u>Domestic Manufacturing</u>
1965	\$ 929.0	\$ 839.6	\$ 89.4	\$ 38.1	\$ 51.3	\$ 890.9
1966	1,009.7	902.7	107.0	50.4	56.6	959.3
1967	1,313.0	1,156.0	157.0	80.0	77.0	1,233.0
1968	1,376.2	1,200.2	176.0	82.0	94.0	1,294.2
1969	1,409.3	1,233.3	176.0	88.0	88.0	1,321.3
1970	1,330.5	1,133.5	197.0	91.0	106.0	1,239.5
1971	1,353.6	1,160.6	193.0	101.0	92.0	1,252.6
1972	1,497.7	1,254.5	243.2	110.4	132.8	1,387.3
1973	1,719.3	1,431.4	287.9	127.1	160.8	1,592.2
1974	2,075.0	1,663.0	412.0	168.9	243.1	1,906.1
1975	2,292.0	1,731.5	560.5	202.3	358.2	2,089.7
1976	2,144.7	1,544.6	600.1	204.9	395.2	1,939.8
Avg. Annual Growth	1.09	1.06	1.20	1.18	1.22	1.08

According to FMC's Annual Reports to Stockholders, more than 60% of foreign shipments is accounted for by the machinery group, where such volume is equivalent to about 20% of the group's total. Only 8%-9% of the output of the chemical, fiber and film, and ordnance groups is marketed outside of this country.

Estimated Sales Versus Reported Sales

Our estimates of value of shipments by 4-Digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. In total FMC had manufacturing operations with plants of 100 or more employees in 22 4-digit SIC industries during 1965, 27 during 1968, 31 during 1972, 32 during 1974 and 1976. The increase in the number of SIC industries came about mainly through acquisitions of other companies (see Table 75). The acquisition of Link-Belt in 1967 complemented and extended the machinery lines to include 5 new SIC industries. The increase from 1968 to 1972 is attributed to the acquisitions of Kilby Steel Company (late 1968), Galis Manufacturing Company (1972) and Wayne Manufacturing (1972). In addition to these acquisitions, the ordnance group in 1972 entered the recreational vehicle (motor home) field. The increase in the number of 4-digit SIC industries in the latter years came about through expansion of existing lines to related fields and through expansion of existing lines to the point where MEI would capture its significance (plants with 100 or more employees).

Since our estimated sales are based on domestic manufacturing plants with 100 or more employees, it is appropriate to compare our estimates of sales with FMC's reported domestic manufacturing, column (f) of Table 77.

The ratios of estimated sales to reported domestic manufacturing are as follows:

<u>Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
Estimated	\$812.7	\$1,306.8	\$1,676.7	\$2,104.3	\$2,615.0
Reported Domestic	\$890.9	\$1,394.2	\$1,387.3	\$1,906.1	\$1,939.8
Ratio					

The ratios of estimated sales to reported domestic manufacturing averaged 12% for the 5 years. For 1965, our estimate is below reported domestic manufacturing. For 1968, 1972, 1974 and 1976 our estimates are above reported domestic manufacturing.

Discrepancies Between Estimated and Reported - An Explanation

The greatest discrepancy between our estimated sales and reported domestic manufacturing occurred for the years 1972 (21%) and 1976 (35%). The 1976 discrepancy is due primarily to the divestitures of FMC's fibers division and Peerless Pump division. Estimates of sales of these divisions are based on full year operations. Since these divisions were sold in the middle of 1976 and sales of these divisions were not reported at all, estimates of sales will exceed reported domestic manufacturing to this extent.

In addition to the mid-year divestiture factor, there are several other factors contributing to our estimates of sales being greater than reported domestic manufacturing. These factors are focused on in the following review of FMC's development.

The strategies pursued by management, especially the acquisitions in the rayon, freight car and heavy machinery fields, have complemented the ordnance group in inducing greater cyclicity in the business. The products marketed by FMC's ordnance group are subject to defense budgeting and government procurement policies. Defense volume has fluctuated widely and declined significantly, especially after the Vietnam War when contracts were renewed more sporadically and when pressures to deal with various urban problems in this country climbed so as to subject defense expenditures to increasing scrutiny. As evidence of this, the company by 1972 had redeployed part of its resources to civilian activities such as recreational motor homes and underground mining systems. Although sales of the products marketed by the machinery group grew almost as rapidly as FMC's consolidated sales (8.6% versus 9.0% average annual rate), it is extremely sensitive to the capital spending cycle of the economy. Machinery volume typically lags the general condition of the economy.

FMC's growth potential was also limited in the chemical and fibers and films areas. As was mentioned earlier, FMC's fibers and films difficulties stemmed from the erosion of rayon's share of both apparel and industrial (tire cord, etc.) markets and concurrent relentless increase in production costs, reflecting the rising cost of dissolving pulp and more stringent pollution abatement requirements. FMC's initial response to this situation was the decision in 1967 to enter production of polyester fiber, the recipient of most of rayon's lost market share. In 1968, FMC's polyester production capacity was 80 million pounds and by 1973 this had tripled to 240 million pounds; by 1975, capacity had reached 480 million pounds. FMC's entry into the polyester fiber field, however, was met with three severe setbacks: (1) deep price erosion because of lower production and severe competition, (2) loss of production at one of its largest polyester plants due to flooding caused by a storm in June of 1972 and (3) quality control difficulties with its production of polyester fibers. As evidence of this last point, when industry tonnage shipments of polyester textile filament increased some 40% in 1972, aided by price reduction of approximately 35%, FMC's polyester volume actually declined. The price reduction apparently made it difficult for producers of less-than-first quality yarn to move their products at all.

The dominant product in FMC's fiber division however, continued to be rayon, which continued to lose market shares through 1976. In response to this, when flood conditions had hit one of its largest rayon plants, management

decided to shut down its operation permanently instead of rehabilitating. Moreover, the loss of 1974-1975 recession prompted management to close its oldest fiber facility and to discontinue this line altogether.

The situation with its chemical group was not as severe. Its phosphorous production, which is second to Monsanto and sold principally to the detergent industry, had been under pressure. This pressure reflects the concern that the phosphates used in detergents are harmful to the environment. In response, demand for phosphates slackened during the 1970's as soap companies developed new processes which reduced or eliminated phosphate contents.

The problems described above provides some clues in explaining the increasing discrepancies between our estimated sales and reported domestic manufacturing since 1972. The cyclical nature of FMC's businesses, especially the heavy machinery and ordnance fields, creates fluctuating employment levels which tends to diminish the accuracy of our estimates. The number of employees depends on the size and duration of contracts and on the stages of production. Although MEI makes adjustments for seasonal industries by converting to average annual employment, it cannot capture intricate variations. In the fiber division, the difficulties surrounding both rayon and polyester productions which had caused discontinuation of lines (BCF carpet fiber and rayon filament year in 1972) and unscheduled closing of plants also contributed to the discrepancies. More elaborately, these closings and discontinuation of lines have occurred during the year (as oppose to the beginning)

and accordingly sales would be registered for only part of the year while our estimates are based on full year's operation.

In addition to the above factors, there are two other factors responsible for our estimates being greater than reported domestic manufacturing. Recall that our estimated sales are based on (1) the data as set forth in MEI and (2) the assumption implicit in our estimating procedure, namely that each plant operates at its respective industry's average value of shipments per employee. Our estimates then apply to a firm possessing typical plants in various industries (as classified by MEI for the 5 years under analysis) with each plant operating at its industry's average value of shipments per employee and each subject to typical difficulties, e.g., strikes, start-up problems, etc., associated with its industry. Precipitated by increases in the rate of inflation and expiration of Federal wage controls, a total of nine strikes in 1974 had severely affected several of FMC's operations. In 1976, FMC had encountered a major strike at several bearing and chain plants. These strikes may contribute to the discrepancies between estimated sales and reported domestic manufacturing if these strikes are atypical of the industry (company specific). The last factor contributing to our estimates being greater than reported domestic manufacturing is the below industry's average value of shipment operation of FMC's recreational vehicle division. FMC's 1972 internal expansion into this field was beset by many production difficulties which had prevented operation from attaining mass production status. This division had incurred losses every year and was finally offered for sale in 1976.

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of sales of a "typical" firm with characteristics basically similar to FMC's domestic manufacturing activities in current and constant dollars for the years 1965, 1968, 1972, 1974, and 1976 are presented in Table 78.

TABLE 78

FMC

ESTIMATED SALES AND GROWTH OF SALES

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
In Current Dollars	\$ 812.7	\$1,306.8	\$ 1,676.7	\$ 2,104.3	\$ 2,615.0
(a) Index of (1965=100)	100	162	206	259	322
In Constant Dollars	\$ 840.1	\$1,293.4	\$ 1,507.9	\$ 1,452.2	\$ 1,395.5
(b) Index of (1965=100)	100	154	179	173	166
(c) = (a) / (b)	100	105	115	150	194

Line (a) of Table 78 is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for FMC's (or our typical firm's) domestic manufacturing activities. During the early years, the divergence between the two growth patterns is relatively small and reflects an essentially flat pattern of price changes.

Beginning in 1974, the double effect of the oil embargo and the expiration of Federal price controls boosted consumer prices in excess of 12% and industrial chemical product prices 47%. This had the effect of increasing nominal sales growth and distorting real growth.

The real growth pattern can be described in two ways: (1) our estimate of real growth - line (b) of Table 78 and (2) the company's current dollar reported domestic manufacturing data deflated our estimated company price index -line (c) of Table 78. In Table 79, FMC's domestic manufacturing sales are deflated by our estimated price index.

TABLE 79
FMC
DOMESTIC MANUFACTURING SALES

<u>Domestic Manufacturing</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
In Current Dollars	\$ 890.9	\$ 1,294.2	\$ 1,387.3	\$ 1,906.1	\$ 1,939.8
(a) Index of (1965=100)	100	145	156	214	218
In Constant Dollars (Using estimated price Index)	\$ 890.9	\$ 1,232.6	\$ 1,206.3	\$ 1,270.7	\$ 999.9
(b) Index of (1965=100)	100	138	135	143	112

Line (a) is the growth pattern of reported domestic manufacturing in current dollars. Line (b) is FMC's domestic manufacturing growth subjected to domestic manufacturing price changes as experienced by our "typical" firm.

To facilitate comparison, the two real growth patterns are presented together in Table 80.

TABLE 80
FMC
COMPARISON OF ESTIMATED TO REPORTED REAL SALES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	154	179	173	166
B) index of Reported Real Sales (b)	100	138	135	143	112

(as deflated by our implicit price index)

(a) from line (b) of Table 78.

(b) from line (b) of Table 79.

Line (A) of Table 80 shows the real sales grew 54%, 79%, 73% and 66% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. Line (B), on the other hand, shows that real sales grew 38%, 35%, 43% and 12% over the 1965-1976 period respectively. The discrepancies between Line (A) and line (B) can be attributed to the differences between our estimated sales and reported sales. That is, if estimated sales equal reported sales for each of the 5 years under analysis, the two real growth patterns - line (A) and line (B) of Table 80, would be identical.

Referring back to Table 79, if we now make the assumption that our implicit price index accurately reflects the company's actual composite price changes of all products included in its reported domestic sales, then the following statement can be made: Whereas reported domestic sales on a current dollar basis grew 118% over the 1965-1976 period, physical volume or sales adjusted for price changes rose only 12% over the same period.

GENERAL ELECTRIC

General Electric is one of the largest and most diversified industrial corporations in the U. S. , ranking 9th with 1976 sales of \$15.7 billion in Fortune's list of large industrial corporations. In 1965, General Electric had sales of \$6.2 billion. Measured in current dollars, they grew an arithmetic average of 9.1% per year over the 1965-1976 period. The company is primarily engaged in developing, manufacturing and marketing a wide variety of products in the electrical and electronics industries. General Electric's diversified profile came about principally through internal expansion as opposed to the acquisition of other companies. Except for the 1976 merger with Utah International, Inc., a metal mining concern with sales of \$1 billion, its small acquisition activity was mostly limited to radio broadcasting stations and cable television operations.

Prior to 1970 General Electric's reported sales were classified into 4 broad product groups, each of which have some degree of commonality in manufacturing or marketing. Beginning in 1971, General Electric employed a five-way classification of sales. With the aid of the 5-year summaries of sales contained in Annual Reports to stockholders, we were able to ascertain in the yearly sales in current dollars of the five major groups (presented in Table 81) consistent for the years 1967 through 1975. In 1976, the company expanded the number of groups to six to include the businesses of Utah International, Inc.

General Electric's six major product groups are: Consumer, Industrial Power Equipment, Industrial Components and Systems, Aerospace, International, and Natural Resources. The Consumer Group has accounted for

TABLE 81
(In Millions of Dollars)
GENERAL ELECTRIC
SALES OF MAJOR PRODUCT GROUPS

	<u>Consumer</u>	<u>Industrial Power Equipment</u>	<u>Industrial Component & Systems</u>	<u>Aero- Space</u>	<u>International Including Exports</u>	<u>Natural Resources</u>	<u>Corporate Elimination and Unallocated Items</u>	<u>Total</u>
1965	\$N/A	\$ N/A	\$ N/A	\$ N/A	\$ N/A	-	\$ N/A	\$ 6,214
1966	N/A	N/A	N/A	N/A	N/A	-	N/A	7,177
1967	1,985	1,221	2,503	1,675	1,143	-	(786)	7,741
1968	2,153	1,521	2,644	1,747	1,154	-	(837)	8,382
1969	2,155	1,474	2,774	1,688	1,201	-	(844)	8,448
1970	1,969	1,880	2,848	1,666	1,393	-	(1,029)	8,727
1971	2,383	2,131	2,865	1,623	1,584	-	(1,161)	9,425
1972	2,782	2,249	3,158	1,514	1,830	-	(1,294)	10,239
1973	3,097	2,477	3,728	1,611	2,318	-	(1,656)	11,575
1974	3,214	2,787	4,529	1,916	3,218	-	(2,251)	13,413
1975	2,880	2,922	4,320	1,972	3,745	-	(2,440)	13,399
1976	3,307	3,074	4,787	2,049	4,024	1,001	(2,595)	15,697

between 18.1 and 24.1% of world-wide sales, the Industrial Power Equipment Group for between 14.3 and 20.1%, the Industrial Components and Systems Group for between 26.2 and 29.9%, the Aerospace Group for between 11.2 and 19.6% and the International Group for between 12.5 and 23.6% of world-wide sales over the 1967-1976 period. In 1976, the Natural Resources Group (Utah International, Inc.) contributed 5.5% of worldwide revenues. Group sales as listed in Table 81 and as reported in General Electric's Annual Reports include inter-group transactions. To avoid double counting, General Electric made the appropriate eliminations at the corporate level and these entries are listed under Corporate Elimination and Unallocated Items in Table 81.

General Electric sales growth potential was limited by a number of factors during the 1965-1976 period. First, a major strike beginning in October 1969 and lasting until February 1970 had the effect of limiting consolidated sales growth to a slight increase of 2% from \$8,382 million in 1968 to \$8,448 million in 1969. According to its 1969 Annual Report to stockholders, the strike was widespread and production was "severely limited at a majority of the Company's plants...". Second, the economic recessions of 1970 and 1975 slowed world-wide sales growth in these years. 1970 sales were only a slight 3.3% above that of 1969. 1975 sales of \$13,399 million were slightly below the \$13,413 million of 1974. Third, the energy crisis beginning in late 1973 had severely limited the demand for several of the company's major products by large industrial customers such as public electric utilities as well as general consumers. In the product descriptions that follow, these and other factors are examined more closely to provide some insights as to the growth of General Electric's various product lines.

Product Description - Consumer Group

General Electric manufactures, distributes and services a broad line of major household appliances including air conditioners, clothes washers and dryers, dishwashers, food waste disposers, trash compactors, electric ranges, refrigerators and freezers, and televisions. These products are sold directly to consumers as well as to building contractors for installation in new dwellings. This group also manufactures a broad line of small appliances principally for sale to consumers including such items as clocks and timers, radios, security devices and various electric and electronic appliances for personal care, garment care and food preparation. In addition to the wide variety of small and major appliances, General Electric also manufactures a wide line of lamps and bulbs including incandescent, fluorescent, photo, miniature and high intensity bulbs and lamps.

In 1966, General Electric entered the radio broadcasting business with the acquisitions of WSIX AM and FM and National General Corp., a system of cable television systems in 4 cities. Subsequent acquisitions expanded this line to three AM and five PM radio stations, three T. V. stations and 12 cablevision systems in 1976.

The annual rate of sales growth of the Consumer group from 1967 through 1976 averaged 6.3% per year and showed a pattern sensitive to the overall condition of the economy and in particular to consumer's income and the housing industry. In 1969, sales increased by a slight \$2 million on a base of \$2.153 billion in 1968. This reflects two principal occurrences. The first was a 5-month strike ending in February of 1970. While the longer of the strike occurred in the fourth quarter of 1969, its impact on sales was more severe in the first quarter of 1970. In the final two months of 1969,

considerable sales volume was derived from shipments of finished goods inventory. Sales dropped 8.6% in 1970 to \$1,969 million from \$2,155 million in 1969. The second occurrence was the beginning of the general slackening in the pace of the U.S. economy.

The combination of inflation, recession and energy crisis adversely affected 1974 and 1975 group sales. As a result of a major slump in housing and a lack of consumer confidence group sales advanced a slight 3.8% in 1974. This dramatic drop in growth, as compared to previous years growth of 21.0% in 1971, 16.7% in 1972 and 11.3% in 1973 reflects the continuation of declaration of the consumer group. In 1975, the trend continued and resulted in a 10.4% drop in group sales from \$3,214 million in 1974 to \$2,880 million. Sales of major appliances were hit hard as consumers postponed consumption of durable goods. According to General Electric's 1974 Annual Report, "Unit shipments of GE and Hotpoint major appliances decreased somewhat less than the 10% decline recorded for total industry shipments of major appliances in 1974." For the first ten months of 1975, however, industry unit shipments continued to decline another 26%.

In addition to decreased demand for major appliances, General Electric's household lamp and bulb business suffered similar setbacks as consumers reduced their use of lighting in the wake of the energy crunch and soaring electric bills.

Product Description - Industrial Power Equipment Group

This group is engaged principally in supplying electric utility companies with products such as steam and gas turbine-generators and nuclear power reactors for the generation, transmission and distribution of electricity.

Sales growth of this group averaged 11.2% per year from 1967 to 1976 and experienced positive sales advances for every year except 1969. The aforementioned strike in late 1969 slowed large apparatus shipments and reduced group sales from \$1,521 million in 1968 to \$1,474 million in 1969. In 1970, group sales advanced 27.5% to \$1,880 million reflecting, in part, the completion of equipment whose delivery was deferred from the previous year.

Energy conservation combined with the economic slowdown of 1974-1975 created a major problem for electric utilities. For the first time since the Great Depression peak load growth of electricity had slowed and underutilization of capacity reached a high of 30%. Electric utilities, in turn, reduced their demand for power equipment and immediately cancelled orders and or otherwise deferred new orders. Further compounding group's sales problems during this period was the political and public uncertainty of nuclear power plants. General Electric is a major factor in boiling water reactor system, nuclear fuel and disposal of nuclear waste, and the ultimate effect of these factors was to slow growth of group sales to 4.8% increase in 1975 and 5.2% increase in 1976 from group's prior (1967-1974) average annual growth rate of 12.9%.

Product Description - The Industrial Components and Systems Group

This group is General Electric's largest revenue contributor, manufacturing and servicing a diverse set of products and generating over 26% of consolidated sales in 1976. Representative products include appliance controls, small motors, various electronic components, engineering plastics, silicones, laminated and insulating materials, motor and drives for general industrial use and rail transportation equipment, specialized electronic

equipment for the medical and communication industries such as X-ray machines and other diagnostic equipment, ballasts batteries, capacitors, industrial heaters, communication systems and computer time-sharing apparatus. In connection with the last product, General Electric was also involved in the manufacturing of computers and computer systems prior to 1971 at which time the business was sold to a subsidiary of Honeywell, Inc.

Sales growth of this group averaged 7.7% per year from 1967 to 1976 and showed positive year-to-year changes in every year except 1975. In 1975, sales dropped 4.6% from \$4,529 million in 1974 to \$4,320 million. This was attributed to major weaknesses in the construction and consumer goods industries. The transfer of the computer business to Honeywell, Inc. in 1970 was reflected in a lowering group sales growth rate from \$2,848 million in 1970 to \$2,865 million in 1971, a 0.6% increase.

Product Description - Aerospace Group

This group is General Electric's growing division and the company's revenue contributor. Aerospace generated 11.2% of 1976 consolidated sales and averaged a 2.5% annual sales increase from 1967 to 1976. During the late 1960's, sales of military and defense products such as power plants for military aircraft, armament systems, and re-entry systems for ballistic missiles were the main contributors to group revenue. However, with a shift in Government priorities away from defense accompanying the ending of the Vietnam War, group sales began a downward slide in 1969, a decline that lasted until 1973. In the interim, General Electric shifted its product emphasis to commercial aircraft power plants, power plants for marine vessels, radar, sonar and space flight systems and earth orbiting satellites. The transfer of technology to the

civilian economy continued into such diverse areas as modular housing, earth resources, waste management, air pollution control and monitoring, health care, and aircraft safety.

Product Description - International Group

The operations of General Electric's affiliates in such countries as Canada, Italy, Brazil, Spain, Mexico and Australia are included in this group along with exports from its U.S. operations to customers abroad. Since this study is concerned with domestic manufacturing activity, ideally we should have data on the dollar value and the product mix of net exports.

Unfortunately, General Electric's Annual Reports to stockholders contained little helpful information on these matters. Dollar value of exports were available only for a few years: 1968 - \$505 million, 1969 - \$ 515 million, 1973- \$1,000 million, 1974 - 1,500 million, 1975 - \$1,600 million and 1976 - \$1,900 million. Data on imports was even more sparse and limited us to a single statement made by management in its 1974 Annual Report - "During the past five years, General Electric contributed over \$2.5 billion to the U.S. balance of payments by exporting over four times as much as it imported in materials and products for sale in the U.S." As for product mix, the 1975 Annual Report states - "The bulk of General Electric's export sales continues to derive from high-technology products such as aircraft engines, gas turbines, steam turbines, transportation systems and nuclear steam supply systems."

International sales have increased at an average annual rate of 15.5% from 1967 to 1976 and exceeds the 9.1% arithmetic average annual growth rate of the company as a whole. Exports have increased from 43.8% of international sales in 1968 to 47.2% in 1976. The strong growth in group sales, particularly in export sales can be attributed to the need of developing countries for power systems, transportation equipment and other capital goods.

Estimated Sales vs. Reported Sales

Our estimates of sales by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974, and 1976 are presented in the appendix to this section. In 1965, 1968, 1972, 1974 and 1976, General Electric had manufacturing operations with plants of 100 or more employees in 52 4-digit SIC industries. In 1972, General Electric had manufacturing in 53 4-digit SIC industries. Although the number of 4-digit SIC industries remained essentially constant over the period, there were significant changes in the particular 4-digit SIC industries. These reflected primarily the expansion of the Aerospace Group into civilian areas and away from defense products.

To compare our estimates of sales with General Electric's reported sales for the 5 years in our analysis, it is necessary to isolate the company's domestic manufacturing activities from its world-wide operations. Since our estimates of sales are based on domestic manufacturing plants with 100 or more employees, company's foreign operations and non-manufacturing activities should be netted out of world-wide sales. Unfortunately, as was mentioned earlier, General Electric's reporting procedure did not allow for a clear separation between foreign and domestic manufacturing operations. Dollar figures on imports were not available and export figures were available for only

3 of the 5 years under analysis. In addition, non-manufacturing sales such as computer services, radio broadcasting, service contracting of products, etc., were included in the sales figures of each group and were not separable from its manufacturing operations. Ratios of our estimates to reported consolidated sales minus international sales are presented in Table 82. (For 1976, sales of the Natural Resources Group was also subtracted because Utah International, Inc. is a non-manufacturing concern.)

TABLE 82
GENERAL ELECTRIC
(In Millions of Dollars)
RATIO OF ESTIMATED TO REPORTED SALES

<u>Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Estimated	\$ 4,371.0	\$ 6,074.6	\$ 7,497.7	\$ 8,660.2	\$ 9,660.4
Reported	N.A.	7,228	8,409	10,195	10,672
Ratio		.84	.89	.85	.91

The ratio of our estimates to reported sales averaged .87 for the 4 available years. For each year, our estimates are lower than reported sales. If exports for 1968, 1974, and 1976 were included in reported sales above, the ratios would be .79, .74 and .77 respectively. Since dollar figures for imports were not available for any of the 5 years, the actual ratio of our estimates to domestic manufacturing activity is somewhere between .79 and .84 for 1968; .74 and .85 for 1974 and .77 and .91 for 1976.

Discrepancies Between Estimated and Reported - An Explanation

Primary contributor to the difference between our estimate of domestic manufacturing activity and General Electric's reported sales is General Electric's non-manufacturing activity which is not captured by MEI. In the Consumer's group, the non-manufacturing operations consists of (1) servicing its large lines of major appliances - claimed in its 1976 Annual Report to be "the strongest service network of any manufacturers," and (2) its network of radio, T.V. and cable broadcasting systems. In the Industrial Power Equipment Group, the non-manufacturing operation consists of nuclear waste disposal services and storage. In the Industrial Components and Systems group, the non-manufacturing operations consists of (1) General Electric's world-wide computerized information services system, (2) General Electric's world-wide apparatus of service shops, which provide maintenance, inspection, repair and rebuilding of electrical and mechanical apparatus produced by the company as well as by other manufacturers, and (3) General Electric Supply Company, a wholly-owned consolidated subsidiary, marketing and distributing General Electric's products as well as products produced by other manufacturers to commercial, utility and industrial customers.

General Electric's efficient manufacturing operations (suggested in its annual reports to stockholders) is another factor that may be responsible for our estimates to be lower than reported domestic sales. Recall, implicit in our estimating procedure is the assumption that each plant operates at its respective industry's average value of shipments per employee. Thus our estimates of sales apply to a typical firm possessing plants in various industries (as classified by MEI) with each plant operating at its respective industry's average value of shipments per employee and each experiencing typical

difficulties associated with its industry, e.g., strikes, start-up problems, etc. Consequently, if General Electric's domestic manufacturing operations are in fact more efficient and/or encountered less difficulties than the industry's average firm, then our estimates will be biased downward.

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of sales of a firm with characteristics similar to General Electric's domestic manufacturing activities in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in Table 83. Line (a) is the growth pattern of estimated sales in current dollars (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for General Electric's domestic manufacturing activities. The divergence between the two growth paths increased at an increasing rate through time and reflects a continuous increase in prices. From 1965 to 1968 prices of General Electric's domestic manufactured products increased 6%; from 1968 to 1972, 10.4%, from 1972 to 1974, 14.5% and from 1974 to 1976, 18.7%.

The real growth pattern can be described in two ways: (1) our estimate of real growth - line (b) of Table 83 and (2) the company's current dollar reported domestic sales deflated by our estimated price index - line (c) of Table 83. In Table 84, General Electric's reported domestic sales are deflated by our estimated price index. Line (a) is the growth pattern of reported domestic sales in current dollars.

TABLE 83

GENERAL ELECTRIC

ESTIMATED SALES IN CURRENT AND CONSTANT DOLLARS

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$ 4,371.0	\$ 6,074.6	\$ 7,497.7	\$ 8,660.2	\$ 9,660.4
(a) Index of (1965=100)	100	139	172	198	221
In Constant Dollars	\$ 4,529.2	\$ 5,946.2	\$ 6,672.7	\$ 6,700.4	\$ 6,308.3
(b) Index of (1965=100)	100	131	147	148	139
(c) = (a) / (b)	100	106	117	134	159

Line (b) is General Electric's reported domestic sales growth subjected to our estimated domestic manufacturing price changes.

To facilitate comparison, the two real growth patterns are presented together in Table 85. Since domestic sales for 1965 are not available (world-wide sales were reported only), our estimated real growth pattern - line (b) of Table 83 will be re-indexed so that we can compare the two real growth patterns with 1968 as the base year. Our estimate of real sales growth shows a 12% increase from 1968 to 1972, a .9% increase from 1972 to 1974, and a 6.2% decrease from 1974 to 1976. On the other hand, real reported domestic sales growth, as deflated by our implicit price index show a 5% increase from 1968 to 1972, a 6.7% increase from 1972 to 1974, and a 12.5% decrease from 1974 to 1976.

The discrepancies between the two real growth paths can be attributed to differences between our estimated sales and reported domestic sales. That is, if estimated sales were exactly equalled to reported domestic sales, then the two real growth patterns would be identical because the same price index was used to deflated both.

If we now make the assumption that our implicit price index accurately reflects the company's composite selling price changes for all of its domestically manufactured products and services, then the following statement can be made (refer to Table 84):

Whereas reported domestic sales on a current dollar basis grew 48% over the 1968-1976 period, physical volume or real sales actually declined 2% during the same period.

TABLE 84

GENERAL ELECTRIC
(In Millions of Dollars)

REPORTED DOMESTIC SALES

<u>Reported Domestic Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	N/A	\$ 7,228.0	\$ 8,409.0	\$10,195.0	\$ 10,672.0
(a) Index of (1968=100)	-	100	116	141	148
In Constant Dollars (using est. price index)	-	\$ 6,818.9	\$ 7,187.2	\$ 7,608.2	\$ 6,711.9
(b) Index of (1968=100)	-	100	105	112	98

TABLE 85
GENERAL ELECTRIC
COMPARISON OF ESTIMATED TO REPORTED REAL SALES

	<u>Real Sales</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated (a)		100	112	113	106
B) Index of Reported (b) (as deflated by our implicit price index)		100	105	112	98
(a)	from line (b) of Table 83, re-indexed with 1968 as the base year				
(b)	from line (b) of Table 84.				

B. F. GOODRICH

B. F. Goodrich was ranked 112th on the Fortune list of large industrial companies in the U. S. with sales of \$1.99 billion in 1976. In 1965 B. F. Goodrich had sales of \$980 million. The sales measured in current dollars, grew at an average rate of 6.9% per year from 1965 to 1976. Although tires have been B. F. Goodrich's most prominent product for a large part of its history, the company is also a major producer of a diverse range of other products. This includes chemicals, plastics and industrial rubber goods.

B. F. Goodrich's products are classified in to 4 major groups: (1) Tires and Related Products Group, (2) Plastic Materials Group, (3) Chemicals and Man-Made Rubber Group and (4) Industrial Transportation and Other Products Group. The Tires and Related Products Group has accounted for between 44.2 and 54.6% of total sales, Plastic Materials Group for between 10.2 and 24.0%, Chemicals and Man-Made Rubber Group for between 9.8 and 11.9% and the Industrial Transportation and Other Products Group for between 19.4 and 27.1% of total sales over the 1966-1976 period. Table 86 presents B. F. Goodrich's consolidated sales broken down into these 4 major categories for the years 1966-1976. For a clear understanding of B. F. Goodrich's products and the importance of each segment, the Tires and Related Products Group is further divided into (1) Tires and (2) Related Products.

B. F. Goodrich's consolidated current dollar sales exhibited positive year-to-year gains for 8 of the eleven years between 1965 and 1976. In 1967, 1970 and 1975 sales dropped 3.2%, 2.0% and 3.3% respectively. During 1967, sales were adversely affected by strikes involving 11,000 employees and lasting more

TABLE 86
B. F. GOODRICH
DISTRIBUTION OF SALES

(In Millions)

	<u>Tires & Related Products</u>		<u>Plastic</u>	<u>Chem. &</u>	<u>Industrial</u>	
	<u>Tires</u>	<u>Related</u>	<u>Materials</u>	<u>Man-Made</u>	<u>Trans. an</u>	<u>Total</u>
		<u>Product</u>		<u>Rubber</u>	<u>Other Prod.</u>	
1965						\$ 980.1
1966	\$ 445.4	\$ 104.6	\$ 105.9	\$101.8	\$ 281.4	\$ 1,039.1
1967	411.0	105.8	110.3	106.1	273.0	1,006.2
1968	492.0	121.8	124.4	119.2	282.3	1,139.7
1969	524.0	117.1	136.2	126.0	325.8	1,229.1
1970	524.0	108.3	144.5	124.3	303.7	1,204.8
1971	598.7	99.5	155.4	130.1	316.6	1,300.3
1972	709.8	113.6	203.6	159.0	320.8	1,506.8
1973	769.1	107.5	263.0	188.8	332.7	1,661.1
1974	884.5	101.8	363.0	233.2	383.7	1,966.2
1975	900.5	90.6	298.6	218.6	392.9	1,901.2
1976	822.9	60.3	478.3	217.1	417.4	1,996.0

than 85 days. During 1970, a number of factors caused the decline. Most important was a succession of labor strikes occurring at several of the company's plants as well as strikes at a number of major customers, among which were General Motors and companies in the trucking industry. A second factor was the economic recession of 1970. The sales decline in 1975 reflected the world-wide economic recession, with B. F. Goodrich's sales particularly affected by declines in the construction and automotive industries.

In the 4 year period, 1971-1974, the company experienced increases in sales in all four major product groups. Through 1974, sales benefited principally from increased demand for and prices of chemicals and plastic materials, increased demand for radial tires and increased foreign operations. During the same period, however, B. F. Goodrich's growth was limited by several factors. Principal among these have been the discontinuance of certain operations, increased manufacturing costs for tires, and a protracted decline in demand for tires beginning in mid 1973.

In the products description that follows, the above mentioned factors and others are discussed more fully with respect to the growth pattern of each major product group.

Product Description - Tires and Related Products Group

This group is B. F. Goodrich's largest revenue contributor, generating 44.2% of total sales in 1976. Separately, the Tire Products division contributed 41.2% of sales, while the Related products division contributed only 3%. B. F. Goodrich is the fourth largest U. S. tire producer following Goodyear (#1), Firestone (#2) Uniroyal (#3) with approximately 9% of the market. The company supplies both the original equipment market through sales to automobile manufacturers and the replacement market through sales to company-operated retail stores, independent dealers, oil companies and fleets.

The replacement market accounts for approximately three-fourths of domestic tire revenues.

Sales growth of this division averaged 6.8% per year between 1966 and 1976 and exhibited positive year-to-year results for every year except 1967 and 1976. Both years were characterized by major strikes that severely reduced production and sales. In 1967, tires sales dropped 7.75 to \$411.0 million from \$445.4 million in 1966. In 1976 a 141-day strike by the United Rubber Workers Union shutdown all of the company's domestic tire plants and, together with the disposal of the company's Dutch subsidiary, depressed tire sales from \$900.5 million in 1975 to \$822.9 million, a decline of 8.6%.

In addition to 4 strike years (the other two had occurred in 1970 and 1973) the sales growth of this division was limited by several other factors:

- (a) the economic recessions of 1970 and 1975 limited sales growth to zero percent in 1970 and a small 1.8% increase in 1975.
- (b) the successful introduction of radical-ply tires by B. F. Goodrich in 1965 necessitated a huge modernization program (averaging about 12% of beginning gross plant between 1966 and 1969) to convert plants to the production of the new tire. The program in most plants, required the addition of new equipment. This meant inefficient operations in the short-run in a few plants and in one large plant a complete shutdown because its equipment was not susceptible to piecemeal conversion. During the years of conversion, which continued up to and including 1976, numerous tire

production lines came to a standstill and even after the changes had been completed, initial radical production was highly inefficient. By 1975 profitability improved sharply because of the diminished disruptions from conversion of facilities to radical production and the production of a more profitable product mix.

- (c) the decline in demand for tires for the first time in 23 years. For the tire industry as a whole shipments declined 14.1% in 1974 and 5.1% in 1975 (see Table 87). The depressed demand that actually began in mid-1973 can be attributed to two reasons. First, as a result of higher automobile operating costs, the growth in miles driven slowed considerably. Second, the same number of tires are capable of generating more mileage, primarily reflecting the shift to longer wearing radial. In addition, tire mileage-inhibiting trends such as heavier and more powerful cars and higher average traveling speeds were reversed.

Despite these factors suggesting a decline in B. F. Goodrich's tire shipments, the company's tire current dollar revenues continued to show positive growth through most of the late 1960's and early 1970's. This was due to higher prices, reflecting higher rubber costs and to a more profitable product mix.

B. F. Goodrich's Tire Related revenues consists of goods and services marketed through company-owned stores and dealers. These include automobile

TABLE 87
B. F. GOODRICH
INDUSTRY TIRE SHIPMENTS

(In Million of Units)

	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>
Passenger Car				
Replacement	141.3	142.0	123.5	123.0
Original Equipment	<u>51.3</u>	<u>56.0</u>	<u>43.3</u>	<u>39.4</u>
Total	<u>192.6</u>	<u>198.0</u>	<u>166.8</u>	<u>162.4</u>
Truck & Bus				
Replacement	19.9	22.7	21.2	19.8
Original Equipment	<u>12.6</u>	<u>13.5</u>	<u>11.8</u>	<u>8.1</u>
Total	<u>32.5</u>	<u>36.2</u>	<u>33.0</u>	<u>27.9</u>
Farm				
Replacement	3.0	3.6	4.0	3.5
Original Equipment	<u>1.6</u>	<u>1.9</u>	<u>2.1</u>	<u>2.0</u>
Total	<u>4.6</u>	<u>5.5</u>	<u>6.1</u>	<u>5.5</u>
Total	229.7	239.7	205.9	195.4

Source: Rubber Manufacturer's Association (Data exclude shipments by non-RMA members)

supplies, accessories and services as well as household appliances manufactured by others.

Product Description - Plastic Materials Group

The principal product of this group is polyvinyl chloride (PVC) resins and compounds of which B. F. Goodrich continues to be the largest U.S. producer. The company produces general purpose resins, specialty resins and special purpose compounds. The compounds are sold to producers of various end products, including automotive parts, wire and electrical insulation, vinyl siding and pipe. Specialty resins are used in upholstery, footwear, fabric coating, wall and floor coverings, weather stripping and adhesives. PVC accounts for 85-90% of this group's sales. The remaining products are polyurethanes used in fabric coatings, abrasion-resistant film and sheet, molded parts and adhesives; acrylonitrile-butadiene-styrene, a synthetic resin used in automotive parts, pipe and appliance; and synthetic latices used in fabric coatings and adhesives.

Sales growth for this group averaged an impressive 18.1 percent per year raising group's share of total from 10.2% in 1965 to 24.0% in 1976. Variation in percentage change from prior year's level however, ranged from a low of negative 17.7% in 1975 to a high of 60.2% in 1976.

As a result of an acquisition of a large foreign vinyl production plant and increased demand, group sales advanced 31.0% in 1972 from \$155.4 million in 1971 to \$203.6 million. In 1973, unit sales remained strong despite the reversal of a declining price trend that had helped to expand the plastic market through the 1960's. Production was at near capacity and approximated 1972 levels. While sales advanced 29.2% from \$203.6 million in 1972 to \$263 million in 1973, the 1974 group sales jumped a more impressive 38.0% to \$363 million. The

primary cause of this increase was the continued high demand for inventory build-up in the face of raw material shortages, a development which resulted in sharp increases in selling prices. By 1975, as the economy went through one of its worst recessions since the depression, sales plummeted. This was further complimented by customer inventory cut-backs following the previous year's buildup. In addition, a major customer, Certain-Teed, had brought its own plant into operations late in 1974. Sales dropped 17.7% in 1975 to \$298.6 million.

B. F. Goodrich sales of polyvinyl chloride plastics in 1976 advanced 60.2% to \$478.3 million. The company claimed that they had almost equalled the record volumes of 1973 and 1974. Increased automobile sales and a recovery in the construction industry were main contributors to the 1976 sales improvement.

Product Description - Chemicals and Man-Made Rubber Group

The products of this group are used internally in the production of tires and other products as well as externally as a source of supply to other manufacturers. Principal products include high-volume general purpose rubbers for tires and rubber bands and a wide variety of synthetic rubbers, used to enhance resistance to oxygen, ozone, weather and oil. This group also manufactures a line of compounding ingredients for plastic and rubber, including anti-oxidants, anti ozonants, accelerators and related ingredients.

The sales growth of this group averaged 8.5% per year from 1966 to 1976. Positive year-to-year sales gains were achieved for every year except the two recession years, 1970 and 1975. Reduced demand in the automobile industry was the primary contributor to the 1.3% and 6.3% sales drop in 1970 and 1975 respectively.

Large sales increases were experienced during the three year period, 1972-1974 and principally reflect increased demand. The initial (1972) sales jump of 22.2% from 130.1% million in 1971 to \$159.0 million is attributed to the consolidation of Ameripol, Inc., previously a 100%-owned subsidiary whose sales were not included in the company's reports.

Strikes by the United Rubber Workers Union had inhibited sales growth in 1967, 1970, and 1976 but due to increased demand and higher prices, did not materially affect 1973 sales.

Product Description - Industrial Transportation and Other Products Group

The most important products of this group are belting and hose. The group also produces braking systems for aircraft and trucks, film and sheeting packaging, industrial coated fabrics, industrial yarns, adhesives, gaskets, vinyl upholstery and wall coverings and aerospace products. An important function of this group is to develop new products and to enter new markets primarily by utilizing the basic research and technology of the company's Chemical and Plastics division.

Sales behavior for this group was characterized by wide fluctuations and growth averaged 4.2% per year from 1966 to 1976. The principal adverse impact on group sales can be traced back to the company's discontinuance of certain product lines and manufacturing operations. B. F. Goodrich's divestiture program began in 1971 after management had noted poor performances in certain line.

On the positive side, group sales benefited as a result of acquisitions made in 1969 and 1974, years when sales advanced 15.4% and 15.3% respectively.

TABLE 88
B. F. GOODRICH
Acquisitions and Divestitures, 1965-1976

<u>Year</u>	<u>Company or Business (Operating Group)</u>	<u>Action</u>
1965	Four Wheel Brake Service - Trucking Services (Tires and Related Products)	Acq.
1968	BFG-Australia Ltd. (Tires and Related Prod.)	Acq.
1968	BFG-C.S.R. Chemicals Ltd. Austria (Chemicals)	Acq.
1969	Motor Freight Corp. (Industrial Products)	Acq.
1969	Rayco (Tires and Related Products)	Div.
1969	Footwear Plant (Industrial Products)	Div.
1971	N. V. Rubberfabrick Vredestein-Dutch (Tires and Related Products)	Acq.
1971	Vinyl resin Plant (Plastics)	Div.
1971	Golf Ball Centers, Latex Catheters and Syringes - Plant (Industrial Products)	Div.
1971	Apache Ind. (Chemicals)	Acq.
1972	Vinyl Production - Plant (Plastics)	Acq.
1972	Acrolonitrile Plant	Div.
1972	R. F. Inc. (Industrial Products)	Acq.
1972	Ameripol, Inc. (Industrial Products)	Acq.
1972	Footwear Plant (Industrial Products)	Div.
1972	Motor Freight Corp. (Industrial Products)	Div.
1973	Sponge and Rubber Operations - 2 Plants (Industrial Products)	Div.

TABLE 88
Acquisitions and Divestitures, 1965-1976
(Continued)

<u>Year</u>	<u>Company or Business (Operating Group)</u>	<u>Action</u>
1974	Surgical Glove Plant (Industrial Products)	Div.
1974	Submarine Engineering Association, Inc. (Industrial Products)	Acq.
1975	Domestic Tire Plant (Tires & Related Products)	Div.
1975	Australia Tire Subsidiary	Div.
1976	Dutch Tire Subsidiary	Div.

The businesses and manufacturing operations that were affected appear in Table 88 where B. F. Goodrich's total divestiture and acquisition activities are listed.

Foreign Sales

The company's major foreign subsidiaries are B. F. Goodrich Canada (which typically contributes about one-third of foreign sales) and B. F. Goodrich Europe, with ten tire and industrial product plants in the Benelux countries. In addition, the company also operates chemical plants in Australia, Costa Rica, the Netherlands, New Zealand and Venezuela.

Unfortunately, foreign sales generated by these foreign operations are available only for a limited number of years and are presented in Table 89.

TABLE 89
B. F. GOODRICH FOREIGN SALES

<u>Year</u>	<u>Foreign Sales</u>	Percentage of <u>Total Sales</u>
	(In Millions of dollars)	
1971	\$ 250.2	19.2%
1972	\$ 372.0	24.7%
1973	\$ 459.7	27.7%
1974	\$ 564.2	28.7%
1975	\$ 558.5	29.4%
1976	\$ 520.3	26.1%

Estimated Sales Versus Reported Sales

Estimates of the value of shipments by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. B. F Goodrich had manufacturing operations with plants of 100 or more employees in 11 4-digit SIC industries during 1965 and 1968, 10 during 1972 and 9 during 1974 and 1976. This decrease in the number of SIC industries is attributable primarily to the divestiture program begun in 1971.

Since our estimated sales are based on domestic manufacturing plants, the appropriate measure to compare from Goodrich's reports is domestic sales plus net exports (exports minus imports). However, dollar figures for net exports and domestic sales figures for two years are not available. Consequently, presented in Table 90 are ratios of estimates to domestic sales for 1972, 1974 and 1976.¹

TABLE 90
B. F. GOODRICH RATIO OF ESTIMATED SALES TO
DOMESTIC SALES

<u>Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Estimated	\$ 667.6	\$ 878.8	\$ 1,099.8	\$ 1,390.5	\$ 1,604.9
Rep. Domestic	N/A	N/A	\$ 1,134.8	\$ 1,402.0	\$ 1,475.7
Ratio (Est/Rptd)			.97	.99	1.09

¹Although adjustments can not be made to account for net exports, the fairly large size of Goodrich's foreign sales by foreign subsidiaries (over 25% of total sales between 1972 and 1976) suggests that the relative importance of net exports in total sales is probably small.

Discrepancy Between Estimated and Reported - An Explanation

Our estimates are slightly below reported domestic sales for 1972 and 1974. For 1976, our estimate is 9% higher than reported domestic sales, and is attributable to the complete shut-down of Goodrich's tire operations during the 141-day United Rubber Workers Union strike. Recall that our estimates are based on the assumption implicit in our estimating procedure that each plant operates on its industry's average value of shipment per employee. This assumption necessarily implies that each plant experiences typical difficulties (strikes, start-up problems, etc.), associated with its industry. Hence, as was the case for Goodrich, if a plant or set of plants experienced greater difficulties than its industry's average, then our estimate of sales for the plant (or set of plants) can be greater than its actual value of shipment. Although the United Rubber Workers Union strike in 1976 was fairly industry-wide, production from non-struck tire plants allowed the industry to ship more units in 1976 than in 1975. Goodrich's shipment however decreased and was attributed to the fact that it was the only major manufacturer with all its tire plants on strike.

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of estimated sales of Goodrich's domestic manufacturing operations in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in table 91.

TABLE 91
B. F. GOODRICH SALES ESTIMATED AND GROWTH OF ESTIMATED SALES

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
In Current Dollars	\$ 667.6	\$ 878.8	\$ 1,099.8	\$ 1,490.5	\$ 1,604.9
(a) Index of (1965=100)	100	132	165	208	240
In Constant Dollar	\$ 693.6	\$ 850.6	\$ 989.1	\$ 984.5	\$ 951.9
(b) Index of (1965=100)	100	123	143	142	137
(c) = (a)/(b)	100	107	115	146	175

Line (a) is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for the company's domestic manufacturing activities. The divergence between the two growth paths is small for 1968 and 1972. For 1974 and 1976 the divergence increased substantially. This divergence pattern reflects an essentially flat pattern of price change during the early years and a rising pattern of changes in the later years.

The real growth pattern can be described in two ways: (1) our estimate of real growth - line (b) of Table BFG-6 and (2) the company's current dollar reported sales deflated by our estimated price index - line (c) of Table 91. In Table 92, Goodrich is reported domestic sales are deflated by our implicit price index.

TABLE 92

B. F. GOODRICH REPORTED DOMESTIC SALES

<u>Reported Domestic Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
			(In million of Dollars)		
In Current Dollars	N.A.	N.A.	\$ 1,134.8	\$ 1,402.0	\$ 1,475.7
(a) Index of (1972=100)			100	124	130
In Constant Dollars	-	-	\$ 986.8	\$ 960.3	\$ 843.3
(b) Index of (1972=100)			100	97	85

Line (a) is the growth pattern of reported domestic sales in current dollars.

Line (b) is Goodrich's reported real domestic sales growth pattern as derived from the deflation of reported domestic sales by our implicit price index.

To facilitate comparison, the two real growth patterns are presented together in Table 93.

TABLE 93

B. F. GOODRICH COMPARISON OF ESTIMATED TO REPORTED REAL SALES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	-	-	100	99	96
B) Index of Reported Real Sales (b)	-	-	100	97	85

(as deflated by our implicit price index)

(a) from line (b) of Table 91 but re-indexed to 1972=base year.

(b) from line (b) of Table 92.

Line (A) of Table 93 shows that real sales declined 4% over the 1972-1976 period while Line (B) shows that during the same period, real sales declined 15%. The sale cause of the discrepancies between line (A) and line (B) is that our estimated sale do not equal reported domestic sales for every year in our analysis. That is, if estimated sales exactly equal reported sales in current dollars, the two real growth patterns - line (A) and line (B) would be identical.

Referring back to Table 92, if we now make the assumption that our implicit price index accurately reflects Goodrich's actual composite selling price changes of all products included in its reported domestic sales, then the following statement can be made: whereas reported domestic sales on a current dollar basis grew 30% over the 1972-1976 period, physical volume or sales adjusted for inflation declined 15%.

W. R. GRACE

W. R. Grace was ranked 50th on the Fortune list of large industrial companies in the U.S. with sales of \$3.62 billion in 1976. In 1965 W. R. Grace had sales of \$1.00 billion. These sales, when, measured in current dollars, grew at a compound rate of 12.4% per year over the 1965-1976 period. During the past decade, Grace's management has transformed the company from a foundering natural resources, foods and shipping concern with operations principally in Latin America into an entirely different entity with diverse activities in chemicals, consumer products and certain natural resources. This major salvage operation has been effected largely through an aggressive corporate-wide acquisition and divestiture program.

Grace's diversification program began with the acquisitions of the Davison Chemical Corporation and Dewey and Almy Chemical Company in 1954. Its expansion into consumer products was extremely rapid during the late 1960's as it acquired businesses with such disparate lines as bubblegums, ice cream, pickles, seafood and fashionwear. This is evident from Appendix A which lists Grace's acquisitions and divestitures from 1965 to 1976 for foreign concerns as well as domestic concerns. In total, Grace had acquired over 100 domestic companies and subsequently sold 30 during the 12 year span.

As a result of Grace's active acquisition and divestiture program and the use of different accounting methods in consolidation, the reporting of distribution of sales has changed frequently. The number of categories has changed from time to time as well as occasional shifting of items from one group to another. Consequently, year-to-year comparisons of individual group's

sales were difficult to obtain. Nevertheless, Table 94 presents a reasonably realistic and fairly accurate measure of the importance and growth of the eight segments of Grace's business for the years 1967 through 1976. Comparable data for the years 1965 and 1966 were not available. As Table 94 reveals, there exist high variation in relative share of each group as well as high variation in year-to-year sales growth of each individual group. These variations are due largely to Grace's active acquisitions and divestitures of foreign and domestic companies. In an attempt to isolate some of these variations and to describe Grace more clearly, we were able to obtain (with minimal assumptions) domestic sales broken down into the same eight categories. Table 95 presents a fairly accurate picture of the importance and growth of the eight segments of Grace's domestic business for the years 1967 through 1976.

The eight groups are listed below along with their range in relative shares of both total sales and domestic sales since 1967.

<u>Group</u>	<u>Relative Share of Sales</u>			
	<u>World Wide</u>		<u>Domestic</u>	
Chemicals and Plastics	29.4	- 45.9%	26.8	- 32.9%
Agricultural Chemicals	12.2	- 21.8%	16.0	- 30.0%
Chemed & Figi	4.3	- 7.0%	6.7	- 9.8%
Restaurants	0.8	- 6.9%	0.0	- 5.9%
Foods	18.6	- 25.2%	1.5	- 25.3%
Consumers	0.0	- 22.6%	0.0	- 29.4%
Natural Resources	2.7	- 9.6%	0.0	- 4.1%
Steamship	0.0	- 6.5%	0.0	- 5.1%

TABLE 94

W. R. GRACE

DISTRIBUTION OF SALES
(In Millions)

	<u>Chem.</u> <u>Plastics</u>	<u>Agric.</u> <u>Chem.</u>	<u>Chem.</u>	<u>Rest-</u> <u>aurants</u>	<u>Foods</u>	<u>Con-</u> <u>sumers</u>	<u>Natural</u> <u>Resour.</u>	<u>Steam-</u> <u>ship</u>	<u>Disc.</u> <u>Act.</u>	<u>Total</u>
1965										\$1,003
1966										1,279
1967	\$ 502	\$343	\$ 68	\$ 19	\$391	\$ -	\$151	\$102	\$ -	\$1,576
1968	535	343	80	15	438	121	102	104	-	1,738
1969	583	334	90	15	407	161	117	85	-	1,792
1970	563	311	111	58	410	293	76	96	-	1,918
1971	615	280	124	80	464	398	68	20	-	2,049
1972	709	283	140	117	518	478	66	-	4	2,315
1973	246	363	164	189	585	582	77	-	2	2,808
1974	1,076	504	195	240	652	660	145	-	-	3,472
1975	1,085	515	219	100	657	797	156	-	-	3,529
1976	1,260	469	252	140	(1,079)		174	-	241	3,615

TABLE 95
W. R. GRACE
DOMESTIC DISTRIBUTION OF SALES
(In Millions)

	<u>World- Wide Sales</u>	<u>Dom. Sales</u>	<u>Chem. & Plas.</u>	<u>Agri. Chem.</u>	<u>Chemed</u>	<u>Rest.</u>	<u>Foods</u>	<u>Consu- mers</u>	<u>Nat. Res.</u>	<u>Steam- Ship</u>	<u>For. Sales</u>
1965	\$1,003	\$ 655	N/A	N/A	N/A	\$ -	N/A	\$ -	\$ -	N/A	\$ 348
1966	1,279	867	N/A	N/A	N/A	-	N/A	-	-	N/A	412
1967	1,576	1,008	332	302	68	-	255	-	-	51	568
1968	1,738	1,133	348	296	80	-	285	72	-	52	605
1969	1,792	1,125	363	301	90	-	221	107	-	43	667
1970	1,918	1,251	388	267	103	26	180	280	7	-	667
1971	2,049	1,374	400	246	115	36	204	349	24	-	675
1972	2,311	1,553	452	249	130	53	230	388	51	-	758
1973	2,806	1,835	508	319	153	65	257	474	59	-	971
1974	3,472	2,166	581	444	180	85	254	535	87	-	1,306
1975	3,529	2,297	615	453	204	100	184	646	95	-	1,232
1976	3,374	2,376	749	422	234	140	35	698	98	-	998

As Table 95 reveals, the breakdown of domestic sales exhibits similar variability in percentage share as well as in individual group sales growth as world-wide breakdown of sales. Growth in world-wide sales, excluding discontinued operations, averaged 12.2% per year with a high of 28% in 1967 and a low of negative 4% in 1976. Domestic sales growth averaged 12.5% per year with high of 18% in 1973 and 1974, and a low of negative 1% in 1969. Foreign sales growth averaged 11.3% per year with a high of 38% in 1967 and a low of negative 19% in 1976. Variation in these sales growth can be attributed to fluctuating business activity, price changes and most importantly to the numerous acquisitions and divestitures made by the company during this period. In the products description that follows, these factors will be examined with particular attention to the domestic segments, as this study is concerned with domestic manufacturing operations.

Product Description - Chemicals and Plastics Group

This group is Grace's largest revenue earner and comprises several divisions which, in 1976 accounted for about 35% of worldwide sales and about 70% of domestic sales. The principal products of this group include:

- (1) Inorganic Chemicals - A complete line of petroleum refining and petro-chemical catalysts is manufactured by the Davision Chemical division. Grace is one of the leading producers of fluid cracking catalysts and is a major factor in the market for automotive exhaust emission control catalysts and catalyst supports. In addition, Grace internationally produces a broad line of silica-based dessicants used as ingredients in paper coating, as processing aids in plastic moldings and as anticaking agents in powders.

- (2) **Construction Products** - This division manufactures and markets a varied line of building specialties including vermiculite and perlite for insulation and fireproofing, ingredients used in the manufacture of concrete, coatings and sealants for many construction applications and a line of coatings primarily for floor treatment.
- (3) **Plasticizer Alcohols and Resins** - The Hatco segment of this division is a major producer of alcohols for use in plasticizers. The Marco Chemical division produces reinforced, unsaturated polyester resins used in boats and automotive components. Also included in this division is a varied line of synthetic lubricants.
- (4) **Container Products** - Dewey and Almy produces a number of products such as can sealing compounds, flowed-in jar and crown seal gaskets and side seam cements. Other specialties include industrial and retail automotive chemicals, container coatings and gas absorbents.
- (5) **Organic Chemicals** - Dewey and Almy manufacture amino-acid based agents and sarcosine surfactants for use in detergents, cosmetics, agricultural chemicals and toothpaste. Other operations produce polyvinylidene chloride coatings for paper and plastic film; polyvinyl acetate emulsions for paint and adhesives; styrenbutadiene and other copolymers for textile treatment, carpet manufacturing and non-woven production; and polyelectrolyte dispersants.

- (6) **Automotive Products** - Grace is a leading producer of plastic operators to use in automotive and industrial lead-acid batteries. The company also produces specialty auto parts in Europe, U.K., France and Germany.
- (7) **Other Chemical Products** - The Polyfibron division markets photopolymer printing plate system. This process, which allows the direct production of plastic printing plates by photo-composition techniques, has application primarily in medium size printing operations. Specialty paper products are sold in U.S. and various types of packaging and specialty tapes are marketed in Italy and elsewhere in Europe. Grace also sells general purpose printing blankets to the offset printing industry.
- (8) **Plastics and Packaging** - The Cryovac Division is major world producer of saran and polyolefin shrink films and packaging systems. These materials are used to package many food products and other retail items. A major line is a system for packaging primal cuts of fresh meats for shipment from packaging houses to retail butchers and supermarkets.

In addition to the bags, Grace supplies sealing equipment. The company also manufactures vinyl films, molded plastic items, rigid plastic packaging systems and molded plastic office accessories.

World-wide sales growth of the Chemical and Plastics Group averaged 11% per year with a high of 27% growth in 1974, reflecting the economic

downturn of 1969/1970. Domestically, this group's sales growth averaged 9.6% per year and recorded positive advances for every year from 1967 through 1976. The impact of acquisitions and divestitures on domestic year-to-year results are listed in Table 96. As the Table reveals, Grace's acquisitions of domestic chemical and plastic companies began in 1954 and ended in 1972 with the majority of the acquisitions occurring before 1967.

TABLE 96
W. R. GRACE - CHEMICALS & PLASTICS
DOMESTIC ACQUISITIONS AND DIVESTITURES, 1967 - 1976
(Dollars in Millions)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales of Acquisition</u>
	<u>Prior to 1967 (Yr. Acq.)</u>		
	Dewey & Almy (54)	Rigid Containers & Sealing Compounds	N/A
	Davison Chemicals (54)	Catalysts	N/A
1968	Dawbarn Bros., Inc. (63)	Extruded Polyolefin Fibers	4.9
	Zonolite Co. (63)	Vermiculite & Other Insulating Material	11.1
	Elm Coated Fabrics (64)	Thin, Rigid Calendered Vinyl	8.1
	Hampshire Chemical Corp. (65)	Cheating Agents	3.3
	Southbridge Plastic Products	Calendered Vinyl Sheet	10.1
1972	Ideal Roller and Mfg. Co. (66)	Printing Press Rollers	7.9
	Southern Resin and Fiberglass (65)		N/A
	Concrete Products, Inc. (66)	Vermiculite	N/A

TABLE 96 (Continued)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales of Acquisitions</u>
	Transparent Paper Products	Flexible Packaging Metals	N/A
	Ellary Rubber CO., Inc. (66)	Vinyl Sheets	N/A
	<u>1967 Acquisitions</u>		
	Construction Chemicals Co., Inc.	Distributor	N/A
	Uniroyal, Inc. Polyester Operations	Polyester Resins	N/A
	Electrovert, Inc.	Construction Products Materials	N/A
	<u>1969 Acquisitions</u>		
1973	EMA Bond, Inc.	Electrolysis Solution Bonding	N/A
	Atlas Roof Deck, Inc.	Waterproofing Roofs	N/A
	E. W Zimmerman Construction Chemicals, Inc.	Distributor	0.9
	<u>1969 Acquisitions</u>		
	P.D.C. Industries Inc.	Plastic Bags, Marketing Services	3.0
	<u>1971 Acquisitions</u>		
	Jet Containers, Inc.	Plastic Tableware	2.6

N/A = Not Available

Product Description - Agricultural Chemicals Group

Principal products of this group includes ammonia and phosphatebased fertilizer materials. Grace's phosphatic fertilizer business is based on the company's mining operations in Florida. The ammonia fertilizer business is based on the company's production of ammonia which is derived from anhydrous ammonia. These products are marketed to retailers and farmers through company-owned distributions and formulation centers and through independent wholesalers. Other continuing operations of this group includes formulated pesticides, animal feed supplements and artificial insemination services. The company's American Breeders Service is the world's largest marketer of bull semen for dairy and beef cattle. The company was also in the farm and field seed business from 1965 to 1971. This business had contributed approximately \$45 million per year to consolidated sales during the 1965-1971 period.

Sales growth of the Agricultural Chemicals Group, both worldwide and domestically, averaged approximately 5% per year over the 1967-1976 period. The greatest increase in sales occurred in 1973 (28%) and 1974 (39%) and reflects largely the chemical price explosion that occurred as a result of the oil embargo in 1973. Similar to Allied Chemical's fertilizer business, the phenomenal growth in sales can be traced back to the shortage/inflation psychology of 1974-1975 which resulted in increased inventory accumulation and higher prices for fertilizer materials (see Allied Chemical Table 51).

The impact of acquisitions and divestitures on domestic year-to-year results are listed in Table 97. As the Table reveals, Grace's acquisitions of domestic agricultural chemical companies began in 1964 and continued strong until 1969. During this period, Grace had acquired 13 companies with combined

sales in excess of \$100 million. In 1970 and 1971, as a result of poor performance and a change in management's diversification strategies (towards consumer-oriented products), Grace divested 6 of these companies. In 1975, Grace resumed its activity in this area with the acquisition of Red Barn Chemicals, Inc., a wholesaler of fertilizers.

Product Description - Chemed Group

Chemed was incorporated in 1970 as a wholly-owned subsidiary of Grace to take over certain chemical businesses and commenced doing so as of April 30, 1971. In May 1971, Chemed made a public offering of approximately 4% of its outstanding shares.

Chemed is comprised of several divisions which in combination contributed 7% of world-wide sales and 9.8% of domestic sales in 1976. The Dubois Chemicals Division markets a wide variety of institutional and industrial cleaning compounds. Dishwashing and kitchen sanitation products, floor cleaning chemicals and industrial cleaning materials for applications such as paint spray booth maintenance and machinery cleaning are produced by this division. Chemed also markets total cleaning systems, including engineering and equipment services to industrial customers. Specialty cleaning products for the medical market are also produced by this division.

Chemed's Dearborn Division is the third largest supplier to the \$730 million market for water treatment chemicals (W. R. Grace estimate), with Grace accounting for about 9% of this market. In addition, Chemed supplies related engineering services through its Elson T. Killam and Duncan Lagnese subsidiaries and pollution monitoring devices through its Research Appliance Company Division. Its Cambridge Scientific Industries division sells water treatment monitoring devices and dispensing equipment.

TABLE 97
W. R. GRACE - AGRICULTURAL CHEMICALS
DOMESTIC ACQUISITIONS AND DIVESTITURES, 1967-1976
(Dollars in Millions)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales at Acquisition</u>
<u>Prior to 1967 (Yr. Acq.)</u>			
	Walnut Grove Prodcuts (64)	Animal Feed & Supplements	23.2
1970	Rudy-Patrick Seed Co. (65)	Farm Seed	33.3
	West Kentucky Liquified Fertilizer CO. (64)	Distributor Agr. Chem.	
	DeKalb Molasses Feed Co. (65)	Animal Feed and Supplement Mfg.	
	Farr Co. (66)	Beef Cattle Formula Feed Supplement Mfg.	
1970	Miller Products Co.	Seeds	
	Southwest Fertilizer & Chemical Company	Mixed Fertilizers & Pesticides	
<u>1967 Acquisitions</u>			
1971	Pfister Associated Gorwers, Inc.	Seed	
1971	Westport Feed & Grain Co., Inc.	Dealers	
1971	Nolfolk Grain & Feed Co., Inc.	Dealers	
	American Breeders Services, Inc.	Bull Semen	
<u>1969 Acquisitions</u>			
1971	D. B. Kibler, FLorida	Phosphate Rock Reserves	
	Standard Oil Company (N.J.) Fertilizer	Fertilizer Formulating Facilities	
<u>1975 Acquisitions</u>			
	Red Barn Chemicals, Inc.	Wholesaleing - Fertilizers	

In the medical products segment, Chemed markets special hospital germicides and cleansers. The Veratex Corporation (another Chemed operation) manufactures and distributes by direct mail disposable medical and dental products to the health care industry. Other Chemed businesses market medical equipment, clinical laboratory services and diagnostic services.

Other businesses of Chemed include Figi, a mail-order food marketer; Packard Shirt, Inc., a made-to-measure men's shirt manufacturer, selling both by direct mail and by independent salesmen (divested in 1974); and Rocket Pictures Co., Inc., a scientific movie producer. Chemed's domestic sales growth averaged 14.9% per year with positive advances in each year from 1967 through 1976.

Prior to 1970, Chemed's products were marketed solely in the U.S. From 1970 to 1976, Chemed's foreign sales accounted for approximately 7% of group's total sales. Domestically, Chemed's sales grew an averaged of 14.9% per year and experienced positive year-to-year advances for every year from 1967 through 1976. The impact of acquisitions and divestitures on year-to-year results are listed in Table 98. Between 1964 and 1970, Grace acquired a total of 13 companies in this area and subsequently divested 2 of them in 1974.

Product Description - Restaurants

Grace's entry into the Restaurant business took place in October of 1967 with the purchase of 51% of Jacques Borel, one of France's largest supplier of prepaid foods for canteens and operator of hamburger establishments in Paris and of a chain of highway eating places and motels. Through several small

TABLE 98
W. R. GRACE - CHEMED
ACQUISITIONS AND DIVESTITURES, 1967-1976

(Dollars in Millions)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales at Acquisitions</u>
	Prior to 1967		
	Du Bois Chemicals (64)	Industrial Cleaning Compound	37.2
	Dearborn Chemical Co. (65)	Water Treatment Chemicals	9.3
	The Veratex Corp. (65)	Medical Supplies	
	<u>1968 Acquisitions</u>		
	Figi's, Inc.	Mail Order Selling-Cheese	4.9
	Alron Products Co. Inc.		
	<u>1969 Acquisitions</u>		
1974	Packard Shirt, Inc.	Mail Order Shirts	
	Forrestal Chemicals, Inc.	Water Treatment	
	<u>1970 Acquisitions</u>		
1974	Rocket Pictures Co., Inc.	Scientific Movies	
	Bignal Dental Supply Co., Inc.	Dental Supplies	
	Cambridge Scientific Industries, Inc.	Control Systems	0.6
	Zipf Laboratories, Inc.	Clinical Laboratory	0.6
	Pathco, Inc.	Clinical Laboratory	0.0
	Elson T. Kilham Assoc., Inc.	Sanitary Engineers	2.4

acquisitions in Belgium, Germany, Italy, Portugal and Spain and with further purchase of Borel's stocks to 65% interest, sales of the foreign segment of the group rose from \$19 million in 1969 to \$155 million in 1974. In 1975, Grace reduced its ownership in Borel to a minority position.

Grace entered the domestic restaurant business in 1970 with the acquisition of Far West Services, Inc., a chain of family dinner houses and snack shops that specializes in a limited menu and fast service. In 1976, Grace acquired El Torito-la Fiesta, a restaurant chain concentrating in Mexican cuisine.

Product Description - Foods

Prior to late 1962, Grace's participation in the food industry was limited to a comparatively constant Latin American operation with annual sales in the \$25 - \$30 million range. Through an energetic acquisition program, this group has since become Grace's second largest. In 1967 this group accounted for almost 25% of corporate sales and despite many divestitures (mostly domestic companies) continued to contribute a high share of corporate revenue in 1975 (18.6%). Grace's first important acquisition in this area is Van Houten & Zoon (1962), a \$30 million plus Dutch chocolate company followed by the 1964 acquisitions of Ambrosia Chocolate Co. with sales of \$16.8 million. Numerous overseas and domestic acquisitions later brought into the company such disparate lines as beer brewing, various lines of chewing gums, candies, ice cream, soft drinks, frozen seafoods and pasta.

Sales growth on a world-wide basis averaged 7% per year and fluctuated usually in line with economic conditions. Domestically, sales growth averaged a negative 11.2% per year and reflects both the impact of economic conditions as well as divestitures. During the period of analysis, domestic operations consisted

of business involved primarily in a) chocolate and related products, candies and confectionaries, b) frozen processed seafoods and c) Nalley's and Morton Food's snack and convenience products. Aside from the short-lived (1966-1969) 53% interest in Miller Brewing Co., Grace's general strategy in the U.S. initially was to concentrate its expansion in the confectionary and convenience frozen food areas. According to management's estimates, based on government statistics, these markets were among the faster growing within the food industry during the 1960's. Candy, cookies and crackers, which took 2.9¢ of the grocery dollar (excluding non-foods) in 1960, increased slightly to 3.0¢ in 1970, while most non-essential food items dropped sharply during this period. Frozen foods, especially frozen vegetables, enjoyed increased per capital consumptions of 30%-45% over this same period and increased to 5.5¢ of the grocery dollar in 1970 from 5.1¢ in 1960.

A number of factors have been at work to keep total food industry volume growth behind that of the economy, and this led Grace to divest all of its domestic food operations by 1976, except for a small (\$35 million) chocolate operation. Although disposable personal income (in constant dollars) grew 4.2% annually during the 15 years ending 1970, annual expenditures for groceries increased by only 2.6%. Also, during the early 1970's the food industry experienced intense competition in all sectors and the situation was further aggravated by rising farm prices and retail price controls. Lastly, Grace was handicapped by not having a sufficiently large, diversified group of products with sufficient geographic concentration to allow it to appeal to the mass population necessary to be really successful in this business. These factors in combination, helped to keep profits from growing as rapidly as sales. (See Table 99).

TABLE 99
W. R. GRACE OPERATING DATA-FOODS (a)
(In Millions)

	<u>Pro Forma</u>			
	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>
Sales & Operating Revenues	\$ 518	\$ 585	\$ 652	\$ 657
% of Grace	22%	20%	19%	19%
Net Income from Operations	\$ 5.4	\$ 3.6	\$ (5.7)	9.3\$
% of Grace	6%	2%	(3%)	5%
Net Operating Margin	1.0%	.4%	(.9%)	1.4%

a) Data for domestic operations separately were not available.

The impact of acquisitions and divestitures on group's domestic year-to-year results are listed in Table 100.

TABLE 100
W. R. GRACE - FOODS
DOMESTIC ACQUISITIONS AND DIVESTITURES, 1967-1976
(Sales in Millions of Dollars)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales Acquired</u>
	<u>Prior to 1967 Year Acquired</u>		
1968	Van Houten & Zoon (1962)	Chocolate Confections	\$ 30.0
	Ambrosia Chocolate (1964)	Intermediates for Dairies, Bakeries	16.8
1975	Nalley's Inc., (1966)	Snack & Specialty Foods	38.6
1975	Leaf Brands, Inc. (1966)	Chewing Gum & Candy	18.9
1969	Miller Brewing Co. (57%) (1966)	Beer	99.0
	<u>1967 Acquisitoin</u>		
1976	Sea pak Corp.	Frozen Shrimp	26.9
	<u>1968 Acquisitions</u>		
1974	Pearson Candy Company	Candy	3.7
1972	Iner-Ammerican Foods, Inc.	Crab Meat	2.9
	<u>1970 Acquisitions</u>		
1974	Morton's Inc.	Spices, Snacks	N/A
1974	Fredonia Food Specialties Inc.,	Frozen Pizza	4.0
	<u>1971 Acquisitions</u>		
1974	Wayne Candies, Inc.	Candy	8.8
	<u>1972 Acquisitions</u>		
1976	Offshore Fisheries, Inc.	Frozen Fish	2.5

Production Description - Consumers Group

Grace entered the consumers field in 1968 with the acquisition of one foreign (Bekaert, Belgium) and 5 domestic companies (Joshua Meier, John Meyer, Florida Service Station, CITC Inc. and Golding Bros.). These companies had combined sales of \$121 million in 1968. Largely as a result of continued domestic acquisitions, group sales climbed to \$797 million in 1975 and measured in current dollars have advanced an average of 32.0% per year over the 1968-75 period. In every year, with the exception of 1974, Grace had acquired at least two companies. (See Table 101).

Principal products of this group can be classified into 3 basic categories: Fashion products, Leisure products and Education and Real Estate. Each category is described below. Fashion products - despite considerable effort to improve performance, these product lines, with one exception, have been a continuous problem for Grace. The mattress ticking business, in which Grace is an important factor in Europe, outperformed the other operations in this category. The major problem area had been John Meyer, a manufacturer of women's apparel. The women's apparel business is susceptible not only to economic influences, but also to abrupt fashion changes. Success in anticipating or reacting to these factors depends to a great extent on management's ability to rapidly alter both styles and marketing approach. Although considerable adjustments in both management and product line had been made to resolve the situation, Grace in 1975 finally divested John Meyer.

The company's footwear business consisted initially of a chain of men and women shoes retail stores, two imported footwear companies, and a manufacturer of women's shoes. The importing companies were never profitable and were sold in 1973. The retailing company was the only consistently

profitable operation and in recognition of this, Grace expanded the number of units from 31 in 1970 to 50 in 1976. Also included in this category is Lettise, a manufacturer of women's leather handbags.

Leisure products - businesses included in this category are: a retail sporting goods chain, toys wholesaling and retailing, automotive parts and accessories manufacturing and recreational vehicle manufacturing.

Education and Real Estate - educational products include distribution of trade books and school supplies primarily to colleges, schools and public libraries. In the real estate segment, Grace specializes in residential and commercial development.

In total, the Consumers group comprises a diverse set of activities of which only a few are manufacturing activities and of primary concern to this study. The only domestic manufacturing activity included here are the operations of the acquired companies marked with an asterisk in Table 101. Unfortunately, only limited data are provided by Grace with respect to pricing, volume growth and general strategy for these companies.

TABLE 101
W. R. GRACE - CONSUMERS
DOMESTIC ACQUISITIONS AND DIVESTITURES, 1968 -1976
(Sales in Millions of Dollars)

<u>Year Sold</u>	<u>Company Required</u>	<u>Business</u>	<u>Sales of Acquisition</u>
<u>1968 Acquisitions</u>			
	*Joshua Meier Co., Inc.	Office Furniture and and Supplies	\$ 3.8
1975	*John Meyer of Norwich	Women's Apparel	28.0
1972/ 1975	Florida Service Station	Real Estate	2.5
1973	CITC Inc.	Importer - Shoes	5.2
	*Golding Bros.	Mattress Ticking	50.0
<u>1969 Acquisitions</u>			
	*Lettise	Women's Leather Handbags	3.2
	Pix of America	Retailer of Men's and Women's Shoes	8.5
	*Recreatives, Inc.	All Terrain Vehicles	N/A
<u>1970 Acquisitions</u>			
	Lawrence Maid Footwear Inc.	Manufacturer of Women's Shoes	1.2
	Herman's World of Sporting Goods	Retailer of Sporting Goods	4.7
	*Fan Coach Inc.	Manufacturer of Mobile Homes	8.7
1974	F.A.O. Schwartz	Retailing - Toys	
	Baker & Taylor	Distributor - Books	75.6
<u>1971 Acquisitions</u>			
1973	Futura Inc.	Importer - Shoes	N/A
	Lachman-Rose Company	Wholesaling & Retailing Toys	10.3
	*Mr. Gasket	Specialty Auto Parts	N/A

TABLE 101 (Continued)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales of Acquisitions</u>
	<u>1971 Acquisitions (Continued)</u>		
	*Appliance Industries	Specialty Auto Parts	\$ 7.7
1975	*Shasta Industries	Mobile Homes	25.6
	The Elmex Corp.	Wholesaling - Toys	20.7
	Leonard Brooks Sporting Goods, Inc.	Retailing - Sporting Goods	3.1
	<u>1972 Acquisitions</u>		
	J.M.S. Distributors, Inc.	Retailing - Toys	N/A
	Pearce Mayer & Greer, Inc.	Real Estated	N/A
	Capital Sporting Goods, Inc.	Retailing - Sporting Goods	N/A
	*M.S.P. Industries	Specialty Auto Parts	N/A
	Mooney's Inc.	Retailing - Sporting Goods	0.7
	J. S. Latta and Son, Inc.	Distributor - School Supplies	5.4
	Meon Travel Ltd.	Travel Agency	N/A
	Gloucester New Communities Corp.	Real Estate	N/A
	<u>1973 Acquisitions</u>		
	*American Carry-Products Company Inc.	Auto Accessories	4.1
	Oprea Stores, Inc.	Retailing - Toys	N/A
	*Meritool Inc.	Auto Parts	N/A
	Rinker Corp. & Harker Development Corp.	Commercial Real Estate	8.1
	Atlas Companies	Retailing - Sporting Goods	3.6
	Wall Trading Corp.	Importer - Housewares	5.9
	W. R. Grace Proprieties Inc. (20% interest to 100%)	Real Estate	6.5

TABLE 101 (Continued)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales of Acquisition</u>
	<u>1975 Acquisitions</u>		
	Mead Education Services, Inc.	Distributor - School Supplies	\$ N/A
	Pensick & Gordon Inc.	Wholesaling - Toys & Hobbies	19.8
1976	International World Travel, Inc.	Travel Agency	N/A
	Mr. Phone	Sales Rep. - Auto Accessories	.9
	*Mallory Electric Corp.	Auto, Ignition Systems	4.0
	*Lakewood Industries Inc.	Specialty Auto Parts	.7
	A. S. Development, Inc.	Real Estate	
	<u>1976 Acquisitions</u>		
	Handy City Inc.	Retailing - Home Improvement Products	30.0
	Shepler's Inc.	Retailing - Leisure Apparel	22.1
	Drys Inc.	Retailing - Leisure Apparel	

Product Description - Natural Resources Group

Grace's natural resource activities prior to 1970 were centered principally in Latin America and Africa and consisted of subsidiaries that engaged in the production of crude oil and natural gas in Libya, mining operations and pulp and paper manufacturing in South America. The company's foreign investment in this field had decreased rapidly by 1968 as a result of foreign government - imposed restrictions and policies. Taxes on crude oil were increased to an effective rate of 75% and the rate of productions was limited substantially by the Libyan Government. In 1969 the Peruvian government expropriated the company's sugar properties, which provides an important raw material (bagasse) in the manufacture of paper. Beginning in 1970 the company diversified its natural resource activities geographically to include oil and gas exploration in the U.S. and Canada and mining in Vancouver Island British Columbia.

In 1972, prior to the Arab oil embargo, management decided to place heavy emphasis on developing its natural resource operations. The strategy was to concentrate investment in the energy sector and to do so on a low risk basis within the U.S. Prompted by a mandate from corporate headquarters, Grace's natural resource executives went on a three-year acquisitions spree. At the end of the three year period, Grace had acquired 17 energy related companies (see Table 102) and had set up 3 wholly-owned subsidiaries with combined worldwide sales of \$174 million, an increase of 264% over its 1972 level.

TABLE 102
W. R. GRACE - NATURAL RESOURCES
DOMESTIC ACQUISITIONS AND DIVESTITURES, 1967 - 1976
(Sales in Millions of Dollars)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales at Acquisitions</u>
<u>1971 Acquisitions</u>			
1975	Western Mines Limited 24% Interest	non-Ferrous Mining	\$ 6.1
<u>1972 Acquisitions</u>			
1975	Western Mine Limited +16% Interest	Non-Ferrous Mining	
	Voyager Petroleum, Ltd. 24% Interest	Oil & Gas	1.0
<u>1973 Acquisitions</u>			
	Clearly Petroleum Corp.	Oil & Gas	7.0
	Magness Petroleum Corp.	Oil & Gas	4.1
	Berry Gas Company	Gas	
	Cralco Petroleum Co.	Oil & Gas	
	Colowyo Coal Co.	Coal	
<u>1975 Acquisitions</u>			
	C. R. C. Company	Oil & Gas Reserves	
	Columbia Oil Corp.	Oil & Gas	0.3
	Redrock, Inc.	Oil & Gas	0.3
	Aminim Oil Company	Oil & Gas	
	Heradine Petroleum Co.	Oil & Gas	
	Bomac Exploration Co.	Oil & Gas	4.5
	Hoover & Bracken, Inc.	Oil Reserves	

TABLE 102 (Continued)

<u>Year Sold</u>	<u>Company Acquired</u>	<u>Business</u>	<u>Sales at Acquisitions</u>
	<u>Acquisitions (Continued)</u>		
	Bennet Productions Co.	Oil & Gas	
	Black Warrior Co.	Oil Reserves	
	Polumbus Corp.	Oil & Gas	
	Max Banks	Oil & Gas Reserves	
	Homco International, Inc.	Oil Services	

Estimated Sales Versus Reported Sales

Our estimates of sales by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. In total, Grace, had manufacturing operations with plant of 100 or more employees in 20 4-digit SIC industries.

Since our estimated sales are based on its operation of domestic manufacturing plants, it is necessary to compare our estimates of sales with Grace's reported domestic sales plus net manufactured exports but net of non-manufacturing activities, i.e., steamship operations and wholesaling and retailing operations. Unfortunately, as was mentioned earlier, we were unable to separate all of the non-manufacturing activities (agricultural retailing and wholesaling, consumer products wholesaling and retailing, Chemed's engineering services, etc.) from reported domestic sales and hence, we can expect our estimates to be lower than reported domestic sales.

Presented in Table 103 are ratios of our estimates to reported domestic sales minus Steamship and Restaurant Operations (1965 revenues from Steamship operations weren't available:

TABLE 103
W. R. GRACE RATIOS OF ESTIMATED TO REPORTED SALES

<u>Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Estimated	\$ 468.3	\$ 879.3	\$1,128.4	\$ 1,803.0	\$ 1,954.8
Reported	655.0	1,081.0	1,500.0	2,081.0	2,236.0
Ratio	.71	.81	.75	.87	.87

Our estimated sales are below reported sales for every year in our analysis.

Discrepancies Between Estimated and Reported - An Explanation

As mentioned above, our estimates of sales, which are based on domestic manufacturing plants and which correspond closely to domestic manufacturing productions, should necessarily be compared with reported domestic sales plus manufactured exports but net of non-manufacturing activities and net of foreign manufacturing imports. The ratios of our estimates to reported domestic sales will therefore differ from to the extent that these adjustments are not made. Although revenue of Grace's Restaurant and Steamship (except for 1965) were netted out in the comparisons above, many divers non-manufacturing activities nevertheless remain included in reported domestic sales.

On the opposite side, although exports of domestically manufactured products should be added to domestic sales in the ratios above, the lack of pertinent data prevented us from doing so. If Grace's exports were large relative to its non-manufacturing activities and foreign manufacturing imports, then the ratios of our estimates to domestic sales should exceed unity. However, this is not the case here because Grace's strategy for diversification, whether it be in the domestic market or the international market, was and continues to be the acquisition of companies. As the list of acquisitions and divestitures shows (presented in the appendix to this section), Grace had acquired over 25 foreign manufacturing concerns over the 1965-1976 period. This suggests that foreign production constitutes a large portion, if not the entirety, of foreign sales. In addition, the rapidly growing non-manufacturing activities which are included in Grace's reported domestic sales suggest that this segment, more likely than not, outweighs any manufacturing exports.

Consequently, the primary contributor to our estimates being lower than reported domestic sales is the inclusion of the rapidly growing non-manufacturing activities in the latter statistic. For the year 1965, Grace's Steamship operation was included in addition to the inclusion of the wholesale and retail distribution system of the Agricultural Chemical group in domestic reported sales.

Sales Growth in Current and Constant Dollars

Our Estimated sales and growth of estimated sales of Grace's domestic manufacturing operations in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are present in Table 104.

TABLE 104

W. R. GRACE ESTIMATED SALES AND GROWTH OF ESTIMATED SALES

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
In Constant Dollars	\$468.4	\$879.3	\$1,128.4	\$1,804.0	\$1,954.8
(a) Index (1965=100)	100	188	241	385	417
In Constant Dollars	\$476.3	\$875.3	\$1,042.8	\$1,185.9	\$1,077.1
(b) Index (1965=1000)	100	184	219	249	226
(c) = (a)/ (b)	100	102	110	155	185

Line (a) is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for the company's domestic manufacturing activities. The divergence between the two growth paths is small initially. Beginning in 1974, the divergence increased sub-

stantially. This divergence pattern reflects an essentially flat pattern of price change during the early years and a rising pattern of price changes in the later years.

The real growth pattern can be described in two ways: (1) our estimated of real growth - line (b) of Table 104 and (2) the company's current dollar reported domestic sales deflated by our implicit price index - line (c) of Table 104. In Table 105, Grace's reported domestic sales are deflated by our estimated price index.

TABEL 105

W. R. GRACE REPORTED DOMESTIC SALES

<u>Reported Domestic Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
			(In Millions of Dollars)		
In Current Dollars	\$655.0	\$1,081.0	\$1,500.0	\$2,081.0	\$ 2,236.0
(a) Index (1965=100)	100	165	229	318	341
In Constant Dollars	\$655.00	\$1,059.8	\$1,363.6	\$1,342.6	\$ 1,215.2
(b) Index (1965=100)	100	162	208	204	186

Line (a) is the growth pattern of reported domestic sales in current dollars. Line (b) is Grace's reported real domestic sales growth pattern as derived from the deflation of reported domestic sales by our implicit price index.

To facilitate comparison, the two real growth patterns are presented together in Tabel 106.

TABLE 106

W. R. GRACE COMPARISON OF ESTIMATED TO REPORTED REAL SALES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	184	219	249	226
B) Index of Reported Real Sales (b) (as deflated by our implicit price index)	100	162	208	204	186

(a) from line (b) of Table 104

(b) from line (b) of Table 105

Line (a) of Table 106 shows that real sales grew 126% over the 1965-1976 period while Line (b) shows that during the same period, real sales grew only 86%. The sole cause of the discrepancies between line (A) and line (B) is the fact that our estimated sales do not equal reported domestic sales for every year in our analysis. That is, if estimated sales exactly equalled reported sales, the two real growth patterns - line (A) and line (B) would be identical.

Referring back to Table 105, if we now make the assumption that our implicit price index accurately reflects Grace's actual composite selling price changes of all products and services included in its reported domestic sales, then the following statement can be made: Where-as reported domestic sales on a current dollar basis grew 241% over the 1965-1976 period, physical volume or sales adjusted for inflation rose only 86%.

APENDIX A

W. R. GRACE

<u>Year Sold</u>	<u>Company Acquired (Business) (Operating Equity)</u>	<u>Sales at Acquisitions (In Millions)</u>
<u>1976 Acquisitions</u>		
	El Torito-la Fiesta Restaurants, Inc. (Restaurants) (Consumer Services)	\$ 23.0
	Handy City, Inc. (Retailing-Home) Improve-Products (Specialty Retailing)	\$ 30.0
	Shepler's Inc.; Drys, Inc., (Retailing- Leisure Apparel) (Specialty Retailing)	22.1
	Jacques Borel Internal, France + 7% Int.	N.A.
<u>1975 Acquisitions</u>		
	Heradine Petroleum Co.; Great Plains Land CO. (Oil & Gas) (Teal)	N.A.
	Bomac Exploration Co. (Contract Driling)	4.5
	Hoover & Bracken, Inc. (Oil Reserves)	N.A.
	Bennett and Production Co. (Oil & Gas) Teal)	N.A.
	Black Warrior Co. (Oil Reserves) (Cleary)	N.A.
	Polumbus Corp. (Oil & Gas) (Natural Resources)	N.A.
	Max Banks (Oil & Gas) (Natural Resources)	N.A.
	Homco International, Inc. (Oil Service) (Natural Resources)	\$ 21.0
	C.R.C. Co. (Oil & Gas Reserves) (Cleary)	N.A.
	Columbia Oil Corp. (Oil & Gas) (Cleary)	0.3
	Redrock Inc. (Oil & Gas) (Cleary)	0.3
	Red Barn Chemicals, Inc. (Wholesaling - Fertilizers) (Ag. Chem.)	N.A.
	Amini Oil Company (Oil & Gas) (Cleary)	N.A.
	Mead Education Services, Inc. (Distributing - School Supplies) (Baker & Taylor)	N.A.

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisitions</u>
	Pensick & Gordon, Inc. (Wholesaling-Toys Hobbies) (Toy hobby Housewares)	\$ 19.8
	International World Travel Inc. (Travel Agency) (Grace Bros.)	N.A.
	Mr. Phone, Inc. (Sales Rep-Automotive Access.) (Mr. Gasket)	0.9
	Cav. Vito Basille & Filii S.A.R.L., Italy (Pasta) (Barilla)	N.A.
	Mallory Electric Corp. (Auto. Ignition Systems) (Mr. Gasket)	4.0
	A. S. Development, Inc. (Real Estate Development) (Grace Land)	N.A.
	<u>1973 Acquisitions</u>	
	Giovanni Voiello Molin e Pastifici A.R.L., Italy (Pasta) (Barilla)	N.A.
	American Carry-Products Company, Inc. (Auto. Access.) (Leisure Performance)	4.1
	Colowyo Coal Co. (Coal) Natural Resources	0.0
	Cralco petroleum Company (Oil & Gas)	N.A.
	Berry Gas Company (Gas)	N.A.
	Magness Petroleum Corp. (Oil & Gas)	4.1
	Spree Stores, Inc. (Retailing - Toys) (Elmex)	N.A.
	Cleary Petroleum Corp. (Oil & Gas) (natural Resources)	7.0
	Meritool, Inc. (Spare Auto Parts) (Appliance Industries)	N.A.

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisition</u>
	Rinker Corp. & Harker Development Corp. (Commercial Real Estate) (Grace Land)	\$ 8.1
	Atlas Companies (Retailing - Sporting Goods) (Herman's)	3.6
	Wall Trading Corp. (Importer - Housewares) (Toy Hobby Housewares)	5.9
	W. R. Grace Properties, Inc. 20% Interest (Real Estate Development)	6.5
	<u>1972 Acquisitions</u>	
	S.A.E.F., Italy (Pasta) Barilla)	N/A
	J.M.S. Distributors, Inc. (Retailing - Toys) (Elmex)	N/A
	Pearce Mayer & Greer, Inc. (Real Estated Development)	N/A
	Capital Sporting Goods, Inc. (Retailing - Sporting Goods) (Herman's)	N/A
	Voyager Petroleums, Ltd. 24% Interest (Oil & Gas)	1.0
	Christiaens, B.V. Belgium (Mattress Ticking) Bekaert)	N/A
	M.S.P. Industries (Specialty Auto Parts) (Automotive Products)	N/A
	GE. ME. AZ. - Cusin Alimentary S. P. A., Italy (Food) (Borel, Barilla)	N/A
	Mooney's Inc. (Retailing - Sporting Goods) (Herman's)	0.7
	Odenwald - Konserven G.m.b.H., West Germany (Chewing Gum) (Leaf)	N/A
	J. S. Latta and Son, Inc. (Distributing - Schools Supplies) (Educational Services)	5.4

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisition</u>
1975	Western Mines Ltd. + 16% Interest	\$ N/A
1976	Offshore Fisheries, Inc. (Frozen Fish) (Sea-Pak)	2.5
	Meon Travel Ltd. (Travel Agency) (Grace Travel)	N/A
	Gloucester New Communities Corp. (Real Estate) (Grace Proprieties)	N/A
	<u>1971 Acquisitions</u>	
1975	Shasta Industries (Mobile Homes) Recreational Vehicles)	25.6
	Mr. Gasket (Specialty Auto Parts)	N/A
1975	Western Mines Limited 24% Interest (Non-Ferrous Mining)	6.1
	Mr. Gasket (Specialty Auto Parts)	N/A
	Appliance Industries (Specialty Auto Parts) (Mr. Gasket)	7.7
1974	Jet Containers, Inc. (Plastic Tableware)	2.6
	The Elmex Corp. (Wholesaling - Toys) (Toy Hobby Housewares)	20.7
1974	Wayne Candies, Inc. (Candy) Grocery Products)	8.8
	Leonard Brooks Sporting Goods, Inc. (Retailing - Sporting Goods) Sporting Goods Division	3.1
	<u>1970 Acquisitions</u>	
	Barilla Co., Italy 80% Interest (Pasta)	75.0
	Elson T. Killam Assoc., Inc. (Sanitary Engineers) (Chemed)	2.4
	Lachman-Rose Company, Inc. (Wholesaling & Retailing - Toys) (Toy Hobby Housewares)	10.3

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisition</u>
<u>1970 Acquisitions (Continued)</u>		
1975	Fan Coach, Inc. (Mobile Homes) Recreational Vehicles	\$ 8.7
	Mibrassa, Brazil 50% Interest (Tin Mining) (Cesbra)	1.0
	Far West Services, Inc. (Restaurant Chain)	22.9
	Conflux S.p.A., Italy (Jams, Compotes) (Materne)	N/A
	Lawrence Maid Footwer, Inc. (Women's Shoes)	1.2
1973	Futura, Inc. (Shoe Importer)	N/A
	Herman's Sporting Goods, Inc. (Retailing - Sporting Goods)	4.7
1974	Morton's Inc. (Spices, Snacks) (Nalley's)	N/A
1974	Parent's Magazine, F.A.O. Schwartz (Retailing - Toys) (Toys Hobby Housewares)	75.6
1974	Rocket Pictures Co., Inc. (Scientific Movies) (Chemed)	N/A
	Bignal Dental Supply Company, Inc. (Dental Supplies) Chemed)	N/A
1974	Fredonia Food Specialties, Inc. (Frozen Pizza) (Grocery Products)	4.0
	Cambridge Scientific Industries, Inc. (Control Sytems) (Chemed)	0.6
	Zipf Laboratories, Inc. (Clinical Laboratory) (Chemed)	0.6
	Pathco, Inc. (Clinical Laboratory) (Chemed)	0.0
<u>1969 Acquisitions</u>		
	Bekaert S.A., Belgium (Mattress Ticking)	23.5
	Pix of America, Inc. (Retailing - shoes)	8.5
	Rollin S.A., France (Specialty Rubber Goods)	N/A

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisitions</u>
<u>1969 Acquisitions</u>		
1972	Recreatives, Inc. (All Terrain Vehicles) (Recreational Vehicles)	\$ N/A
1973	Salador Companies, France 78% Interest (Salad Oil and Soap)	23.1
1973	Hesselager Pyramide, Denmark (Ice Cream) (Urney, H.B.)	N/A
	Lettisse Inc. (Ladies' Handbags)	3.2
1974	Packard Shirt, Inc. (Mail Order Shirts (Chemed)	N/A
	Forrestal Chemicals, Inc. (Water Treatment (Chemed)	N/A
1971	D. B. Kibler, Florida - Phosphate Rock Reserves	N/A
	Solano Laboratories, Inc. (Plastic Bags, Marketing Services)	3.0
	Standard Oil Company (N.J.) Fertilizer Facilities (Fertilizer Formulating) (Ag. Chem.)	N/A
<u>1968 Acquisitions</u>		
1975	John Meyer of Norwich (Womens' Apparel) (Hatco)	28.0
1972/ 1975	Florida Service Stations, Inc. (Real Estate)	2.5
1973	CITC Inc. (Importer - Shoes)	5.2
1973	EM Abond, Inc. (Electrolysis Solution Bonding)	N/A
	Golding Bros. (Mattress Ticking, Furniture)	40.0
	Atlas Roof Deck, Inc. (Waterproofing Roofs)	N/A
	Figi's Inc. (Mail Order Selling - Specialty Foods (Chemical)	
	Alron Products Company Inc. (Chemed.)	

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisitions</u>
1974	Pearson Candy Company, Inc. (Candy) (Grocery Products)	\$ 3.7
1975	Welland Chemical of Canada Limited (aluminum Chloride) (Davison)	2.4
1972	Inter-American Foods, Inc. (Forzen Shrimp) (American Freezerships)	N/A
1972	American Freezerships, Inc. (Crab Meat) (Grocery Products)	2.9
	E. W. Zimmerman Construction Chemicals, Inc. (Distributor) (Construction Products)	0.9
1975	Restaurants Jacques Borel 51% Interest (Restaurants, Food Services)	16.0
	<u>1967 Acquisitions</u>	
1976	Sea-Pak Corp. (Frozen Shrimp) (Grocery Products)	26.9
	Mantequeras Arias A.A.,Spain (Daily Products)	N/A
	Construction Chemicals Co., Inc. (Distributor) (Construction Products)	N/A
	Pfister Associated Growers, Inc. (Seed) (Ag. Chem.)	15.1
1971	Westport Feed & Grain Co., Inc. (Dealers) (Ag. Chem.)	N/A
	Joshua Meier CO., Inc. (Stationery Products) Consumer	3.8
1975	Tanara S.p.A., Italy 80% Interest (Ice Cream)	6.7
	Materne Companies, France (Jams and Preserves)	8.3
1974	Rene Weil S.A.,France (Ore Trading)	N/A
	American Breeders Service, Inc. (Bull Semen) (Ag. Chem.0	N/A

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisition</u>
<u>1967 Acquisitions (Continued)</u>		
	Ochoa Fertilizer Co., Inc. Puerto Rico (Distributor) (Ag. Chem.)	\$ N/A
	Uniroyal, Inc., Polyester Operations (polyester Resins) (Hatco, Marco)	N/A
	Electrovert, Inc. (Constructions Product Materials) (Construction Products)	N/A
1975	Applied Decsion Systems, Inc. (Mgt. Science) (Recreational Vehicles)	N/A
<u>1966 Acquisitions</u>		
1975/ 1976	Leaf Brands, Inc. (Chewing Gum, Candy) (Grocery Products)	1.89
1969	Miller Brewing Co. 53% Interest (Beer)	99.0
1973	Marela, Ltd., U.K. (Pickles, Vinegar)	N/A
1972	Ideal Roller & Mfg. Co. (Printing Press Rollers) (Polyfibron)	7.9
	Ellay Rubber Company, Inc. (Vinyl Sheet) Hatco, Marco)	N/A
1975	Nalley's Inc. (Snack & Specialty Foods) (Grocery Products)	38.6
1971	Cresco Fertilizers, Ltd., Australia (Fertilizers) (Ag. Chem.)	12.6
	Transparent Paper Products Ltd., Canada (Flexible Packaging Metals) (Cryovac)	N/A
1967	Adretta-Weber & Bandow, West Germany (Vinyl Sheet)	6.0
1970	3 Latin American PVC Mfg. Businesses	N/A
1970	Alimentos Kern de Guatemala 80% Interest (Food)	N/A
	Concrete products, Inc. (Vermiculite) (Construction Products)	N/A

W. R. GRACE (Continued)

<u>Year Sold</u>	<u>Company Acquired (Business)</u>	<u>Sales at Acquisition</u>
	<u>1966 Acquisitions (Continued)</u>	
	Highley Plastics Ltd., Australia New Zealand (Adhesives, Sealants)	\$ N/A
1970	Miller Products Company (Pesticides) (Rudy-Patrick Seed)	N/A
	Southwest Fertilizer & Chemical Company (Mixed Fertilizers and Pesticides) (Ag. Chem.)	N/A
1973	Lucan Dairies Ltd., Hellerup/Solbjerg A/S (Ice Cream) (H.B., Urney)	N/A
	<u>1965 Acquisitions</u>	
	Eucan Holding Co., Ltd., U.K. (Investor in European Chem. Cos.)	7.4
	Southbridge Plastic Products (Vinyl Sheet) (Hatco)	10.1
	Hampshire Chemical Corp. (Chelating Agents)	3.3
	Teroson-Werke G.m.b.H., West Germany (Automotive Insulation, Sealants)	9.3
	The Veratex Corporation (Medical Supplies (Chemed))	N/A
1970	Rudy-Patrick Seed Co. (Seed) (Ag. Chem.)	33.3
	Southern Resin & Fiberglass Corporation (Marco, Hatco)	N/A

MINNESOTA MINING AND MANUFACTURING COMPANY

3M was ranked as the 53rd largest industrial corporation in the U.S. by Fortune Magazine with sales of \$3.52 billion in 1976. In 1965 3M had sales of \$100 billion, which when measured in current dollars grew at an average arithmetic rate of 12% per year over the 1965-1976 period. 3M manufactures and distributes many diverse items for industrial, commercial and consumer use in a broad variety of industries and markets. The company's product is dominated by items of a consumable nature. Even though many of 3M's markets are sensitive to economic change (and thus subject to demand fluctuations), the non-durable nature of most of its products tend to moderate the volatility stemming from cyclical changes in the economy.

3M is one of the United States' most widely diversified multinational enterprises, with products that are used in virtually every segment of the economy. It also is a highly integrated concern whose total operation is characterized by interrelated research, manufacturing, sales and service facilities and by products incorporating similar component materials and using related processes.

In its reports to stockholders, the company has traditionally classified sales into 6 broad product groups which have some degree of commonality in manufacturing or marketing characteristics. However, on several occasions, items have been shifted from one group to another and from time to time the total number of groups has been changed, thus breaking the continuity in year-to-year comparisons. In 1969 the company regrouped some of the products and classified sales into 5 broad categories. In 1970 the company regrouped and expanded the classification of sales into 6 categories again. In 1972 the

company expanded to 7 categories and in 1973 to 8 categories. In addition to the distortion created by regrouping, some distortion occurs because of the "rounding" to the nearest full percentage point in disclosing the annual breakdown of sales by major categories. With the aid of 5 year summaries of sales contained in its annual reports to stockholders, Table 107 below presents a reasonably accurate measure of the importance and growth of each segment of 3M's total business for the years 1967 through 1976. Comparable data for the years 1965 and 1966 were not available.

3M's diverse products are classified into 8 major groups. The groups are listed below along with their range of relative percentage share of total sales since 1967.

Group	Relative Share of Sales
	1967-1976
Graphic Systems	20-22%
Tape and Allied Products	15-18%
Abrasive, Adhesive, Building Service & Chemicals	15-17%
Advertising Services and Protective Products	12-13%
Photographing Printing and Nuclear	11-13%
Recording Material	9-11%
Electric Products	8-9 %
Health Care Products and Services	1-7 %

Consolidated sales growth averaged 12% per year with each year registering a positive gain over the prior year. The smallest gain was

TABLE 107

MINNESOTA MINING & MFG. CO.

DISTRIBUTION OF SALES
(In Millions of Dollars)

	<u>Graphic Systems</u>	<u>Tape & Allied Prod.</u>	<u>Building Svcs. Adhesives & Chem.</u>	<u>Advert. Svcs. & Prot. Prod.</u>	<u>Photo- graphic Print & Nuclear</u>	<u>Record. Mater.</u>	<u>Elect. Prod.</u>	<u>Health Care Prod. & Svcs.</u>	<u>Total</u>
1965	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	\$ 1,000.3
1966	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,152.6
1967	\$ 236.0	\$ 223.0	\$ 212.0	\$150.0	\$ 150.2	\$ 138.0	\$ 110.0	\$ 12.0	\$ 1,231.2
1968	290.0	232.0	232.0	174.0	189.0	145.0	116.0	27.0	1,405.0
1969	322.5	258.0	258.0	193.0	210.5	161.0	129.0	80.6	1,612.6
1970	365.0	270.0	257.0	200.0	218.0	155.0	138.0	84.3	1,687.3
1971	399.0	290.0	281.0	222.0	233.0	166.0	148.0	90.2	1,829.2
1972	450.0	325.0	330.0	270.0	250.0	211.0	169.0	109.1	2,114.1
1973	531.0	409.0	381.0	330.0	280.0	255.0	230.0	129.6	2,545.6
1974	617.0	470.0	441.0	352.0	323.0	294.0	264.0	176.0	2,937.0
1975	693.0	488.0	475.0	375.0	350.0	296.0	246.0	204.3	3,127.3
1976	738.0	570.0	554.0	422.0	387.0	316.0	281.0	246.0	3,514.0

registered in 1970 at 5%, followed by a 6% gain in 1975. Recessions in the U.S. domestic economy were the cause of slow growth for each of those years; domestic sales advanced zero percent in 1970 and 3% in 1975 while overseas sales advanced 13% and 12% respectively. Overall, the pattern of positive growth is attributable to internal expansions, acquisitions and expansion of foreign markets and are detailed below.

Acquisition Program

During the 1960's, management became aware that the traditional areas of 3M's business were maturing, in terms of both overall demand expansion and potential benefit from new product of development. Accordingly, 3M initiated a vigorous acquisition program which in concert with internal programs, was aimed at repositioning 3M's product lines. Typically, acquisitions have been small and designed to provide a foothold in new markets where 3M could complement its sales growth with its existing manufacturing and marketing capabilities. Table 108 lists 3M's acquisition from 1965 to 1976.

Despite the numerous acquisitions, the bulk of recent output still depends upon 3M's basic capability in coating and bonding. Major product lines include a variety of commercial and industrial tapes, coatings, sealers, adhesives, abrasives, magnetic tapes and coated copying papers. While the company has branched out into the plain paper copying and drug fields, these are primarily extensions of 3M's basic strength in coating and bonding.

TABLE 108
 MINNESOTA MINING & MFG. CO.
ACQUISITIONS, 1965-1976

<u>Date</u>	<u>Company</u>	<u>Business</u>	<u>Sales At Acquisition (In Thousands)</u>
1967	Cardiosonics Medical Instruments		N/A
1968	Burgress Cellulose Co.	Paper Specialties Mrg.	\$12,000
1968	Allied Colour Film Service, Ltd.		
1970	Automatic Alarm Corp.	Local Alarm Systems	45,700
1971	Call's Police Signal Corp.	Protective Alarm Systems	N/A
1971	Nekoosa Edwards Paper Co.	Carbonless Coating	N/A
1971	Triangle Connector Co., Inc.	Electrical Terminals & Connectors	N/A
1972	Broemmel Pharmaceuticals	Ophthalmic Preparations	N/A
1972	Adams Rite Manufacturing		N/A
1972	Phillipson Rod Co.	Fishing Rod Mfg.	N/A
1974	Jack Rabbit Company	Mail Order Film Processing	1,800
1974	International Medical Tech.	X-Ray Intensifying Screens	550
1974	Customs Materials, Inc.	Control and Elimination of Static Elect.	2,400
1974	Ferns Medical Corp.	Monitoring Electrodes for Medical Equip.	1,500
1974	Where, What, When Corp.	Information Directories	2,100

TABLE 108 (Continued)

<u>Date</u>	<u>Company</u>	<u>Business</u>	<u>Sales At Acquisition (In Thousands)</u>
1974	Conversion Chem. Corp.	Electroplating and Metal Treatment Chem.	N/A
1974	Kenvert International Corp.		\$ 1,800
1974	Carbonite Corp.	Graphite Shafts for Colf Clubs	2,500
1974	Select Systems, Inc.	Liquid Dispensing Equip.	1,300
1974	Automotive Analytical Labs.	Clinical Testings	2,100
1974	Datavision, Inc.	Character Generators for T.V.	750
1974	Polacout, Inc.	Rear Projection Screens	2,150
1975	RoBrid Corp.	Paper Binding Equipment	N/A
1975	Linolex Systems	Auto. Typing & Word Processing Equip.	4,200
1976	Zip, Change Letters, Inc.	Electrical Sign Comp.	1,357
1976	Meditec, Inc.	Prosthetic Joint Devices	660

Product Description - Graphic Systems Group

Graphic systems is 3M's largest revenue contributor, generating 21% of total sales in 1976. The most important products of this group include a wide variety of copy machines, papers, toners and other supplies for copying equipment. In its microfilm products, 3M produces input and output devices such as cameras to process films, units for transfer of computer output directly to microfilm and a variety of reader and reader/printers for microfilm output. In the visual products area, 3M manufactures a variety of overhead projectors and related transparency makers, films, and accessories designed for education, commercial and Government applications.

Sales growth of this group averaged about 15% per year from 1967 to 1976. Year-to-year sales gain was achieved in every year, both in the domestic market as well as the international market. Despite the 1969/70 and 1974/75 recessions, the Graphic Systems Group continued to register positive year-to-year advances. Most of the division's equipment line consists of less expensive, coated paper copiers which are typically purchased rather than leased. Sales of these units have done well during the recessions as customers reduced their leasing of plain copiers in an attempt to offset declining profitability. Coated paper sales have also remained strong. In addition, sale and lease of microfilm equipment and film have increased dramatically during the 1974/75 period of above normal inflation and declining profit margins. This is reflective of sharp acceleration of costs associated with paper output and data storage and transportation.

Strong advances in other years were achieved through new product introductions and were primarily due to active research developments, as dealt with elsewhere in this section.

Product Description - Tape and Allied Products Group

3M is a leading producer of pressure-sensitive tapes and tape-dispensing equipment. Most manufacturing and marketing functions in this group are handled by four divisions. The Consumer Products Division distributes consumer tapes and dispensing equipment, in addition to household adhesives, desk accessories, scouring pads, repellent sprays and sponges. The Industrial Tape Division sells a variety of tapes and associated equipment for industrial application, used principally for identification, masking and protection purposes. The Packaging Systems Division manufactures tape-dependent closure systems for containers and carton reinforcement. This division also manufactures gift wrapping products such as ribbons and dispensing machinery. The Commercial Tape Division manufactures transparent film, plastic and fibrous-backed pressure-sensitive tapes and related equipment, primarily to business offices. It also sells professional salon products, such as styling tape, hair style retainers and skin protectors; office items such as cleaners and dusting fabrics; a tarnish-preventive silver polish; and safety products, such as respirators and disposable masks.

Sales growth of this group averaged 9% per year and achieved positive advances every year since 1967 despite the two recessions during the period. A large portion of tape output is sold directly to the public, and because of the low cost non-durable nature of these products, this significant portion of its overall sales is typically less sensitive to economic fluctuations.

This segment of the company's business, however, is not without a significant element of economic cyclicality. The principal commercial market for this group's line of tape and dispensing equipment consist of a broad range

of packaging applications utilized in almost every sector of the developed economies of the world. During the 1969/70 recession, sales advanced 5% over the 1969 level and the advance is attributed to higher overseas sales. Toward year-end 1974, packaging activity in the U.S. dropped sharply (as shown in the Table 109 below), and sales climbed only 4% from \$470 million in 1974 to \$468 million in 1975.

TABLE 109
MINNESOTA MINING & MFG. CO.
INDEX OF PACKAGING ACTIVITY
(1967=100)

	<u>Index</u>	<u>% Change</u>
1971	113	N/A
1972	123	+9%
1973	136	+11
1974	131	-44%
1975	125	-5%

Source: Morgan-Grampion, Inc.

Product Description-Abrasives, Adhesives, Building Service and Chemicals

This group represents 3M's third largest source of revenues, accounting for 16% of total sales in 1976. 3M is one of the largest producers of coated abrasives which are used in conjunction with a number of backings, such as paper, fiber, metal and cloth for cutting, grinding, finishing and polishing. These products are distributed to end use customers such as automotive repair shops, consumer hardware and paint outlets, home improvement contractors as well as commercial customers. 3M is also one of the largest producers of

synthetic adhesives, manufactured from natural and synthetic rubber. These adhesives, manufactured from natural and synthetic adhesives, manufactured from natural and synthetic rubber. These adhesives are sold to almost all processing industries such as automotive, aerospace, paper, packaging, furnishings and construction industries. Because of manufacturing and marketing similarities, the division distributes a line of coatings and sealers as well. The Building Service and Cleaning Products Division manufactures and markets cleaning and finishing materials for consumer, institutional and industrial use.

Chemical operations are handled through two divisions. The Chemical Resources Division produces industrial chemicals and resins for both internal use in the production of adhesives and external sale to rubber fabricators. It also manufactures chrome oxide and sulfuric acids. The Commercial Chemicals Division manufactures finishes and sizings that provide materials with water, oil and soil repellency. It also sells elastomers and chemicals for use as solvents, and additives for polishes and waxes. In 1976, the division entered the agricultural field with a weed control product programs.

Sales growth of this group averaged 11% per year from 1967 through 1976. Although group sale remained essentially unchanged from \$258 million in 1969 to \$257 million in 1970, the domestic portion recorded a substantial decline, reflecting sharp cut-backs in Government funded aerospace.

Domestic demand for this group's products typically parallels that of the Tape and Allied Products Group. Low-density abrasives are sold primarily in consumer and building maintenance markets, and thus do not sharply reflect cyclical changes in the economy. Industrial abrasives and adhesives, on the other hand, are used by a variety of cyclical industries including the

automobile, paperboard, packaging and home furnishings industries. These markets remained strong throughout the early 70's until the end of 1974. Trends in packaging activity were examined above, and the following tables (Tables 110-112) summarize the changing patterns of paperboard production, furniture and fixture production and vehicle production. All three markets exhibited similar patterns of cyclical change.

Product Description-Advertising Services and Protective Products

This group comprises several divisions, which in combination contributed about 12% of total sales. The Traffic Control Division produces reflective tapes, sheetings and coatings for use in vehicular and pedestrian traffic control. Traffic control devices such as variable message, highway priority signing systems and optical systems to regulate visibility of highway signals are also manufactured by this group. The Industrial Mineral Products Division color coats granules for residential and other roofing shingles, forms granules for abrasive purposes, manufactures highway paving material, and produces polymers for use by wood fabricators. The Decorative Products Division manufactures films, vinyls, sheeting and associated products for use by the automotive, trucking, aircraft, mobile home and home furnishings industries for ornamentation, safety, identification and advertising purposes. The National Advertising Company is a wholly owned subsidiary offering out door signing services for use along highway and in metropolitan areas for general advertising and corporate identification purposes. Signs are owned by the company and leased to users.

Sales growth of this group averaged 13% per year from 1967 to 1976. Year-to-year increases were achieved through both internal expansion and acquisition. During the 1969/70 recession, sales slowed to a mere 4% increase

TABLE 110
 MINNESOTA MINING & MFG. CO.
Domestic Paperboard Production
 (000 short tons)

	<u>Amount</u>	<u>% Change from prior year</u>
1970	25,383	-4%
1971	26,136	+3%
1972	28,521	+9%
1973	29,460	+3%
1974	28,916	-2%
1975:		
1st quarter	5,634	-25%
2nd quarter	5,947	-23%
3rd quarter	6,265	-14%
4th quarter	6,830	+8%

Source: Federal Reserve Board

TABLE 111

MINNESOTA MINING & MFG. CO.

Furniture and FixturesFederal Reserve Board Index of Quantity Output

(1967=100)

	<u>Index</u>	<u>% Change</u>
1970	99.4	-7%
1971	102.1	+3%
1972	113.5	+11%
1973	126.1	+11%
1974	126.9	+1%
January	110.6	-11%
February	110.6	-12%
March	106.7	-16%
April	105.6	-17%
MAy	109.6	-15%
June	109.6	-16%

TABLE 112
MINNESOTA MINING & MFG. CO.
Worldwide Total Vehicle Production
(General Motors, Ford, Chrysler)

(000 units)

	<u>Units</u>	<u>% Change</u>
1970	12,629	
1971	15,494	+23%
1972	16,559	+7%
1973	18,107	+9%
1974	14,895	-18%
1975:		
1st quarter	2,911	-22%
2nd quarter	3,677	-12%

from \$193 million in 1969 to \$200 million in 1970. In 1974 and 1975 sales increased only 7%. The drop-off in residential and commercial construction combined with similar occurrences in the automobile, truck, mobile home and furniture industries contributed to declines in demand for roofing granules, films, vinyls and sheeting. A major drop-off in revenue was prevented however by the contractual nature of the advertising division.

Product Description-Photographic, Printing and Nuclear Products Group

This group comprises several divisions, which in combination contributed about 11% of 1976 consolidated sales.

The Photographic Products Division produces print and transparency films for amateur and professional use, with the bulk of sales made outside the United States. 3M entered the photographic business through acquisition of the Revere Camera Company (1960), Dynacolor Corporation (1963) and Ferrainia, S.P.A. (1964). Plagued by quality and operational problems, 3M in 1964/65 discontinued the Revere equipment line. This division also produces microfilm and associated processors and viewers; processor chemicals and papers; x-ray films and screens; and professional motion picture film. The Dynacolor Corporation and Allied Color Film Services Ltd., (Consolidated in 1968) operate a chain of film processing centers throughout the United States.

The Printing Products and Industrial Graphics Divisions manufacture and sell a broad line of products to the commercial printing industry and to industrial in-house printing operations. The most important products are pre-sensitized offset plates, plate processing machines and press and plate chemicals for lithographic printing. Other products include materials and plate-making systems (for letter press operations, and graphic arts films, pre-press proofing material and processing chemicals.

The Nuclear Department markets industrial products consisting principally of static eliminators and measuring devices, web and film cleaners, self-luminous objects, and electrically conductive plastics. In the medical field, 3M sells radio-pharmaceuticals (used for diagnostic work such as detection of blood clots, tumors, and lung diseases) and products for therapeutic and research applications. Although produced by the Nuclear Department these products are marketed through the Health Care Group.

Sales growth of this group averaged 15% per year from 1967 to 1976. Positive year-to-year advances were achieved through acquisitions and expansions into foreign markets. The slump in sales growth of 4% during the 1969/70 recession reflects a drop in domestic demand and difficulties in the photographic equipment lines. Growing overseas demand, however, prevented a drop in total group revenues. Beginning in the early 1970's, the photographic sector achieved better than expected results. At that time, (1) unprofitable photographic equipment lines were discontinued, (2) the amateur film products were improved and marketed more aggressively in foreign markets and (3) the coordination of domestic and international activities under the control of a single unit resulted in a greatly improved marketing effort for film products. Some of these benefits extended into the 1974/75 interval where group sales increased 15% in 1974 and 8% in 1975.

The broad line of products sold to the commercial printing field, however, experienced significant volume deteriorations beginning in late 1974, which became more severe as 1975 progressed. Because of the importance of business advertising, turning point in the demand for press and plate chemicals for lithographic printing, presensitized plates, graphic arts films and other products

marketed by this division generally lag the overall level of economic activity. As shown on Table 113 below, a major drop in sales was not experienced until the first half of 1975.

Product Description-Recording Materials

Products of this group are divided into four divisions whose combined sales contributed approximately 9% to 1976 consolidated sales. The Data Recording Products Division manufactures computer and instrumentation tapes, disk packs, and cartridges as well as digital cassettes and cartridges utilized principally in the data processing and instrumentation fields.

The Mincom Division make audio tape recorders for commercial and educational use. A variety of equipment is also sold principally for use with the tape products of other division including mechanical devices and components associated with audio, video and data recording equipment. The Alarm services Department of this division offers central alarm services for protection against crime and fire.

The Magnetic Audio/Video Products Division distributes blank tapes for transmittal of both sound and vision, with application in the movie and television fields, as well as in the home.

The Film and Allied Products Division manufactures a wide variety of synthetic backings which are sold internally in the manufacturing of many important 3M lines. Synthetic backings are sold principally to the packaging, electrical and medical markets.

Sales growth of this group averaged 9% per year from 1967 to 1976 but suffered somewhat in the past two recessions. Several factors were responsible for this occurrence. The overall weak demand for computer memory products and consumer audio tapes combined with the vertical integration of this group

TABLE 113
 MINNESOTA MINING & MFG. CO.
Printing and Publishing
Federal Reserve Board Index of Quantity Output
 (1967=100)

	<u>Index</u>	<u>% Change from prior year</u>
1970	104.1	-2%
1971	102.5	-2%
1972	107.9	+5%
1973	113.2	+5%
1974	112.3	-1%
1975:		
January	104.1	-6%
February	104.7	-6%
March	104.0	-6%
April	100.2	-10%
May	101.4	-9%
June	103.2	-8%
July	103.0	-9%

into the production of synthetic backing (used throughout 3M's tape, abrasive, amateur photographic film, microfilm, reflective sheeting, printing products and recording products lines) helped to hold down sales. That is, when demand for these end products dropped off during the two recessions, much of the loss in revenue were absorbed by the Film and Allied Products Division. In addition, the entrance of foreign competition into the audio tape market, which precipitated loss of market share and price competition, further weakened sales growth during the latter recession.

Product Description Electrical Products Group

This group is comprised of five divisions and is similar to the Recording Materials Group in that it produces a wide range of products in seemingly unrelated markets, products which are primarily dependent on the production and research in coating and bonding.

The Electronic Products Division sells an assortment of components to electronic equipment manufacturers. The division services are the computer and telecommunications industries with a package of assembly equipment, interconnecting cable systems and connectors, epoxy circuit material and protection tapes for use by printed circuit producers, and sells ceramic metalized packages to the microelectronics industry.

The Industrial Electrical Products Division distributes electrical products, principally to the electrical original equipment and motor repair markets. Among the principal products are electrical tapes used for holding, insulation and protection purposes; heavy insulations for high voltage, high temperature applications; foam resins for use on electrical components; and tubings utilized in electrical functions.

The Prehler Insulation Company (a wholly owned subsidiary) is a sales warehouse unit that distributes 3M's resins, tubings, adhesives, and electrical

and industrial tapes. The Electro-Products Division manufactures ground fault circuit interrupters, insulating and connector products used principally in the construction, utility and mining industries. The Technical Ceramics Division manufactures and sell ceramics, which are used in the electrical and mechanical areas.

Sales growth for this group averaged 9% per year from 1967 to 1976. Aided by the introduction of new products and acquisition, this group was able to achieve sporadic jumps in sales from time to time. Sales, however, were severely affected by the 1974/75 recession. Virtually all of its major markets suffered a sharp deterioration in demand, causing the group's revenues to fall 7% in 1975.

A primary market for 3M's electrical products is construction by public utilities, both electrical and telephone. As Table 114 indicates, these expenditures declined in 1975 due to a drop in domestic building activity.

3M's electrical products business also depends on residential and non-residential building activity, color television production and major appliance production. As the following tables (Table 114-116) indicate, each market dropped significantly in 1975.

TABLE 114
MINNESOTA MINING & MFG. CO.
Utility Construction Expenditure
(In billions)

	Electrical (a)		Telephone	
	<u>Amount</u>	<u>Change from Prior Year</u>	<u>Amount</u>	<u>Change from Prior Year</u>
1976	4.3	+5	12.6	+6
1975	4.1	-11	11.9	-6
1974	4.6	+5	12.6	+7
1973	4.4	+10	11.8	+11
1972	4.0	+8	10.6	+9
1971	3.7	+12	9.7	+8
1970	3.3	+9	9.0	+7

(a) for distribution only

Sources: "Electrical World" surveys; United States Independent Telephone Association.

TABLE 115
MINNESOTA MINING & MFG. CO.

New Construction Contrcts
(Million of Square Feet)

	<u>Residential</u>		<u>Non-Residential</u>	
	<u>Square Feet</u>	<u>Change from Prior Year</u>	<u>Square Feet</u>	<u>Change from Prior Year</u>
<u>1975</u>				
First Quarter	250	-42%	215	-30%
Second Quarter	428	-25	280	-24
Third Quarter	412	-4	272	-29
Fourth Quarter	<u>352</u>	+20	<u>227</u>	-17
Full Year	1,442	-15%	994	-25%
<u>1976</u>				
First Quarter	366	+46%	212	-1%
Second Quarter	515	+20%	276	-1
Third Quarter	523	+27	281	+3
Fourth Quarter	<u>405</u>	+15%	<u>235</u>	+4
Full Year	1,809	+26%	1,004	+1%

Source: Dodge Construction Potentials

TABLE 116
MINNESOTA MINING & MFG. CO.
Factory and Appliance Production

	<u>Color T. V. Factory Production</u>		<u>Major Appliance Production (a)</u>	
<u>1975</u>				
First Quarter	1,245	47%	22,266	-35%
Second Quarter	1,478	-36	23,769	-29
Third Quarter	1,761	-1	26,424	-15
Fourth Quarter	<u>1,734</u>	<u>+13</u>	<u>24,472</u>	<u>-10</u>
<u>1976</u>				
First Quarter	1,730	+39%	27,246	+9
Second Quarter	2,071	+40	25,605	+8
Third Quarter	2,126	+21	25,233	-5
Fourth Quarter	<u>2,173</u>	<u>+25</u>	<u>25,500</u>	<u>+4</u>
Full Year	8,100	+30%	25,900	+7%

(a) Seasonally adjusted annual rate

Sources: Electronic Industry Association and Association of Home Appliance Manufacturers.

Product Description-Health Care Products and Services

This group is 3M's smallest sales category contributing 7% of total sales in 1976. Riker Laboratories, acquired from Dart Industries in 1970, provides approximately 50% of group's sales. Principal pharmaceutical products include: 1) antiobesity drugs, 2) analgesics, 3) muscle relaxants, 4) bronchiodilators, and 5) antacids.

The non-drug products of this group is an outgrowth of the company's coating and bonding operations. Principal products originally included medical and surgical tapes. Through internal developments and numerous small acquisitions, the group had expanded its product line to include drapes and masks used in hospital operating procedures, diagnostic products, stethoscopes, skin enclosures, EKG pads for electrocardiogram procedures, transistorized electro-surgical cautery equipment, dental supplies such as plastic and metal temporary crowns; disposable tubing for anesthesiology and inhalation therapy, air driven instruments for bone cutting or drilling; fiber-optics systems; and electro-medical monitoring equipment and clinical laboratory analytical services.

The rapidly growing health care group was one of the few strong performers in the recessionary environment of 1975. Despite reduced benefits from acquisitions, revenues rose 16% from \$176 million in 1974 to \$204.3 million in 1975.

Foreign Sales

Table 117 presents the historical trend of sales separately for international sales including exports (except for 1976) and domestic sales for the years 1965 through 1976. International sales have grown on a current dollar basis an average of 16% per year while domestic sales have grown on an average of 10% per year. The proportion of foreign sales has increased steadily from 30% in 1965 to 43% in 1975.

TABLE 117
MINNESOTA MINING & MFG. CO.
BREAKDOWN OF INTERNATIONAL AND DOMESTIC SALES
(In Millions of Dollars)

	<u>International Sales</u> <u>(Including Exports)</u>	<u>Domestic</u> <u>Sales</u>	<u>Total</u> <u>Sales</u>
1965	\$ 300.1	\$ 700.2	\$ 1,000.3
1966	335.0	817.6	1,152.6
1967	375.0	856.2	1,231.2
1968	465.0	940.0	1,405.0
1969	535.0	1,077.6	1,612.6
1970	605.0	1,082.3	1,687.3
1971	675.0	1,154.2	1,829.2
1972	800.0	1,314.1	2,114.1
1973	1,005.0	1,540.6	2,545.6
1974	1,190.0	1,747.0	2,937.0
1975	1,330.0	1,797.3	3,127.3
1976	1,356.0*	2,158.0	3,514.0

*Does not include exports.

Estimated Sales Vs. Reported Sales

Our estimates of value of shipments by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. 3M had manufacturing operations with plants of 100 or more employees in 19 4-digit SIC industries during 1965 and 1968. The acquisition of Riker Laboratories in 1970 (about \$45 million in sales) and expansion of existing lines to the point where they would be reflected in the Marketing Key Plant's tabulations (plants with 100 or more employees) resulted in an increase in the number of 4-digit SIC industries to 21 in 1972, 22 in 1974 and 23 in 1976.

Since our estimated sales are based on domestic manufacturing plants with 100 employees, the most direct comparison is that between our estimates of sales and 3M's reported domestic sales plus net exports. Dollar figures for net exports are not available. However, according to annual reports this segment was small. These are about equal number of foreign facilities as there are domestic facilities producing the same product mix. Presented in Table 118 then, are ratios of our estimates to reported domestic sales.

TABLE 118
 MINNESOTA & MFG. CO.
Comparison of Estimated to Reported Sales

<u>Sales</u> (In Millions of Dollars)	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Estimated	\$ 630.0	\$ 803.9	\$ 1,037.6	\$ 1,310.3	\$ 1,647.4
Reported	<u>\$ 700.2</u>	<u>\$ 940.0</u>	<u>\$ 1,314.1</u>	<u>\$ 1,747.0</u>	<u>\$ 2,158.0</u>
Ratio	.90	.86	.79	.75	.76

Discrepancies Between Estimated and Reported An Explanation

Our estimated sales are below reported domestic sales for every year in our analysis. A primary contributor to underestimation is the fact that 3M's progress has stemmed mainly from the steady extension of its high level of coating and bonding technology into a broad range of products and the later extension of these lines into foreign markets. These high levels of production and technical expertise serves as basic elements for many 3M's end markets and as such necessitated small plant size in many of its division. Production of raw material is strategically located throughout the U.S. and distributed to the various divisions for final fabrication. This is suggested in a statement made by management in its 1977 annual report to stockholders - "The 3M of today is much larger than the 3M of yesterday, but in many ways, it is very much the same company: a growing number of small-to-medium-size businesses, specializing by market and run by teams of generally young management people who draw on one another's research, manufacturing and marketing capabilities to expand their own businesses and develop new ones." Further supporting this contention are management's acquisitions of relatively small companies (except for Riker Laboratories). In general and to the point, it appears that the underestimation of sales is due to the vast number of small plants (under 100 employees) in 3M's manufacturing operations which were not included in MET's data bank.

Through constant extension of activities based on a common technological and manufacturing expertise, 3M has expanded into a wide range of geographical and product markets which have enabled the company, in past business cycles, to sustain a record of steady sales growth. However through a combination of factors, 3M's diversification apparently wasn't much of a stabilizing influence in the 1974/75 recession.

a) In 1974, an important 41% of 3M's consolidated sales were generated outside the U.S. During past periods of worldwide economic decline, slowing activity has affected major economies at different intervals, usually preventing coincident demand deterioration in important markets. However, in 1975, growing business interdependence and the importance of common, negative outside influences caused the economies of the U.S. and other developed nations to show closer timing of business cycle swings.

b) The importance of massive inventory building and subsequent reduction had a pronounced effect upon 3M's production. Many of the company's products are easily storable and relatively inexpensive, while at the same time playing an integral role in customer manufacturing processes. Also, many lines depend upon raw materials, which during 1973-1974 were in short supply, causing concern as to their availability. Thus, numerous items produced by 3M were substantially overbrought by its customers. When deteriorating demand and the realization of the temporary nature of shortages precipitated inventory correction, 3M's order pattern experienced a sharp decline.

c) The Extended and severe nature of the 1974/75 recession caused demand deterioration in unrelated segments of economies to overlap. Typically, fluctuations in spending by consumers, businesses, and various levels of governments were more out of phase than they were during the 1974/75 downturn, and because 3M's products span all economic segments, diversification was no help in stabilizing sales growth.

On the supply side, a wide variety of materials are purchases from outside sources and, principally through expertise in coating and bonding technology,

are converted into products serving many divisions. The bulk of raw materials purchases falls into four categories: (1) structural, conductive and image-forming metals, (2) paper products, (3) natural and synthetic elastomers and (4) a variety of petro-chemical -based synthetics. With the expiration of price controls during the spring of 1974 and with the oil embargo in late 1973, prices of these materials increased substantially and adversely affected profit margins. Price hikes to customers were limited initially by controls but were passed on nonetheless by the middle of 1974.

3M's profit margin also squeezed by start-up expenses associated with the opening of 5 new plants and 2 laboratories in 1974 and 1975. Capital expenditures were cut during the 1970/71 recession, and as a result the pace of fixed asset additions slowed markedly during the 1971-1972 interval (see Table 119). As worldwide economic activity picked up, the company lacked necessary capacity to service peak demand in certain key businesses. Capital outlay increased 58% in 1973 followed by an enormous 85% jump in 1974. However, given the necessary time lag between budgeting , actual outlays, and facility start-up, the addition of new capacity had been out of phase with the 1974/75 downturn. In an effort to slow the squeeze on profits, 3M instituted a hiring freeze in mid-1974 and by late 1974 significant layoffs had been made. As a result, 1975 employee level was below 1973 level and 1976 level was only slightly above that of 1973.

TABLE 119
MINNESOTA MINING & MFG. CO.

Capital Expenditures

<u>Year</u>	<u>Capital Expenditures (In Millions)</u>
1968	\$ 97
1969	111
1970	131
1971	123
1972	114
1973	180
1974	333
1975	273
1976	152

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of estimated sales of 3M's domestic manufacturing productions in current and constant dollars are presented in Table 120.

TABLE 120

MINNESOTA MINING & MFG. CO.

Estimated Sales and Growth of Estimated Sales

Estimated (In Million of Dollars)	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$ 630.0	\$ 803.9	\$ 1,037.6	\$ 1,310.3	\$ 1,647.4
(a) Index (1965=100)	100	128	165	208	261
In Constant Dollars	\$ 657.4	\$ 793.0	\$ 937.1	\$ 969.0	\$ 1,034.0
(b) Index (1965=100)	100	121	143	147	157
(c) = (a)/(b)	100	106	115	141	166

Line (a) is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for the company's domestic manufacturing activities. The price index reveals that the divergence between our current and constant estimated growth patterns is small during the early years. For 1974 and 1976, the divergence between the two is significantly larger and reflects a period of increasing prices.

The real growth pattern can be described in two ways: (1) our estimated of real growth—line (b) of Table 120 and (2) the company's reported domestic sales deflated by our estimated company price index line (c) of Table 119. In Table 121, 3M's reported domestic sales are deflated by our estimated price index.

TABLE 21
MINNESOTA MINING & MFG. CO.

Reported Domestic Sales

<u>Reported Domestic Sales</u> (In Millions of Dollars)	<u>1965</u>	<u>1968</u>	<u>1973</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$ 700.2	\$ 940.0	\$ 1,314.1	\$ 1,747.0	\$ 2,158.0
(a) Index (1965=100)	100	134	188	250	308
In Constant Dollars	\$ 700.2	\$ 886.8	\$ 1,142.7	\$ 1,239.0	\$ 1,300.0
(b) Index (1965=100)	100	127	163	177	186

Line (a) of Table 121 is the growth pattern of reported domestic sales in current dollars. Line (b) is the growth pattern of reported domestic sales in constant dollars.

TABLE 122

MINNESOTA MINING & MFG. CO.

Comparison of Estimated to Reported Real Domestic Sales

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	121	143	147	157
B) Index of Reported Real Domestic Sales (b)	100	127	163	177	186

(a) from line (b) of Table 120

(b) from line (b) of Table 121

Line (A) of Table 122 shows that real sales grew 21%, 43%, 47% and 57% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. Line (B) on the other hand shows that real sales grew 27%, 63%, 77% and 86% over the same respective periods. Because the same price index was used to deflate current dollar series (estimated current dollar sales and reported domestic sales), the discrepancies between line (A) and line (B) of Table 122 can be attributed to the discrepancies between our estimated sales and reported domestic sales. That is, if estimated sales equal reported sales for each of the years under analysis, the two real growth patterns would be exactly identical.

Referring back to Table 121, if we assume that our implicit price index accurately reflects the company's domestic product price changes, then the following statement can be made: whereas reported domestic sales on a current dollar basis grew 208% over the 1965-1976 period, physical volume or sales adjusted for inflation grew only 86% over the same period.

TRW

TRW ranked as the 71st largest industrial company on the Fortune list with sales of \$2.93 billion in 1976. In 1965, sales were \$664.5 million and measured in current dollars have grown at an annual compound rate of 14.5%. TRW's acquisitions in the late 1960's greatly broadened the company's product line and contributed significantly to sales growth. As a result of acquisitions as well as internal developments, the composition of TRW's business has changed materially. Compared to the 52% of sales to the Government in 1962, U.S. military and space business in 1976 accounted for less than 20% of corporate revenues. During the 1970's, TRW's automotive operations have grown rapidly and about 11% of billings in 1976 emanate from its worldwide sales to General Motors and Ford Motor Company.

TRW's diverse products can be classified into 5 major product groups: Vehicle Components, Electronics and Computer-Based Services, Spacecraft and Propulsion Products, Fasteners, Tools and Bearings and Energy products and services. Vehicle components have accounted for between 27 and 20 percent of sales, electronics and computer-based services for between 24 and 29 percent, spacecraft and, propulsion products for between 10 and 20 percent, fasteners, tools and bearings for between 12 and 17 percent and energy products and services for between 7 and 12 percent of total sales.

Table 123 presents TRW's consolidated sales broken down into these 5 major categories for the years 1969-1976. Comparable breakdown for the 1965-1968 period was not available. For a clearer understanding of TRW's products and the importance of each segment, the Vehicle Components Group is further divided into (1) domestic car and truck products, (2) international car and truck

products and (3) replacement parts - car and truck. Table 123 reveals that reported sales growth averaged 15.3% per year from 1965 to 1976. Sales increases of 31% in 1966, 20% in 1967 and 43% in 1968 largely reflect the acquisitions of Scientific Electronics Products, Inc., United Carr, United Greenfield, Reda Pump and others. Table 124 lists acquisitions made by TRW from 1965 to 1976. As the table reveals, the majority of the companies were acquired between 1966 and 1968. Thereafter, TRW's acquisition program remained fairly dormant except for several small companies acquired during the 1970's. As a result of acquisitions and internal expansions, TRW has substantially increased its Vehicles Components share of corporate billings from 27% in 1969 to 40% in 1976 and its Energy Products - Services group from 7% in 1969 to 12% in 1976. Occurring simultaneously is TRW's increased dependency of its international markets from 12.9% in 1965 to 34.2% in 1965 to 21% in 1976.

Reported consolidated sales growth slowed to a crawl between 1969 and 1971 and reflects the impact of the 1969-1971 domestic economic contraction, the 1970 General Motors strike and the decline in TRW's Government business during that period. TRW's sales trend is discussed more fully below following a description of its 5 major product groups.

Product Description - Vehicle Components Group (Domestic, International and Replacement)

Components for automobiles, trucks, and off-the-road vehicles produced 28% of corporate revenues in 1969 and 40% in 1976. During the same period, the Domestic Vehicle components division contributed between 10 and 12% of corporate sales, the International Vehicle components divisions manufacture such products as valves, piston rings, steering gear and systems, suspension components and seatbelts. These products are sold as original equipment (OEM)

TABLE 123
TRW
SALES BREAKDOWN

	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
Domestic Car & Truck Products					158	140	168	208	246	273	252	318
International Car & Truck Products					166	213	217	291	427	452	499	561
Replacement Parts-Car and Truck					114	125	138	157	189	215	250	279
Electronics & Computer- Based Serv.					467	442	383	406	538	669	629	719
Spacecraft & Propulsion Products					308	310	-24	188	211	243	279	330
Fasteners, Tools & Bearings					263	233	228	261	320	357	331	359
Energy Products & Services					<u>112</u>	<u>122</u>	<u>129</u>	<u>177</u>	<u>234</u>	<u>277</u>	<u>346</u>	<u>363</u>
TOTAL SALES	<u>665</u>	<u>864</u>	<u>1,401</u>	<u>1,488</u>	<u>1,588</u>	<u>1,585</u>	<u>1,547</u>	<u>1,688</u>	<u>2,165</u>	<u>2,486</u>	<u>2,586</u>	<u>2,929</u>

TABLE 124
TRW
ACQUISITIONS, 1965-1976

<u>Year</u>	<u>Company</u>	<u>Business</u>	<u>Sales (a)</u>
1966	Scientific Electronic Products, Ind.	Quartz Crystal Mfg.	N/A
1967	Noblesville Castin	Iron Casting	\$ 5
1967	Globe Industries	Miniature Electric Motors	16
1967	Hazelton Labs	Environmental Health Research Service	7
1968	Mission Manufacturing	Petroleum Exploration & Equipment	21
1968	IRC	Resistors and Other Components	51
1968	United Carr	Connectors and Other Components	122
1968	BLW	German Producer of Automotive Valves	9
1968	United Greenfield	Industrial Cutting and Threading Tools	90
1969	Reda Pump, Inc.	Electrical Motors and Pumps	39
1969	Gregory Industries	Stud Welding	13
1970	Credit Data	Computerized Credit Reporting & Charge Authorization Services	10
1972	DeLeuw, Cather & Co.	Engineering Consulting Services	20
1974	Aertech Industries	Solid State Microwave Devices for Avionics and communications	N/A
1974	FDS/i Co.	Supplier of Teller Terminals Systems to Banks	N/A
1975	Vidar Company	Telephone Equipment	N/A
1976	Singer Co.	Computer Services	N/A

(a) In millions, and amount in year proceeding acquisitions.

automotive parts to automobile manufacturers. The Domestic division sells primarily to General Motors and Ford Motor Company. The International division sells primarily to Volkswagen, British Leyland, Renault and Fiat. The Company's Replacement division is concentrated principally in the U.S. and sells a broad line of engine and chassis components to automobile parts stores and other independent jobbers. Approximately 50% of this division's volume consists of sales of components manufactured by other producers, the other 50% consists of sales of products manufactured by TRW itself.

Sales growth for the Vehicle Components Group averaged 15.1% per year from 1969 to 1976. During this period annual sales growth of the International Division averaged 19.7% per year, the Domestic Division averaged 11.4% per year and the replacement division 13.7% per year. In the face of the domestic economic contraction of 1969/1971, automotive group sales jumped 9% in 1970 and 22% in 1971, which reflects the increase in sales of the International division of 28% in 1970 and 30% in 1971.

Group sales jumped 31% from \$656 million in 1972 to \$862 million in 1973. This jump was accompanied by a 47% increase for its International division from \$291 million in 1972 to \$427 million in 1973. The rapid expansion of the International division increased its percentage share of corporate revenues from 10% in 1969 to a high of 20% in 1973 and 19% in 1976. Improvements in foreign competitive position, consolidation of a foreign subsidiary (1970) and the acquisitions of a German automotive concern were cited as major factors.

Sales growth of both the International and Domestic Vehicles Components divisions depends heavily on the world-wide new-vehicle markets while replacement parts revenues depend on automobile travel and consumer disposable income. The 11% drop in sales of the Domestic division in 1970 corresponded to the sharp 20% drop in U.S. car production brought about by the

economic contraction and the General Motors strike. Sales of the Domestic division dropped 8% in 1975 to \$252 million from \$273 million in 1974. Although dollar sales of the Vehicle Components group advanced 9% in 1974 and 6% in 1975, worldwide automotive markets experienced their second successive year of lower production and is attributed to the most severe economic contraction since the depression of the 1930's and to double digit inflation.

Product Description - Electronics and Computer-Based Services

This group is TRW's second largest group, representing 25% of total company sales in 1976. Approximately 36% of this group's revenues represents components shipments, principally to telephone companies, computer manufacturers, automobile products and the government. More than 80% of these shipments represents connectors and electrical components, such as resistors and capacitors. The remaining 20% is comprised of electrical components such as transistors and integrated circuits.

The remaining 64% of this group's revenues comes from sales of computer services and software. Software for Government programs is the predominant product of this division and includes large products such as the Minuteman ICBM, Site Defense of Minuteman and antisubmarine warfare activities. Other aspects of this division include (1) software primarily for use by banks, for credit information on individuals, (2) the electronic systems sector which is involved in communications, guidance and navigational systems for defense and space projects, (3) the Financial Services Division which manufactures and markets teller terminal systems and credit authorization terminals for use by

banks, retail stores and airline ticketing personnel and (4) supervisory control systems for power generation and oil pipelines.

Sales growth for this group averaged 8.6% per year from 1969 to 1976. The group's sales declined 5% in 1970 from 1969 to \$442 million, and declined by 13% in 1971 from 1970 to \$383 million. The huge deterioration in demand in the consumer, computer, military and industrial electronic goods markets accounted for the 1970 and 1971 drops. With the general resurgence in the economy, group sales increased 6% to \$406 million in 1972 from 1971 and coupled with new government contracts sales advanced from 33% from \$406 million in 1972 to \$538 million in 1973. Total group revenue climbed 24% to \$669 million in 1974. However, \$45 million of the \$131 million year-to-year increase in sales was related to acquisitions (no separate data were available for the pooled companies and prior year data were not restated because the mergers were deemed immaterial compared to corporate totals). The economic downturn of 1974/1975 slowed corporate sales growth to 4% but depressed group sales by 6% from \$669 million in 1974 to \$629 million in 1975. The 1974/1975 recession differed from the earlier one in that the military market continued to expand. The recovery in 1976 combined with the acquisition of Singer's computer services advanced sales to \$719 million.

Product Description - Spacecraft and Propulsion Products Group

This group produces turbine and compressor airfoils, as well as fuel pumps for aircraft engines. Approximately 55% of the business derives from commercial billings, while 45% derives from military activity. This group's sales growth averaged 2.4% per year from 1969-1976.

The group also designs and manufactures unmanned spacecraft for defense, space exploration and communications, as well as components for space propulsion and altitude control.

Fluctuation in shipments is a function of changing military and commercial buying trends. Sales of missiles, aircraft parts, space satellites and related hardware are directly related to Defense and NASA procurement and indirectly to research and development spending. The depressed level of sales in the early 70's was a result of decreased Vietnam participation by the U.S. and a major drop in commercial aircraft production.

Product Description - Fasteners, Tools and Bearings

This segment accounted for 12% of corporate sales in 1976. In each of the three major segments, TRW's representation is a result of acquisitions during the 1960's. The largest of these was United Carr, whose major product lines include fasteners and indicator lights for automobiles, molding, plastic knobs and electrical switches for appliances, Palnut lock fasteners for furniture, Dot snap fasteners and attaching machinery for the apparel industry, and stud welding equipment for construction, automobiles and appliances. The automotive industry accounts for about 25% of United Carr's sales and the appliance and construction sectors are its next most important markets. TRW's United Greenfield division manufactures and sells hand tools and expandable cutting tools such as drills, taps and dies. These products are sold through independent distributors to a wide range of industrial users. The group's bearing subsidiary, Marlin-Rockwell, has been a part of TRW since the early 1960's. This division produces ballbearings for use in electric motors, machine tools and power transmission equipment, as well as for automotive and aircraft applications.

TABLE 125
TRW
GROUP SALES VERSUS FRB INDEX

(In Millions)

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>Average Annual Growth Rate 1971-1976</u>
Group sales	\$ 228	\$ 261	\$ 320	\$ 357	\$ 331	\$ 359	9.6%
Adjusted Sales (a)	\$ 230	\$ 261	\$ 315	\$ 330	\$ 281	\$ 289	4.7%
% Incr. (Decr.) from prior year	(5.7%)	13.5%	20.7%	4.8%	(14.8%)	2.8%	
FRB Index (b)	102.4	113.7	127.1	125.7	109.3	121.4	3.5%
% Incr. (Decr.) from prior year	0.1%	11.0%	11.8%	(1.1%)	(13.0%)	11.0%	

a) Total sales divided by the Department of Commerce implicit price deflator for durable goods consumption in each year (1972=100)

b) Production index for durable goods manufacturing (1967=100)

Sales of this group have reflected the cyclicity of the economy.

Product Description - Energy Products and Services Group

This group contributed 12% of TRW's sales in 1976. The largest unit is Reda Pump, which manufactures submergible, electrically driven, centrifugal pumps for oil field production and water pumping systems. The two other major operating companies in this group are Crescent Wire - Cable and Mission Manufacturing Company. Crescent produces insulated wire and cable for oil field use, as well as for the construction and utility industries. Mission's products are also aimed at the energy production market, with such products as expandable pump parts and valves.

DeLeuw Cather & Co. which was acquired in 1972 is also included in this group. It is a consulting firm that has concentrated on the field of transportation engineering.

Other products in this group include steam and gas turbine components, hydraulic motors and modular housing (divested in 1975).

This group's sales growth averaged from 1969 to 1976. The 37 and 32% increases in 1972 and 1973 reflects: (1) the general recovery of the economy, (2) the consolidation of two overseas companies, (3) a contract with Russia to supply oil pumps which was fulfilled in 1973 for about \$20 million and (4) initial full-year sales of about \$7 million housing units.

Post 1973 increases in sales are due mainly to increased demand for Reda's equipment caused by the leap in oil prices which led to an increase in secondary oil well recovery operations.

Foreign Sales

Table 126 below shows the historical trend of consolidated sales broken down by domestic sales and foreign sales. Foreign sales is further broken down into sales by foreign subsidiaries and exports (available only for the year 1971-1976).

Although foreign sales has increased faster (26.4% per year) than TRW's domestic sales (12.5% per year), it remains a minor fraction of total sales. The proportion of foreign sales has increased from a low of 12.5% in 1965 to 34.2% in 1976. Exports contributed between 8 and 16% of foreign sales and have grown approximately 42% per year since 1971. Sales by foreign subsidiaries have contributed between 84 and 92% of foreign sales and have grown at the slower pace of 18.4% per year.

Between 1969 and 1976 the International Car and Truck products division of the Vehicle Components group have accounted for an averaged 60.6% of foreign sales with a high of 68.4% in 1971 and a low of 56.0% in 1976.

Estimated Sales Versus Reported Sales

Our estimates of value of shipments by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. In total TRW had manufacturing operations with plants of 100 or more employees in 18 4-digit SIC industries during 1965, 25 during 1968 and 1972, and 26 during 1974 and 1976. The increase in the number of SIC industries came about mainly through acquisitions of other companies (see Table 124). The increase from 18 to 25 in the number of SIC industries between 1965 and 1968 is a result of acquisitions made during the same period. The increase from 25 to 26 between 1972 and 1974 reflects the expansion of a small steel fabricating foundry plant acquired in 1972.

Since our estimated sales are based on domestic manufacturing plants, it is appropriate that we compare our estimates of sales with TRW's domestic manufacturing sales. Domestic manufacturing sales is the sum of sales to the domestic market and to foreign markets of domestically manufactured products. That is, referring to Table 126, it is the sum of TRW's domestic sales and export sales (presented in column f of Table 126). For the two years, 1965 and 1968, our estimates of sales are compared with reported domestic sales because data on domestic manufacturing sales were not available. The ratios of our estimates to domestic sales (1965 and 1968) and the ratios of our estimates to domestic manufacturing sales (1972, 1974 and 1976) are as follows:

<u>Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions)				
Estimated	\$ 788.0	\$ 1,097.5	\$ 1,335.0	\$ 1,643.0	\$ 2,113.1
Reported	<u>\$ 579.0</u>	<u>\$ 1,285.0</u>	<u>\$ 1,272.0</u>	<u>\$ 1,777.0</u>	<u>\$ 2,091.0</u>
Ratio (Est./ Rptd.)	1.36	.85	1.05	.92	1.01

The ratio of estimate sales to reported sales averaged 1.038 for the 5 years. For 1965, 1972 and 1976, our estimates are above reported sales. For 1968 and 1974, our estimates are below reported sales.

TABLE 126

TRW

BREAKDOWN OF FOREIGN AND DOMESTIC SALES
(In Millions)

	(a) <u>World-Wide Sales</u>	(b) <u>Inter'l Sales</u>	(c) <u>% of Total</u>	(c) <u>Domestic Sales</u>	(c) <u>% of Total</u>	(d) <u>Sales by Foreign Subsid.</u>	(e) <u>Exports</u>	(f) <u>Domestic Manuf. Sales</u>
1965	665	86	12.9%	579	87.1%	N/A	N/A	N/A
1966	864	150	17.4	714	82.6	N/A	N/A	N/A
1967	1,041	168	16.1	873	83.9	N/A	N/A	N/A
1968	1,488	203	13.6	1,285	86.4	N/A	N/A	N/A
1969	1,588	278	17.5	1,310	82.5	N/A	N/A	N/A
1970	1,585	345	21.8	1,240	78.2	N/A	N/A	N/A
1971	1,547	405	26.2	1,142	73.8	375	30	1,172
1972	1,688	453	26.8	1,235	73.2	416	37	1,272
1973	2,165	687	31.7	1,478	68.3	616	71	1,549
1974	2,486	802	32.3	1,684	67.7	709	93	1,777
1975	2,586	888	34.3	1,698	65.7	763	125	1,823
1976	2,929	1,001	34.2	1,928	65.8	838	163	2,091
Avg. Annual Growth	15.3%	26.4%		12.5%		18.4%	42.0%	

Discrepancies Between Estimated and Reported - An Explanation

The greatest discrepancies between our estimated figures and reported figures occurred for 1965 (36%) and 1968 (15%). These discrepancies are difficult to reconcile because only a limited amount of reported information are available for these years. Two possible factors can be mentioned as possible explanations of three discrepancies. First, the discrepancies for 1965 and 1968 might possibly be attributable to the higher ratio of government sales to total sales in those years. Table 127 below shows the historical trend of government sales as a percentage of total sales.

TABLE 127

TRW HISTORICAL TREND OF GOVERNMENT SALES
(In Millions)

	<u>Total Sales</u>	<u>Government Sales</u>	<u>% of Total Sales</u>
1965	665	314	47%
1966	864	414	48%
1967	1,041	514	49%
1968	1,488	579	39%
1969	1,588	571	36%
1970	1,585	513	32%
1971	1,547	388	25%
1972	1,688	368	22%
1973	2,165	463	21%
1974	2,486	478	19%
1975	2,586	575	33%
1976	2,929	616	31%

In 1965 and 1968, government sales as a percentage of total sales were 47 and 39% respectively as compared to 22% in 1972, 19% in 1974 and 21% in 1976.

Products produced for the government, especially missiles, aircraft components, space satellites and related hardware usually are produced under long-term contracts and hence tend to subject the company to a more erratic accumulation of inventories in the form of "work in process" as opposed to "raw material and supplies". Unfortunately, data on "work in process" inventories were not available for these early years, but it is suspected that in 1965 it was high. A high level of inventory accumulation can reflect greater discrepancy between production and sales while a low level of inventory accumulation would yield a closer relationship between production and sales. Furthermore, inventories of a prior year sold during the current year can also contribute to the distortion of the relationship between production and sales of the current year if current inventory accumulation differed from prior year inventories. For 1968, in which our estimates of sales is 15% below reported sales, the possible explanation here is that the discrepancy occurred because current sales consisted of current production plus previous years' inventories.

The second possible explanation for the 1965 and 1969 discrepancies is that our estimates for these years are compared with domestic sales as opposed to domestic manufacturing production. As mentioned earlier, domestic manufacturing production includes exports which were not available for these two years. Consequently the non-addition of export sales to domestic sales will also contribute to the 1965 and 1968 discrepancies.

Discrepancies between our estimated sales and reported domestic manufacturing sale in the latter years are attributable to a different set of factors. Recall that our estimates of sales are based on the assumption implicit in our estimating procedure that all manufacturing plants operate at their respective industry's average value of shipments per employee. This assumption necessarily implies (among other things) that each plant faces the same exact difficulties and restrictions as any other plant in the same industry. Consequently, if a plant or a set of plants of TRW experiences difficulties or restriction greater (or less) than what is typical of the industry, then we can expect our estimates to be greater (or less) than reported domestic manufacturing productions. In the following general discussion on TRW's development, two such difficulties are mentioned. They are: (1) production problems and (2) fixed-price contract.

During the period of analysis, TRW's sales growth was slowed because of several developments: 1) TRW and other bearing producers had lost major market shares to imports due to pricing disparities especially vis-a-vis the yen (Japanese companies accounted for 55% of the \$150 million in bearing imports in 1972). Despite import restrictions imposed on Japanese bearings in 1974 and 1975 and the 1973 monetary revaluations, TRW continued to lose sales to Japanese competitors. 2) TRW's United Greenfield tools subsidiary had suffered major production problems that resulted in the closing of two plants and their replacement with a large plant in 1974, a plant having unanticipated start-up problems that lasted beyond 1976. 3) Because of low productivity and underpriced contracts, losses were incurred in the Spacecraft and Propulsion group during 1973 and 1974 and only a modest positive earnings

was recorded in 1975. The resurgence in turbine blade business from the depressed 1971-1972 levels led to the need to retain many new employees. Deliveries of turbine and compressor blades/vanes during the early 1970's to Pratt and Whitney of United Technologies were covered by fixed-price contracts that did not anticipate double digit inflation. This situation forced TRW to absorb higher-than-expected expenses which kept that operation in the red until late 1975. 4) The fuel crisis that had developed in late 1973 led to less automotive travel, lower new car production and to a shift toward smaller engines, all of which hampered 1974 sales of the Replacement Components division as well as OEM market.

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of estimated sales of TRW's domestic manufacturing production in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in Table 128.

TABLE 128

TRW ESTIMATED SALES AND GROWTH OF ESTIMATED SALES

<u>Estimated Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(In Millions of Dollars)				
In Current Dollars	\$ 788.8	\$ 1,097.5	\$ 1,335.0	\$ 1,643.0	\$ 2,113.1
(a) Index of (1965=100)	100	139	169	208	268
In Constant Dollars	\$ 817.0	\$ 1,068.9	\$ 1,154.5	\$ 1,200.5	\$ 1,330.7
(b) Index of (1965=100)	100	131	141	147	163
(c) = (a) / (b)	100	106	120	141	164

Line (a) of Table 128 is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for TRW's domestic manufacturing production. During the early years, the divergence between the two growth patterns is relatively small and reflects an essentially flat pattern of price change. With the expiration of Federal price controls, the divergence between two growth patterns increased significantly in the later years and reflects on increasing pattern of price change.

The real growth pattern can be described in two ways: (1) our estimate of real growth - line (b) of Table 128 and (2) the company's current dollar reported domestic manufacturing production deflated by our estimated company price index - line (c) of Table 128. Because domestic manufacturing production is available for only three years, the second description of real sales growth will be in terms of domestic sales instead. In Table 129, TRW's reported domestic sales are deflated by our estimated price index.

TABLE 129

TRW REPORTED DOMESTIC SALES

<u>Reported Domestic Sales</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
	(Millions of Dollars)				
In Current Dollars	\$ 579.0	\$ 1,285.0	\$ 1,235.0	\$ 1,684.0	\$ 1,928.0
(a) Index of (1965=100)	100	222	213	291	333
In Constant Dollars	\$ 579.0	\$ 1,212.3	\$ 1,029.2	\$ 1,194.3	\$ 1,175.6
(b) Index of (1965=100)	100	209	178	206	203

Line (a) of Table 129 is the growth pattern of reported domestic sales in current dollars. Line (b) is the growth pattern of reported domestic sales in constant dollars.

To facilitate comparison, the two real growth patterns are presented together in Table 130.

TABLE 130

TRW COMPARISON OF ESTIMATED TO REPORTED REAL DOMESTIC SALES

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	131	141	147	163
B) Index of Reported Real Domestic Sales (b)	100	209	178	206	203

(a) from line (b) of Table 128.

(b) from line (b) of Table 129.

Line (A) of Table 130 shows that real sales grew 31%, 41%, 47% and 63% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively, Line (B) on the other hand shows that real sales grew 109%, 78%, 106%, and 103% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. Because the same price index was used to deflate current dollar series (estimated current dollars sales and reported domestic sales), the discrepancies between line (A) and Line (B) of Table 130 can be attributed to discrepancies between our estimated sales and reported domestic sales. That is, if estimated sales equal reported domestic sales for each of the 5 years under analysis, the two real growth patterns - line (A) and line (B) would be identical.

Referring back to Table 129, if we make the assumption that our implicit price index accurately reflects the company's actual composite price changes of all products sold in its domestic markets, then we can make the following observation: Whereas reported domestic sales on a current dollar basis grew 233% over the 1965-1976 period, physical volume of sales adjusted for price changes grew only 103% over the same period.

UNION CARBIDE

Union Carbide ranked as the 21st largest chemical company in the U.S. with sales of \$6.35 billion in 1976. In 1965, sales were \$2.55 billion and measured in current dollars have grown at a compound annual rate of 8.7%. Although Union Carbide is generally classified as a chemical company, a listing of its major line of business includes a diverse set of non-chemical products such as oxygen and nitrogen gases, carbon and graphite electrodes, fibers and vinyl fabrics and many others.

Union Carbide's classification of its products into major categories has changed a number of times in its annual reports to shareholders since 1965 which has complicated a more detailed analysis of the growth of its products. Prior to 1967, the company had employed a "five-way" distribution of sales. For the years 1967 and 1968 the company, upon consolidating the financial statements of its overseas subsidiaries, increased the number of groups. At the same time, it transferred a considerable portion of sales from both the chemicals and plastic segments to consumer and related products groups to produce, in effect, an "eight-way" classification of sales. Starting in 1973, a "five-way" classification was used.

With the aid of 5-year summaries of sales contained in annual reports to stockholders, we were able to ascertain the yearly sales in current dollars of six major groups consistent for the years 1966 through 1972 and are presented in Table 131.

Union Carbide's six major product groups are chemicals, plastics, gases and related products, metals and carbon, materials systems and consumers and

related products. Chemicals have accounted for between 27 and 30 percent of sales, plastics for between 12 and 17 percent, metals and carbon for between 2 and 5 percent, materials systems for between 0 and 5 percent and consumers and related products for between 18 and 23 percent of sales. Consolidated sales in current dollars grew an average of 5 percent per year from 1965 to 1972. In 1973 and 1974 total consolidated sales increased 21 and 35 percent respectively, reflecting similar increases in each of Union Carbide's major product groups. These changes and others are reviewed below.

Product Description - Chemical Group

Union Carbide is a producer of about 800 chemicals, nearly all of which are hydrocarbon-based. Ethylene, propylene, benzene and its derivatives are the company's basic intermediates which are converted into ethylene oxide and glycol, oxo alcohols, ethanol, styrene, isopropanol, and other chemicals. These in turn are converted by customers and Union Carbide itself into end products such as polyester fabrics, coatings and solvents, plastics, detergents, agricultural chemicals, adhesives and construction material.

Sales growth of the chemical group averaged 10.4 percent per year from 1967 through 1976 and closely parallels the company's total sales growth. Union Carbide's sales have historically exhibited moderate sensitivity to economic fluctuations. The downturn in 1967 reduced consolidated sales 2 percent while sales of the chemical group dropped 5 percent. In a similar manner, the recession starting in 1969 slowed total sales to 3 percent in 1970 and zero growth in 1971 while chemical products sales remained essentially unchanged at \$818 million in 1969, \$819 million in 1970 and \$823 million in 1971. Chemical sales growth continued to parallel consolidated sales growth through the

UNION CARBIDE

TABLE 131

Distribution of sales, 1965-1976
(In Millions of Dollars)

	<u>CHEMICALS</u>	<u>PLASTICS</u>	<u>GASES & RELATED</u>	<u>METALS & CARBON</u>	<u>MATERIALS & SYSTEMS</u>	<u>CONSUMERS & RELATED PRODUCTS</u>	<u>TOTAL SALES</u>
1965	-	-	-	-	-	\$ 420	\$1,2339
1966	\$ 728	\$354	\$ 449	\$ 486	\$103	467	2,587
1967	693	342	352	533	130	496	2,546
1968	762	333	356	553	126	556	2,686
1969	818	359	371	618	145	622	2,933
1970	819	392	379	691	86	659	3,026
1971	823	398	396	654	71	696	3,038
1972	906	452	439	652	79	733	3,261
1973	1,068	606	581	843	(a)	841	3,939
1974	1,478	880	767	1,145		1,050	5,320
1975	1,653	707	892	1,103		1,310	5,665
1976	1,878	923	1,002	1,174		1,369	6,346

a) Components of Materials Systems Group was distributed among other groups.

b) Electronics division moved from Metals & Carbon Group to Consumers & Related Products Group.

economic upturn of 1972 and 1973. While consolidated sales growth of 21 percent in 1973 occurred principally through higher physical volume, the 35 percent jump in 1974 occurred for quite different reasons. Physical volume growth was blunted by raw material shortages and capacity limitations. Sales of the chemical group increased 38 percent principally through higher selling prices.

Product Description - Plastics Group

The basic raw materials and intermediates of this group are exactly the same as that for the chemical group. The intermediates, however are converted to polyethylene, polystyrene and phenolics which are used by customer and Union Carbide to produce wire and cable insulation, packaging materials, adhesives, construction and architectural materials and numerous consumer items.

Sales growth for this group averaged 11.6 percent per year from 1966 to 1976. Similar to the chemical group and gasses and related products group, sales growth for the plastics group dropped 3 percent and reflected the slow business activity of 1967. In 1968 plastics group sales were held down by another 3 percent because of worldwide price-cutting in low-density polyethylene. A very strong expansion in overseas chemicals and plastics businesses masked Union Carbide's poor domestic sales experience in 1970. This was particularly true for the plastics group, which advanced 9 percent in the face of an economic downturn. Foreign billings rose 15 percent in the first half of 1970, compared with only a 3 percent gain in U.S. volume. Moreover, while year-to-year non-domestic sales increased widened from 13 percent to 16 percent between the first and second quarters, the advances in this country shrank from 4 percent in the first quarter to only 1 percent in the second

quarter. For 1970 as a whole, domestic sales remained essentially unchanged dropping slightly from \$2,164 million in 1969 to \$2,156.6 million in 1970. In contrast, foreign sales increased 13 percent from \$768.4 million to \$869.7 million during the same period.

Similar to the chemical group, the plastics group's sales were not immediately responsive to the recession that began in late-1973. Nearly all of the 45 percent increase in 1974 group sales came from higher prices while volume was limited by production capacity. Demand was strong virtually throughout the year. At the end of 1974, only a few product lines - primarily those heavily dependent on the automotive and housing industries - had been affected by the recession. By 1975, despite continued increases in prices, the recession finally took its toll and sales of the plastics group dropped 20 percent.

Product Description - Gases and Related Products Group

Union Carbide is the world leader in the production of industrial gases. High purity oxygen and nitrogen are its two prime products. In the U.S. its capacity for these two products is about twice that of its nearest competitor, Air Products Inc.

Other gases include argon, hydrogen, helium and acetylene. The group also manufactures cryogenic machinery and cooling devices and welding apparatus. Gases are sold primarily to the steel and other metals industries for use in the refining process. Union Carbide also supplied liquid oxygen and nitrogen to the National Aeronautics and Space Administration from 1968 to 1973.

From 1968 to 1972, there was no current dollar sales growth for the gases group. Group sales suffered its most serious drop in 1967 when the recessionary

growth in the economy led to lowered demand by the steel industry. More importantly, this drop was accentuated by the gradually lower levels of usage by the aerospace industry. Sales dropped 22 percent from \$449 million in 1966 to \$352 million in 1967. From 1973 to 1976, when part of the material systems group was consolidated with this group, sales growth averaged 23 percent per year. The greatest increase occurred in 1974 when sales grew 42 percent from \$581 million in 1973 to \$767 million in 1974. This enormous growth occurred, according to company's 1974 annual report to stockholders, because "demand for all products in this group was exceptionally strong... with most of the increase due to higher selling prices."

Product Description - Metals and Carbon Group

The group is engaged in mining on several continents and is the broadest line and largest producer of ferroalloys in the U.S. It is also a major supplier of chromium, manganese, silicon, vanadium, tungsten and uranium concentrates. Carbon and graphite are fabricated in thousands of shapes and forms; the most important is the production of large electrodes used in electric furnaces making steel, alloys, abrasives and phosphorus.

Current dollar sales growth of the group averaged 6 percent per year between 1966 and 1972. In 1973, as a result of reduced importance of the materials systems group (following the sale of \$60 million and other lines), Union Carbide combined the electronics division with the metals and carbon group. In 1974 sales jumped 43 percent to \$1,145 million from \$843 million in 1973. The electronics division contributed some \$18 million or 6 percent of the increase while the remaining growth of 37 percent came principally through continued high demand of electrodes by steel manufacturers and higher selling

prices for most of its products. In 1975 and 1976, Union Carbide again reorganized the statistics of its distribution of sales. The electronics division was pulled out of the metals and carbon group and combined with the consumers and related products group.

Product Description - Materials Systems Group

The materials systems group had accounted for approximately 4 percent of Union Carbide's total sales before 1973 when its various components were distributed among other groups. The group had 4 separate divisions: 1) the coatings service division which specialized in the technology of applying wear-resistant surfaces to aircraft and other machinery parts; 2) the molecular sieves division, whose products are employed in catalysts used by refineries to increase the yield of gasoline from oil and for separating constituents of gas and liquid mixtures; 3) the electronics division which manufactures tantalum capacitors, synthetic crystals, integrated circuits and laser crystals;¹ and (4) the Stellite products division which produced high performance alloys and was sold at the end of 1969 for \$56 million.

Product Description - Consumers and Related Products Group

The consumers and related products group consists of two divisions: the consumers products division and the fibers and fabrics division. The consumers products division manufactures and markets "Everready" batteries and "Glad" plastic bags and wrap, and handles the marketing of "Preston" antifreeze. Other items include insect repellent and until 1974 "Linde" jewelry. The fibers and fabrics division produces and sells disposable diapers (introduced in 1974), casings and specialty films for the food industry, modacrylic fibers for pile coats, blankets and wigs (discontinued in 1973) and mattresses (sold in 1970).

¹In 1970, Union Carbide had discontinued the manufacture of semiconductors.

TABLE 132
UNION CARBIDE
BREAKDOWN OF DOMESTIC AND FOREIGN SALES
(in millions of dollars)

	(A)		(B)		
	<u>DOMESTIC SALES</u>	<u>(%)</u>	<u>FOREIGN SALES (a)</u>	<u>(%)</u>	<u>TOTAL SALES</u>
1965	\$1,809.0	77%	\$ 530.0	23%	\$ 2,339.0
1966	2,013.0	78	574.0	22	2,587.0
1967	1,956.0	77	590.0	23	2,546.0
1968	2,025.3	75	660.7	25	2,686.0
1969	2,164.6	74	768.4	26	2,933.0
1970	2,156.6	71	869.4	29	3,036.0
1971	2,130.7	70	907.3	30	3,038.0
1972	2,270.5	70	990.5	30	3,261.0
1973	2,599.0	66	1,340.0	34	3,939.0
1974	3,496.0	66	1,824.0	34	5,320.0
1975	3,726.0	66	1,939.0	34	5,665.0
1976	4,253.0	67	2,093.0	33	6,346.0

a) Combined exports from U.S. (including Puerto Rico) and sales of products manufactured by consolidated foreign subsidiaries.

Sales grew an average of 10.9 percent from \$420 million in 1965 to \$1,050 million in 1974. The greatest increase occurred in 1974 when sales jumped 25 percent from \$841 million in 1973 to \$1,050 million in 1974 and according to company's annual report to stockholders, can be attributed to both volume and price increases. Ethylene glycol, which is used in making polyester fibers and antifreeze was in short supply throughout 1974. The scarcity had limited the production of antifreeze and led the company to "raise prices dramatically".² Another 25 percent increase was experienced in 1975 and was partly due to the addition of the electronics division to this group and to the easing of the shortage of ethylene glycol which enabled Union Carbide to increase antifreeze volume by more than 40 percent.

Foreign Sales

Union Carbide's foreign sales data include sales by foreign consolidated subsidiaries as well as export sales from U.S. to customers abroad (except for Puerto Rico, which Union Carbide includes as part of domestic sales). Foreign sales growth, including exports have been increasing at an average of 14 percent per year and its proportion of global sales increased from a low of 22 percent in 1966 to 34 percent in the mid-1970's (see Table 132). The greatest increase in foreign sales occurred in 1973 and 1974 when foreign sales increased 35 and 36 percent respectively. The principal contributor to higher sales were greater physical volume and higher selling prices. Higher volume was achieved by the opening of new facilities and the acquisition of a previously minority-owned plastic manufacturing company in the United Kingdom, in response to growing foreign demand.

²1974 Annual Report to Stockholders.

Estimated Sales vs. Reported Sales

Because the company does not report export sales and does not break down foreign sales (including exports) into major groups, our estimates of sales must be compared with reported domestic sales, column A of Table 132. Our estimates of sales by 4-digit SIC industries in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in the appendix to this section. In 1965 and 1968, Union Carbide had manufacturing operations in 20 4-digit SIC industries. In 1972, the number of SIC industries dropped to 17 and dropped further to 15 in 1974. In 1976, the number of SIC industries increased to 16 and reflects the internal expansion of a battery plant.

The ratios of our estimates to reported domestic sales are as follows:

Sales (In Millions of dollars)	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
Estimated	\$ 1,696.8	\$ 1,872.3	\$ 2,205.5	\$ 3,504.0	\$ 4,289.6
Reported Domestic	1,809.0	2,025.3	2,270.5	3,496.0	4,253.0
Ratio	.94	.92	.97	1.00	1.01

The ratio of our estimates of sales to reported sales averaged .97 for the 5 years. For 1965, 1968 and 1972, our estimates are lower than reported sales. For 1974 and 1975, our estimates are greater than reported domestic sales.

Discrepancies Between Estimated and Reported - An Explanation

Our estimates are based on domestic manufacturing plants with 100 or more employees and corresponds closely to domestic manufacturing production. This can be defined as domestic manufacturing sales plus net exports. Therefore, the appropriate ratio of comparison should be Estimated Sales/Reported Domestic Manufacturing Sales plus Net Exports. That is, all non-manufacturing sales and

sales by foreign manufacturing subsidiaries to customers abroad as well as to the domestic market should be netted out of total worldwide sales.

In addition to its many diverse manufacturing operations, Union Carbide also engages in various mining activities and has developed and sold or licensed many manufacturing processes.³ These non-manufacturing activities are not captured by MEI and as such are responsible for our estimates being lower than reported domestic sales. A factor not so much related to our estimating limitations but also responsible for our estimates to be lower than reported domestic sales is the fact that Union Carbide includes Puerto Rico in its definition of domestic sales. The degree and extent to which these two factors affect the discrepancies between our estimates and reported domestic sales are countered by other factors such as exports, strikes, start-up problems and an erratic capital expenditure program. These latter factors, particularly in the later years contribute to increasing the ratio of our estimates to reported domestic sales.

Following along the same line as above, our estimates of sales should be compared to reported domestic manufacturing sales plus net exports. If net exports were positive and increasing through time, then the ratio of our estimates to reported domestic sales should also increase through time. Although dollar figures on net exports aren't available to reveal its true influence, a positive correlation with Union Carbide's increasing foreign sales growth, is nevertheless highly suspected. As was mentioned earlier, foreign sales growth which includes export sales to foreign countries either through foreign subsidiaries or direct sales to foreign customers had increased dramatically during the 1970's. (see Table 132).

In the past, during periods of high profits (and high cash flows) the chemical industry has invariably embarked on major capital expansion programs which have resulted in substantial excess capacity and downward pressure on price. Each chemical company attempts to be the first company with the biggest plant to produce whatever is in tight supply, even if it lacks a particularly strong related market and technological position. Union Carbide's capital outlays as a percentage of beginning gross plant averaged an impressive 10.1 percent per year (see Table 133 despite excess capacity and price attrition in various areas. Simultaneous to experiencing excess capacity in certain areas, Union Carbide had also experienced start-up problems in other areas and found the continued operation of some antiquated units necessary in still other areas due to high volume demand. The apparent misallocation of capital expenditures led eventually to management reexamining their strategy. Union Carbide's 1970 annual report to stockholders states "We are maintaining an aggressive campaign to improve our earnings by the reduction of nonessential programs and personnel and the elimination of unprofitable or marginally profitable business activities. This program also involves the continuing examination of all of our businesses with the objective of concentrating our efforts on those that show significant potential for growth and that match our managerial and technical capabilities." In subsequent annual reports, management from time to time reported improved earnings and efficiencies due to plant closures and product eliminations. For example, the 1973 annual reports, "During recent years, we have eliminated a number of unsuitable operations and shut down obsolete or marginally profitable plants.

As a result, operations were at a high level of efficiencies...". In addition, a discussion on allocation of resources in the 1974 Annual reports, "We have sorted out our businesses according to criteria such as profitability and growth potential. We have proceeded to categorize these businesses on a scale of relative attractiveness, ranging from those that are superior and merit full support to those that are weak, or declining, and call for consideration of withdrawal. With this done, we have allocated our resources - particularly construction capital and research and development effort - preferentially to the more promising businesses." Without claiming to be exhaustive, Table 134 lists 27 product eliminations and/or plant closures from 1971 to 1976.

These product eliminations and plant closures will cause our estimated sales to be greater than reported sales because our estimates are based on full year's operation while most eliminations occurred during the year and hence, sales were reported for only part of the year.

Offsetting this bias somewhat is the matter of plant efficiencies. If these plants were among the more inefficient of the company's plants and of the industry as a whole, our estimates of sales during the earlier years (prior to eliminations) would tend to exceed reported domestic sales because of the assumption implicit in our estimating procedure that each plant operates at the industry's average value of shipments per employee. After elimination, continuing operations as was alluded to earlier by management, should be more efficient and thus decrease the ratio of or estimates to reported sales.⁴ However, this may not be the case as is suggested by the trend in the ratios of

UNION CARBIDETABLE 133Capital Expenditures, 1965-1976
(In Millions of Dollars)

	<u>Capital Expenditures</u>	<u>Beginning Gross Plant</u>	<u>%</u>
1965	\$242	\$2,718	8.9%
1966	351	2,908	12.1
1967	479	3,531	13.6
1968	347	3,948	8.8
1969	322	4,209	7.7
1970	394	4,351	9.1
1971	335	4,600	7.3
1972	244	4,730	5.2
1973	289	4,730	6.1
1974	517	4,962	10.4
1975	862	5,372	16.0
1976	965	6,038	16.0

TABLE 134

UNION CARBIDE

Product Eliminations and Plant Closures (a)

<u>Date</u>	<u>Product</u>	<u>Product or Plant</u>
10/71	Ethylene oxide	small plant
10/71	Sorbic Acid	product
10/71	Methanol	product
10/71	Acrylonitrile	product
10/71	Vinyl acetate monomer	small plant
10/71	Vinyl choride monomer	product
6/72	Plastic bottles	product
8/72	High-density polyethylene	plant
10/72	"Spandex"	product
11/72	Acetone	plant
	Methyl Isobutyl Ketone	Plant
12/72	Disobutyl ketone	plant
	"Fiberbond"	product
1/73	Glass reinforced thermoplastic	product
2/73	Ocean sytems, Inc.	product and plant
5/73	PVC resins, compounds and fabricated plastics	product
8/73	Vinyl chloride monomer, acetylene black,	plant
11/73	Conventional expoxies	2 plants
12/73	Phthalate plasticizers	product
1974	Linde Jewelry	plant and product
1974	Dynel fiber	plant
1976	Polyvinyl chloride dispersion resins	plant and product
1976	Calendered Flexible Vinyl	plant

estimated sales to reported domestic sales. Two possible explanations come to mind: (1) either the eliminated plants were efficient and continuing plants inefficient or (2) countering forces, such as, mid-year plant elimination, strikes, increasing export sales and start-up problems are stronger.

Recall that estimated sales are based on: (1) the data as set forth in MEI and (2) the assumption implicit in our estimating procedure, namely that each plant operates at its respective industry's average value of shipment per employee. Our estimates then apply to a firm consisting of typical plants in various industries (as classified by MEI for each year in our analysis) with each operating at its average value of shipments per employee and each subject to typical difficulties, e.g., strikes, start-up problems etc., associated with its industry. Consequently, aside from accounting obstacles (separating domestic manufacturing sales from worldwide sales), whenever our estimates are greater than reported sales, the firm is either less efficient than or subjected to greater operating problems than the typical firm or any combination of the two. Conversely, whenever our estimates are lower than reported sales (aside from accounting obstacles), the firm is either more efficient than or subjected to lesser operating problems than the typical firm.

Sales Growth in Current and Constant Dollars

Our estimated sales and growth of sales of a "typical" firm with basic characteristics similar to Union Carbide's domestic manufacturing activities in current and constant dollars for the years 1965, 1968, 1972, 1974 and 1976 are presented in Table 135.

TABLE 135

UNION CARBIDE

ESTIMATED SALES AND GROWTH OF ESTIMATED SALES

<u>Estimated Sales</u> (In Millions of Dollars)	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$ 1,696.8	\$ 1,872.3	\$ 2,205.5	\$ 3,454.0	\$ 4,289.6
(a) Index of (1965=100)	100	110	130	207	253
In Constant Dollars	\$ 1,745.5	\$ 1,861.6	\$ 2,031.2	\$ 2,311.0	\$ 2,313.4
(b) Index of (1965=100)	100	107	116	132	133
(c)=(a)/(b)	100	103	112	157	190
(d)	100	98	100	134	182

Line (a) is the growth pattern of estimated sales in current dollars and line (b) is the growth pattern of estimated sales in constant dollars. Line (c) is the ratio of line (a) to line (b) and can be interpreted as the implicit price index for a "typical" firm's domestic manufacturing activities. Line (d) is Union Carbide's domestic selling price index.⁵

Comparison between line (c) and line (d) reveals a somewhat similar pattern.⁶ During the early years the divergence between sales growth in current and constant dollars is small and reflects an essentially flat pattern of price changes. In 1974 and 1976 the divergence increased substantially and reflects the period of increasing prices. The increase was particularly great for both the chemical and plastics groups because of its high dependence on fuel and organic chemical raw material.

Union Carbide's reported domestic sales and sales growth in current and constant dollars deflated by the two price indexes are presented in Table 136.

TABLE 136
UNION CARBIDE
REPORTED DOMESTIC SALES

<u>Reported Domestic Sales</u> (In Million of Dollars)	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
In Current Dollars	\$1,809.0	\$2,025.3	\$3,370.5	\$3,496.0	\$4,253.0
(a) Index of (1965=100)	100	112	126	193	235
In Constant Dollars	1,809.0	1,966.3	2,027.2	2,226.8	2,215.1
(b) Index of (1965=100)	100	109	112	123	122
In Constant Dollars (using company's price index)	1,809.0	2,066.6	2,270.5	2,609.0	2,336.8
(c) Index of (1965=100)	100	114	126	144	129

Line (a) is the growth pattern of reported domestic sales in current dollars. Line (b) is Union Carbide's sales growth subject to domestic manufacturing price changes as experienced by our typical firm and line (c) is real domestic sales growth as reported by the company.

In total, we have three ways of describing real sales growth: (1) our estimate of real growth - line (b) of Table 136, (2) the company's current dollar reported domestic sales deflated by our implicit price index - line (c) of Table 135 and (3) real domestic sales growth as reported by the company - line (c) of

Table 136. To facilitate comparison, the three real growth patterns are presented together in Table 137.

TABLE 137
UNION CARBIDE
REAL SALES GROWTH

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
A) Index of Estimated Real Sales (a)	100	107	116	132	133
B) Index of Reported Real Sals (b) (as deflated by implicit price index).	100	109	112	123	122
C) Index of Reported Real Sales (c) (as reported by the company)	100	114	126	144	129

(a) from line (b) of Table 135.

(b) from line (b) of Table 136.

(c) from line (c) of Table 136.

Line (A) of Table 137 shows that real sales grew 7%, 16%, 32% and 33% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. Line (B), on the other hand, shows that real sales grew 9%, 12%, 23% and 22% over the 1965-1968 period, 1965-1972 period, 1965-1974 period and 1965-1976 period respectively. The discrepancies between line (A) and Line (B) can be attributed to the differences between our estimated sales and reported sales for each of the 5 years, the two real growth patterns - line (A)

and line (B) would be identical. The discrepancies between line (B) and line (C), on the other hand, are due to differences between our implicit price index and the company's reported price index. Differences between the two were alluded to earlier in Footnote 6.

Referring back to Table 136, whereas reported domestic sales grew 135% over the 1965-1976 period on a nominal basis, physical volume or sales adjusted for inflation grew only 22%, based on our estimating procedure, (or 29% based on the company's reports) over the same period.

APPENDIX A

<u>SIC</u> <u>CODE</u>	<u>INDUSTRY TITLE</u>
	<u>Food and Kindred Products</u>
2011	Meat packing plants
2013	Sausages and other prepared meats
2016	Poultry dressing plants
2017	Poultry and egg processing
2021	Creamery butter
2022	Cheese, natural and processed
2023	Condensed and evaporated milk
2024	Ice cream and frozen desserts
2026	Fluid milk
2032	Canned specialties
2033	Canned fruits and vegetables
2034	Dehydrated fruits, vegetables, soups
2035	Pickles, sauces, and salad dressings
2038	Frozen specialties
2041	Flours and other grain mill products
2043	Cereal breakfast foods
2044	Rice milling
2045	Blended and Prepared flour
2046	Wet corn milling
2047	Dog, cat, and other pet food
2048	Prepared feeds, nec
2051	Bread, cake, and related products
2052	Cookies and crackers
2061	Raw cane sugar
2062	Cane sugar refining
2063	Beet sugar
2695	Confectionery products
2066	Chocolate and cocoa products

<u>SIC</u> <u>Code</u>	<u>INDUSTRY TITLE</u>
	<u>Food and Kindred Products</u>
2067	Chewing gum
2074	Cottonseed oil mills
2075	Soybean oil mills
2076	Vegetable oil mills, nec
2077	Animal and marine fats and oils
2079	Shortening and cooking oils
2082	Malt beverages
2083	Malt
2084	Wines, brandy, and brandy spirits
2085	Distilled liquor, except brandy
2086	Bottled and canned soft drinks
2087	Flavoring extracts and syrups, nec
2091	Canned and cured seafoods
2092	Fresh or frozen packed fish
2095	Roasted coffee
2097	Manufactured ice
2098	Macaroni and spaghetti
2099	Food preparations, nec
	<u>Tobacco Manufacturers</u>
2111	Cigarettes
2121	Cigars
2131	Chewing smoking tobacco
2141	Tobacco stemming and redrying
	<u>Textile Mill Products</u>
2211	Weaving mills, cotton
2221	Weaving mills, synthetics
2231	Weaving and finishing mills, wool
2241	Narrow fabric mills

**SIC
CODE****INDUSTRY TITLE****Textile Mill Products**

2251	Women's hosiery, except socks
2252	Hosiery, nec
2253	Knit outerwear mills
2254	Knit underwear
2257	Circular knit fabric mills
2258	Warp knit fabric mills
2259	Knitting mills, nec
2261	Finishing plants, cotton
2262	Finishing plants, synthetics
2269	Finishing plants, nec
2271	Woven carpets and rugs
2272	Tufted carpets and rugs
2279	Carpets and rugs, nec
2281	Yarn mills, except wool
2282	Throwing and winding mills
2283	Wool yarn mills
2284	Thread mills
2291	Felt goods, exc. woven felts & hats
2292	Lace goods
2293	Paddings and upholstery filling
2294	Processed textile waste
2295	Coated fabrics, not rubberized
2296	Tire cord and fabric
2297	Nonwoven fabrics
2298	Cordage and twine
2299	Textile goods, nec

Apparel and Other Textile Products

2311	Mens and boys suits and coats
2321	Mens and boys shirts and night wear

<u>SIC</u> <u>CODE</u>	<u>INDUSTRY TITLE</u>
	<u>Apparel and Other Textile Products</u>
2322	Mens and boys underwear
2323	Mens and boys neckwear
2327	Mens and boys separate trousers
2328	Mens and boys work clothing
2329	Mens and boys clothing, nec
2331	Womens and misses blouses and waists
2335	Womens and misses dresses
2337	Womens and misses suits and coats
2339	Womens and misses outerwear, nec
2341	Womens and childrens underwear
2342	Brassieres and allied garments
2351	Millinery
2352	Hats and caps, except millinery
2361	Childrens dresses and blouses
2363	Childrens coats and suits
2369	Childrens outerwear, nec
2371	Fur goods
2381	Fabric dress and work gloves
2384	Robes and dressing gowns
2385	Waterproof outergarments
2386	Leather and sheep lined clothing
2387	Apparel belts
2389	Apparel and accessories, nec
2391	Curtains and draperies
2392	House furnishings, nec
2393	Textile
2394	Canvas and related products
2395	Pleating and stitching
2396	Automotive and apparel trimmings
2397	Schiffli machine emroideries
2399	Fabricated textile products, nec

<u>SIC</u> <u>CODE</u>	<u>INDUSTRY TITLE</u>
<u>Lumber and Wood Products</u>	
2411	Logging camps and logging contractors
2421	Sawmills and planing mills, general
2426	Hardwood dimension and flooring
2429	Special product sawmills, nec
2431	Millwork
2434	Wood kitchen cabinets
2435	Hardwood veneer and plywood
2436	Softwood veneer and plywood
2439	Structural wood members, nec
2441	Nailed wood boxes and shook
2448	Wood palets and skids
2449	Wood containers, nec
2451	Mobile homes
2452	Prefabricated wood buildings
2491	Wood preserving
2492	Particleboard
2499	Wood products, nec
<u>Furniture and Fixtures</u>	
2511	Wood household furniture
2512	Upholstered household furniture
2514	Metal household furniture
2515	Mattresses and bedsprings
2517	Wood TV and radio cabinets
2519	Household furniture, nec
2521	Wood office furniture
2522	Metal office furniture
2531	Public building and related furniture
2541	Wood partitions and fixtures
2542	Metal partitions and fixtures

**SIC
CODE****INDUSTRY TITLE****Furniture and Fixtures**

2591 Drapery hardware and blinds and shades
 2611 Furniture and fixtures, nec

Paper and Allied Products

2611 Pulp mills
 2621 Paper mills, except building paper
 2631 Paperboard mills
 2641 Paper coating and glazing
 2642 Envelopes
 2643 Bags, except textile bags
 2645 Die-cut paper and board
 2646 Pressed and molded pulp goods
 2647 Sanitary paper products
 2648 Stationery products
 2649 Converted paper products, nec
 2651 Folding paperboard boxes
 2652 Set up paperboard boxes
 2653 Corrugated and solid fiber boxes
 2654 Sanitary food containers
 2655 Fiber cans, drums and similar products
 2661 Building paper and board mills

Printing and Publishing

2711 Newspapers
 2721 Periodicals
 2731 Book publishing
 2732 Book printing
 2741 Miscellaneous publishing
 2751 Commercial printing, letterpress
 2752 Commercial printing, lithographic
 2753 Engraving and plate printing

<u>SIC</u>	<u>INDUSTRY TITLE</u>
<u>COED</u>	
	<u>Printing and Publishing'</u>
2754	Commercial printing, gravure
2761	Manifold business forms
2771	Greeting card publishing
2782	Blankbooks and looseleaf binders
2789	Bookbinding and related work
2791	Typesetting
2793	Photoengraving
2794	Electrotyping and stereotyping
2795	Lithographic platemaking services
	<u>Chemicals and Allied Products</u>
2812	Alkalies and chlorine
2813	Industrial gases
2816	Inorganic pigments
2819	Industrial inorganic chemicals, nec
2821	Plastics materials and resins
2822	Synthetic rubber
2823	Cellulosic man-made fibers
2824	Organic fibers, noncellulosic
2831	Biological products
2833	Medicinals and botanicals
2834	Pharmaceutical preparations
2841	Soap and other detergents
2842	Polishes and sanitation goods
2843	Surface active agents
2844	Toilet preparations
2851	Gum and wood chemicals
2865	Cyclic crudes and intermediates
2869	Industrial organic chemicals, nec
2873	Nitrogenous fertilizers

**SIC
CODE****INDUSTRY TITLE****Chemicals and Allied Products**

2874 Phosphatic fertilizers
 2875 Fertilizers, mixing only
 2979 Agricultural chemicals, nec
 2891 Adhesives and sealants
 2892 Explosives
 2893 Printing ink
 2895 Carbon black
 2899 Chemical preparations, nec

Petroleum and Coal Products

2911 Petroleum refining
 2951 Paving mixtures and blocks
 2952 Asphalt felts and coatings
 2992 Lubricating oils and greases
 2999 Petroleum and coal products, nec

Rubber and Mis. Plastic Products

3011 Tires and inner tubes
 3021 Rubber and plastics footwear
 3031 Reclaimed rubber
 3041 Rubber and plastics hose and belting
 3069 Fabricated rubber products, nec
 3079 Miscellaneous plastics products

Leather and Leather Products

3111 Leather tanning and finishing
 3131 Boot and shoe cut stock and findings
 3142 House slippers
 3142 Mens footwear, except athletic
 3144 Womens footwear, except athletic

<u>SIC</u> <u>CODE</u>	<u>INDUSTRY TITLE</u>
	<u>Leather and Leather Products</u>
3149	Footwear, except rubber, nec
3151	Leather gloves and mittens
3161	Luggage
3171	Womens handbags and purses
3172	Personal leather goods, nec
3199	Leather goods, nec
	<u>Stone, Clay, and Glass Products</u>
3211	Flatt glass
3221	Glass containers
3229	Pressed and blown glass, nec
3231	Products of purchased glass
3241	Cement, hydraulic
3251	Brick and structural clay tile
3253	Ceramic wall and floor tile
3255	Clay refractories
3259	Structural clay products, nec
3261	Vitreous plumbing fixtures
3262	Vitreous china food utensils
3263	Fine earthenware food utensils
3264	Porcelain electrical supplies
3269	Pottery products, nec
3271	Concrete block and brick
3272	Concrete products, nec
3273	Ready-mixed concrete
3274	Lime
3275	Gypsum products
3281	Cut stone and stone products
3291	Abrasive products
3292	Asbestos products
3293	Gaskets, packing and sealing devices

<u>SIC</u> <u>CODE</u>	INDUSTRY TITLE
<u>Stone, Clay, and Glass Products</u>	
3295	Minerals, ground and treated
3296	Mineral wool
3297	Nonclay refractories
3299	Nonmetallic mineral products, nec
<u>Primary Metal Industries</u>	
3312	Blast furnaces and steel mills
3313	Electrometallurgical products
3315	Steel wire and related products
3316	Cold finishing of steel shapes
3317	Steel pipe and tubes
3321	Gray iron foundries
3325	Steel foundries, nec
3331	Primary copper
3332	Primary lead
3333	Primary zinc
3334	Primary aluminum
3339	Primary nonferrous metals, nec
3341	Secondary nonferrous metals, nec
3351	Copper rolling and drawing
3353	Aluminum sheet, plate, and foil
3354	Aluminum extruded products
3355	Aluminum rolling and drawing, nec
3356	Nonferrous rolling and drawing, nec
3357	Nonferrous wire drawing and insulating
3361	Aluminum foundries
3362	Brass, bronze, and copper foundries
3369	Nonferrous foundries, nec
3398	Metal heat treating

<u>SIC</u> <u>CODE</u>	<u>INDUSTRY TITLE</u>
3399	Primary metal products, nec
	<u>Fabricated Metal Products</u>
3411	Metal cans
3412	Metal barrels, drums, and pails
3421	Cutlery
3423	Hand and edge tools, nec
3425	hand saws and saw blades
3429	Hardware, nec
3431	Metal sanitary ware
3432	Plumbing fittings and brass goods
3433	Heating equipment, except electric
3441	Fabricated plate work (boiler shops)
3444	Sheet metal work
3446	Architectural metal work
3448	Prefabricated metal buildings
3449	Miscellaneous metal work
3451	Screw machine products
3452	bolts, nuts, rivets, and washers
3463	Automotive stampings
3465	Automotive stampings
3466	Crowns and closures
3469	Metal stampings, nec
3471	Plating and polishing
3479	metal coating and allied services
3482	Small arms ammunition
3483	Ammunition, exc. for small arms, nec.
3484	Small arms
3489	Ordnance and accessories, nec

**SIC
CODE****INDUSTRY TITLE****Fabricated Metal Products**

3493	Steel springs, except wire
3494	Valves and pipe fittings
3495	Wire springs
3496	Misc. fabricate wire products
3497	Metal foil and leaf
3498	Fabricated pipe and fittings
3499	Fabricated metal products, nec

Machinery: Except Electrical

3511	Turbines and turbine generator sets
3519	Internal combustion engines, nec
3523	Farm machinery and equipment
3524	Lawn and garden equipment
3531	Construction machinery
3532	Mining machinery
3533	Oil field machinery
3534	Elevators and moving stairways
3535	Conveyors and conveying equipment
3536	Hoists, cranes, and monorails
3537	Industrial trucks and tractors
3541	Machine tools, metal cutting types
3542	Machine tools, metal forming types
3544	Special dies, tools, jigs & fixtures
3545	Machine tools accessories
3446	Power driven hand tools
3547	Rolling mill machinery, nec.
3551	Food products machinery
3552	Textile machinery
3553	Woodworking machinery

**SIC
CODE****INDUSTRY TITLE****Machinery: Except Electrical**

3554	Paper industries machinery
3555	Printing trades machinery
3559	Special Industry machinery, nec
3561	Pumps and pumping equipment
3562	Ball and roller bearings
3563	Air and gas compressors
3564	Blowers and fans
3565	Speed changers, drives, and gears
3567	Industrial furnaces and ovens
3568	Power transmission equipment, nec
3569	General industrial machinery, nec
3572	Typewriters
3573	Electronic computing equipment
3574	Calculating and accounting machines
3576	Scales and balances, exc. laboratory
3579	Office machines, nec
3581	Automatic merchandising machines
3582	Commercial laundry equipment
3585	Refrigeration and heating equipment
3586	Measuring and dispensing pumps
3589	Service industry machinery, nec
3592	Carburators, pistons, rings, valves
3599	Machinery, except electrical, nec

Electric and Electronic Equipment

3612	Transformers
3613	Switchgear and switchboard apparatus
3621	Motors and generators
3622	Industrial controls
3623	Welding apparatus, electric

**SIC
CODE****INDUSTRY TITLE****Electric and Electronic Equipment**

3624	Carbon and graphite products
3629	Electrical industrial apparatus, nec
3631	Househld cooking equipment
3632	Household refrigerators and freezers
3633	Household laundry equipment
3634	Electric housewares and fans
3635	Household vacuum cleaners
3636	Sewing machines
3639	Household appliances, nec
3641	Electric lamps
3642	Current-carrying wiring devices
3644	Noncurrent-carrying wiring devices
3645	Residential lighting fixtures
3646	Commercial lighting fixtures
3647	Vehicular lighting equipment
3648	Lighting equipment, nec
3651	Radio and TV receiving sets
3652	Phonograph records
3661	Telephone and telegraph aparatus
3662	Radio and TV communication equipment
3671	Electron tubes, receiving types
3672	Cathode ray television picture tubes
3673	Electron tubes, transmitting
3674	Semiconductors and related devices
3675	Electronic capacitors
3676	Electronic resistors
3677	Electronic coils and transformers
3678	Electronic connectors
3679	Electronic components, nec
3691	Storage batteries, dry and wet
3692	Primary batteries, dry and wet

SIC CODE	INDUSTRY TITLE
	Electric and Electronic equipment
3693	X-ray apparatus and tubes
3694	Engine electrical equipment
3699	Electrical equipment and supplies, nec
	 <u>Transportation Equipment</u>
3711	Motor vehicles and car bodies
3713	Truck and bus bodies
3714	Motor vehicle parts and accessories
3715	Truck trailers
3721	Aircraft
3724	Aircraft engines and engine parts
3728	Aircraft equipment, nec
3731	Ship building and repairing
3732	Boat building and repairing
3743	Railroad equipment
3751	Motocycles, bicycles, and parts
3761	Guided missiles and space vehicles
3764	Space propulsion units and parts
3769	Space vehicle equipment, nec
3792	Travel trailers and campers
3795	Tanks and tank components
3799	Transportation equipment, nec
	 <u>Instruments and Related Products</u>
3811	Engineering & Scientific instruments
3822	Environmental controls
3823	Process control instruments
3824	Fluid meters and counting devices
3825	Instruments to measure electricity
3829	Measuring & controlling devices, nec
3832	Optical instruments and lenses

**SIC
CODE****INDUSTRY TITLE****Instruments and Related Products**

3841	Surgical and medical instruments
3842	Surgical appliances and supplies
3843	Dental equipment and supplies
3851	Ophthalmic goods
3861	Photographic equipment and supplies
3873	Watches, clocks, and watchcases

Miscellaneous Manufacturing Industries

3911	Jewelry, precious metal
3914	Silverware and plated ware
3915	Jewelers materials & lapidary work
3942	Dolls
3944	Games, toys, and childrens vehicles
3949	Sporting and athletic goods, nec
3951	Pens and mechanical pencils
3952	Lead pencils and art goods
3953	Marking devices
3955	Carbon paper and inked ribbons
3961	Costume Jewelry
3962	Artificial flowers
3963	Buttons
3964	Needles, pins, and fasteners
3991	Brooms and brushes
3993	Signs and advertising displays
3995	Burial caskets
3996	Hard surface floor coverings
3999	Manufacturing industries, nec

ALLIED CHEMICALESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS

(In Millions of Dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2399				\$ 18.3	\$ 76.1
2661	\$ 8.6				
2812	\$ 137.0	\$ 142.2	\$ 230.3	\$ 248.0	\$ 299.6
2816	9.0	9.5	12.0	10.0	10.5
2819	175.4	287.8	277.7	377.5	301.2
2821	76.6	79.6	86.4	59.0	103.5
2824	158.4	180.9	180.2	188.6	196.4
2865	179.0	112.2	209.4	170.5	124.1
2869	20.0	21.3	24.5	29.9	29.8
2873	77.7	97.8	137.2	85.6	77.4
2874	30.9	38.5	57.6	62.4	58.1
2879			8.4	11.2	6.5
2899		4.3			
2911	112.9	120.4	132.6	126.1	131.5
2951	4.4	20.2	5.3	7.5	
2952	19.9				
3021	4.2	5.5	7.8	5.9	5.4
3079	4.2	11.2	14.1	5.8	
3295	3.1				
3312	29.8	30.4	31.3	33.1	37.7
2662					2.7
Total	\$1,051.1	\$1,161.8	\$1,414.8	\$1,439.4	\$1,460.5

AMERICAN CYANAMIDESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS
(In Millions of Dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2295		\$ 7.5	\$ 8.5	\$ 8.2	\$ 9.3
2816	\$ 45.3	61.4	71.8	65.0	68.6
2819	39.0	52.9	67.7	56.3	51.1
2821	47.9	53.1	78.5	70.8	69.0
2823			24.3	26.0	22.9
2824	28.8	30.8	28.7	29.3	31.0
2834	69.2	83.6	108.5	92.4	111.1
2842	5.1	6.0	6.8		
2844	54.8	58.8	138.2	152.7	172.1
2865	106.4	123.4	153.6	138.0	141.8
2869	66.9	70.9	86.5	99.5	99.4
2873	31.1	45.6	80.0	128.4	116.1
2891	19.3	21.5	20.8	21.8	23.0
2892	6.3	5.6			
2952	23.8	27.2			
3079	65.2	56.3	56.4	59.1	60.9
3431	4.5	5.4	5.6	5.4	6.2
3841	10.1	10.5	12.2	12.0	27.4
3851			1.9	1.9	2.6
Total	\$ 623.7	\$ 720.5	\$ 950.0	\$ 966.8	\$1,012.5

DU PONTESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS
(In Millions of Dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2282				\$ 12.2	\$ 12.2
2295	\$ 3.3	\$ 3.8	\$ 4.2	12.2	9.3
2816	185.6	193.7	257.2	210.1	242.8
2819	438.6	293.7	318.4	270.4	219.5
2821	359.0	387.4	612.3	663.4	716.0
2822	128.5	156.9	146.2	164.7	92.7
2824	867.6	1,000.6	1,179.8	1,383.0	1,602.0
2833					13.1
2834			18.1	30.8	45.8
2851	80.0	113.7	142.5	185.3	124.1
2865	106.5	140.2	125.6	138.0	191.5
2869	428.0	454.0	623.0	686.8	587.1
2892	44.1	40.9	24.4	32.6	19.1
3079	82.	94.6	124.2	100.4	112.7
3482				138.6	119.9
3484				50.6	62.0
3559	7.5	7.7	8.9	8.0	7.6
3541			2.2	2.5	2.3
3679				14.3	18.1
3761				18.0	17.2
3811			9.7	16.6	25.8
2221					14.8
3861	65.0	86.1	102.1	98.8	121.4
3999	<u>3.4</u>	<u>8.3</u>	<u>4.3</u>	<u>4.6</u>	<u>4.7</u>
Total	\$2,799.2	\$2,981.6	\$3,703.1	\$4,241.9	\$4,381.7

FMCESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS
(In Millions of Dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2812	\$ 81.4	\$ 133.3	\$ 139.6	\$ 71.8	\$ 83.6
2819	121.9	146.8	203.2	174.7	137.8
2821	4.8	68.9	141.3	168.1	163.9
2823	132.5	255.3	179.0	178.6	183.1
2824					25.8
2869	13.4	14.2	17.3	19.9	19.9
2879	69.3	73.3	92.8	111.8	58.8
3079	27.3	36.1	36.7	14.8	15.2
3325			7.3	5.9	5.5
3489	43.8	95.1	48.1	49.9	53.1
3494		2.4	2.6	7.6	7.2
3523	29.8	28.8	49.4	62.3	54.5
3524	18.1	19.2	17.7	17.0	16.1
3531	28.5	31.6	44.6	50.0	54.5
3532	8.5	11.3	34.0	26.2	23.0
3533	2.4	14.7	15.9	16.5	15.8
3535		27.0	60.9	66.0	48.8
3536		7.9	7.9	13.4	23.0
3537	9.3	9.0	9.8	10.0	9.2
3551	40.4	48.0	42.8	45.1	42.7
3552	1.8	1.9	2.0	2.2	
3554	16.1	17.6	6.7	9.8	10.6
3559		7.7	8.9	10.7	10.1
3561	33.6	33.9	39.0	27.1	27.6
3562	2.4	22.1	22.5	21.7	23.7
3564					5.6
3568	70.7	77.4	82.6	79.9	71.8
3569		4.6	5.2	4.6	4.4
3589			28.4	20.8	15.7
3622				10.3	10.1
3674					3.8
3713	4.2	8.7	9.1	5.8	6.9
3743			41.1	41.0	33.8
3791			22.1	21.7	27.4
3795	79.9	96.6	89.4	87.0	100.3
3829					2.2
Total	\$ 840.1	\$1,293.4	\$1,507.9	\$1,452.2	\$1,395.5

GENERAL ELECTRICEstimated Value of Shipments in Constant Dollars
(In Millions)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
3761	\$ 188.5	\$ 205.9	\$ 257.3		
3484	39.0	70.9	40.3	\$ 43.9	\$ 27.0
3489	14.6	23.8	4.8	5.0	5.3
2751	6.6	7.9	8.7		
2821	33.5	31.9	54.9	79.6	77.7
2822	71.4	90.8	91.4	109.7	123.6
3079	37.9	40.5	50.8	53.2	48.7
3229	15.1	13.7	10.4	11.5	12.5
3264	13.5	13.1			
3321	12.3	12.5	13.5	9.4	8.9
3325	7.2	6.9	7.3	7.9	7.3
3357	204.0	202.3	159.9	148.8	167.8
3443	32.5	51.3	53.4	44.1	48.1
3469			4.7	4.5	4.5
3499	14.1	15.0	21.8	23.0	24.5
3511	224.3	355.9	473.8	536.9	409.5
3545	22.9	34.0	38.4	41.9	39.5
3559	9.9	12.8	14.8		
3561	11.2	11.3	11.1	10.8	11.0
3566	4.6	9.3	13.6	14.4	10.3
3567	25.9	27.5	23.2	24.5	22.7
3569	58.3	64.9	78.3	68.8	66.4
3573	198.8	260.0	56.2	37.1	54.1
3585	72.6	76.7	111.3	100.9	65.3
3589	12.4	2.7			
3599	3.3	3.8	4.4	4.7	4.4
3825	26.8	29.0	39.3	49.4	52.2
3612	163.0	249.0	346.7	337.5	310.6
3613	183.2	271.9	322.3	286.0	328.1
3621	291.3	297.6	373.9	427.0	256.1
3622	151.1	142.3	172.6	223.2	202.0
3629	25.2	25.3	45.6	53.1	65.2
3631	37.6	60.0	52.2	68.1	71.1
3632	259.4	415.3	377.2	453.4	394.4
3633	265.3	407.0	345.0	413.4	440.8
3634	65.2	91.1	115.5	127.5	134.4
3639	92.0	191.7	225.8	134.6	138.7

(Continued next page)

GENERAL ELECTRIC
(Continued)

Estimated Value of Shipments in Constant Dollars
(In Millions)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
3641	\$ 263.5	\$ 283.3	\$ 349.4	\$ 355.4	\$ 366.4
3645	16.6	15.3	15.2	25.5	25.5
3643	45.0	45.5	46.1	42.8	42.6
3651	106.1	130.0	237.9	366.1	467.8
3662	222.0	307.5	417.3	404.1	419.6
3671	68.1	86.2	89.9	78.2	78.8
3673			2.2	2.5	2.8
3674	23.0	28.9	51.0	55.2	67.9
3679	59.2	99.6	167.1	125.4	97.8
3691	17.3	16.1	28.9	38.8	48.7
3693	45.6	45.7	45.2	59.5	89.8
3699	25.4	52.6	54.0	64.4	72.9
3724	375.5	493.2	685.0	818.8	600.9
3714				14.7	15.5
3728	110.5	126.3	106.9	141.5	134.2
3743	175.1	302.6	254.8	8.2	6.7
3829				54.0	42.8
3822	36.1	38.5	40.5	47.7	39.5
3873	45.7	49.0	56.6	39.2	49.9
3999			4.3	4.6	5.5
Total	\$4,529.2	\$5,946.2	\$6,672.7	\$6,700.4	\$6,308.3

B.F. GOODRICH

ESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2241	\$ 4.9	\$ 5.3			
2296	98.0	98.4	\$ 120.6	\$ 111.7	\$ 122.8
2399	3.5	4.2			
2821	119.6	185.7	243.3	230.0	241.6
2822			73.2	87.8	82.4
2869	40.1	42.6	51.9	59.8	59.7
3011	295.4	346.2	380.6	397.5	365.1
3021	71.6	90.5	29.8		
3041	8.9	15.7	29.1	25.6	34.6
3069	42.1	45.0	37.8	44.7	17.8
3293	1.9	1.8	2.0	4.3	4.5
3728	7.6	15.2	20.8	23.1	23.4
Total	\$ 693.6	\$ 850.6	\$ 989.1	\$ 984.5	\$ 951.9

MINNESOTA MINING AND MANUFACTURING COMPANY

ESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2641	\$ 331.0	\$ 346.3	\$ 379.1	\$ 375.8	\$ 386.5
2649	21.4	25.0	24.6	25.1	26.6
2821	14.4	37.2	39.3	44.3	103.5
2834			42.2	49.3	52.3
2851	8.9	9.1	9.8	15.9	28.2
2891	14.6	58.2	15.6	32.6	28.8
2893				4.1	4.2
2899	42.4	43.9	57.1	54.5	51.1
3079	6.4	11.2	16.9	17.7	18.3
3231	5.0	6.1	9.5	6.4	6.6
3264	27.0	26.1	26.7	26.1	22.5
3281	2.7	3.0	3.5	3.2	3.4
3291	32.4	30.7	26.5	19.0	19.6
3295	6.3	7.2	9.5	9.7	6.7
3479	2.0	1.8	2.0	1.9	2.2
3555	4.9	7.3	18.4	17.3	13.3
3579	2.3	2.6	7.0	4.3	4.5
3651	37.5	34.4	47.6	50.7	70.1
3672					4.1
3679	4.7	13.4	17.6	17.1	21.8
3842			2.9	2.7	2.7
3861	86.7	120.6	164.6	173.0	140.5
3993	<u>6.8</u>	<u>8.9</u>	<u>16.8</u>	<u>18.3</u>	<u>16.5</u>
Total	\$ 657.4	\$ 793.0	\$ 937.2	\$ 969.0	\$1,034.0

TRWESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
3079	\$ 6.4	\$ 6.8	\$ 8.4	\$ 8.9	\$ 9.1
3321		2.0	2.3	7.1	6.7
3361				5.5	6.8
3357	21.5	26.0	33.1	31.9	35.9
3369		2.2	2.5	1.9	2.0
3399			3.8	3.0	3.4
3423	21.7	22.7	24.4	18.4	32.2
3452	31.2	34.3	41.0	41.5	40.3
3471	2.7	2.9			
3494	43.8	47.7	52.0	60.7	57.3
3541		5.0	4.5	5.0	6.8
3544			4.2	3.8	3.2
3545		42.5	48.0	57.6	59.4
3559	2.5	2.6			
3561		8.5	14.0	13.5	13.8
3562	34.2	50.9	57.4	57.9	66.4
3592	11.6	12.4	14.6	13.2	13.9
3612	2.8	5.4	6.7	7.0	13.5
3622	6.8	6.4	7.5	10.3	12.6
3629		15.3	21.6	24.0	20.9
3643		22.6	22.0	24.4	22.3
3662	323.9	371.2	292.3	289.3	318.9
3674	20.3	22.8	29.5	29.0	37.7
3679	90.4	118.8	181.7	176.7	224.5
3714	139.8	173.7	185.1	209.3	205.4
3724	48.4	56.4	85.7	83.9	97.6
3825	7.1	7.7	9.8	12.4	15.7
3964	1.9	2.1	2.4	4.3	4.4
Total	\$ 817.0	\$1,068.9	\$1,154.5	\$1,200.5	\$1,330.7

UNION CARBIDE
ESTIMATED VALUE OF SHIPMENTS IN CONSTANT DOLLARS

(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2299	\$ 4.7	\$ 5.2	\$ 4.5		
2515	7.0	7.5			
2643	11.6	18.4	26.8	\$ 53.7	\$ 54.9
2813	79.9	128.2	127.6	131.5	124.0
2819	73.1	94.0	115.1	129.6	132.7
2821	181.9	180.4	282.6	309.6	346.6
2834	4.3	4.9			
2869	601.7	659.8	709.5	816.2	835.8
3079	56.8	60.8	81.8	85.7	88.3
3313	254.9	235.6	249.4	299.0	216.5
3356	125.1	115.9			
3479	4.0	3.5	6.1	9.5	10.9
3549	2.4	5.1	5.2	2.4	2.2
3559	52.1	53.9	62.4	59.0	70.7
3585	25.3	26.7	30.7	26.9	27.5
3623	7.3	3.4	3.6	7.1	6.6
3624	118.4	111.6	120.9	161.1	138.6
3629	3.9	3.9	4.7		
3679	12.5	23.0	52.8	57.0	72.5
3691					7.5
3692	<u>120.5</u>	<u>119.8</u>	<u>147.5</u>	<u>162.8</u>	<u>178.1</u>
Total	\$1,747.5	\$1,861.6	\$2,031.2	\$2,311.0	\$2,313.4

W. R. GRACE
ESTIMATED VALUD OF SHIPMENTS IN CONSTANT DOLLARS
(In Millions of Dollars)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2022	\$	\$ 10.5	\$ 9.5	\$ 8.9	\$ 9.6
2035		60.4	62.0	72.0	
2065		28.7	43.6	27.5	20.3
2066	17.8	18.7	12.1	9.0	14.8
2082		99.0			
2092		48.2	51.7	50.1	51.2
2099			49.6	44.4	
2295	6.6	7.5	8.5	8.2	9.3
2337		4.2	6.2	8.9	
2641	4.1	4.2	4.7	4.5	4.6
2643	26.2	33.8	36.8	57.5	54.9
2661	2.9	3.1	3.3	3.7	3.4
2819	53.6	82.3	94.8	90.2	81.7
2821	47.9	84.9	125.6	141.5	146.6
2822	14.2	16.6	18.3	22.0	30.9
2841	38.3	45.2	48.7	65.0	76.4
2842	10.2	12.0	13.6	23.2	26.8
2869	93.6	99.3	121.1	159.3	159.1
2873	10.3	13.0	34.3	42.8	38.7
2874	66.9	83.5	125.2	145.6	135.7
2875	5.0	11.5	13.6	23.6	26.8
2899	25.5	35.1	62.7	59.9	61.2
3079	10.5	13.5	19.8	38.4	33.5
3144			8.4	14.5	14.6
3171			3.0	2.9	5.0
3272		4.7	5.0	5.2	5.0
3293	13.1	12.9	13.9	17.0	20.3
3295	9.5	10.9	6.4	6.5	6.7
3296			3.3	3.5	3.7
3341	17.8	19.6			
3533					7.9
3551	2.3	2.4	2.5	2.5	2.5
3555			7.9	4.9	5.3
3579		5.3	7.0	8.6	9.0
3714			10.9	11.0	11.6
3792			3.1	3.1	
3861		4.3	5.7		
Total	\$ 476.3	\$ 875.3	\$1,042.8	\$1,185.9	\$1,077.1

ALLIED CHEMICAL
ESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2399				\$ 25.4	\$ 112.8
2661	\$ 8.4				
2812	136.0	130.7	204.3	355.7	581.2
2816	8.9	9.6	12.5	15.2	20.0
2819	174.2	264.5	246.3	541.4	584.3
2821	75.7	80.7	89.9	121.2	196.5
2824	158.1	187.6	204.7	262.3	291.0
2865	176.9	113.8	218.0	259.7	235.6
2869	19.8	21.6	25.5	45.5	56.6
2873	75.8	92.5	102.1	106.3	126.6
2874	30.3	37.0	51.0	90.1	98.2
2879			9.4	14.4	17.9
2899		4.4			
2911	111.3	119.6	154.3	319.7	381.1
2951	4.5	20.5	6.6	16.8	
2952	19.9				
3021	4.0	5.8	9.5	8.3	8.8
3079	4.0	11.6	15.4	8.0	
3295	3.1				
3312	29.1	31.2	40.8	56.3	79.0
3662					4.2
Total	\$1,040.0	\$1,131.1	\$1,390.3	\$2,246.3	\$2,793.8

AMERICAN CYANAMID
ESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2295		\$ 7.8	\$ 9.6	\$ 11.4	\$ 13.8
2816	\$ 44.7	62.3	74.7	99.1	130.3
2819	38.7	48.6	60.1	80.8	99.0
2821	47.3	53.8	81.7	107.8	131.0
2823			27.6	36.2	33.9
2824	28.7	31.9	32.6	40.8	46.0
2834	68.7	83.4	114.9	104.5	147.6
2842	4.8	6.1	7.4		
2844	51.5	60.2	151.4	178.1	227.7
2865	105.2	125.1	159.9	210.2	269.2
2869	66.1	71.9	90.1	151.6	188.7
2873	30.3	43.2	59.5	159.5	189.9
2891	18.6	22.1	24.9	34.9	42.4
2892	6.3	5.7			
2952	23.8	27.7			
3079	62.6	58.2	61.7	80.5	97.0
3431	4.5	5.4	6.6	7.9	11.2
3841	9.7	10.8	13.9	15.9	42.0
3851			2.1	2.5	4.1
Total	\$ 611.5	\$ 724.2	\$ 978.7	\$1,321.7	\$1,673.8

DUPONT
ESTIMATED VALUE OF SHIPMENTS
(In Millions of Dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2282				\$ 17.0	\$ 18.1
2295	\$ 3.3	\$ 3.9	\$ 4.8	17.0	13.8
2816	183.4	196.4	267.7	320.0	460.8
2819	435.5	269.9	282.4	387.8	425.9
2821	354.7	392.8	637.4	1,010.4	1,359.0
2822	129.9	155.3	147.7	215.2	144.5
2824	865.9	1,037.6	1,340.2	1,923.7	2,374.1
2833					21.7
2834			19.2	34.8	60.8
2851	77.1	119.2	168.2	270.0	333.9
2865	105.2	142.2	130.8	210.2	235.6
2869	422.9	460.4	648.5	1,046.0	1,114.3
2892	43.9	41.8	28.1	48.9	35.7
3079	78.7	97.8	135.7	136.8	179.4
3482				185.5	188.5
3484				67.7	97.4
3559	6.8	8.0	10.8	13.0	16.2
3541			2.7	3.8	4.3
3679				15.9	21.0
3761				20.5	38.2
3811			11.2	22.6	26.0
2221					21.9
3861	63.8	86.6	105.4	110.4	156.6
3999	<u>3.3</u>	<u>8.3</u>	<u>4.7</u>	<u>5.7</u>	<u>7.2</u>
Total	\$2,774.4	\$3,020.2	\$3,945.5	\$6,082.9	\$7,354.9

FMC
ESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2812	\$ 80.8	\$ 122.5	\$ 123.8	\$ 103.0	\$ 162.2
2819	121.0	134.9	180.2	250.5	267.4
2821	4.7	69.9	147.1	256.0	311.1
2823	132.2	264.7	203.4	248.5	271.4
2824					38.3
2869	13.2	14.4	18.0	30.3	37.8
2879	69.3	71.4	103.8	144.2	161.0
3079	26.2	37.3	40.1	20.1	24.2
3325			9.1	9.6	12.0
3489	42.6	99.5	58.3	66.8	83.4
3494		2.5	3.1	11.9	14.0
3523	28.1	30.0	60.6	90.7	100.4
3524	16.9	20.0	21.6	24.7	30.0
3531	26.7	33.3	59.2	76.4	107.8
3532	8.0	11.7	39.8	37.6	48.7
3533	2.3	15.6	20.3	26.1	34.4
3535		28.1	74.7	94.9	89.0
3536		8.2	9.7	19.3	42.0
3537	8.8	9.3	12.0	14.3	16.8
3551	38.2	50.9	53.3	66.3	76.7
3552	1.7	2.0	2.5	3.1	
3554	14.4	19.4	8.8	14.9	19.3
3559		8.0	10.8	17.4	21.7
3561	30.3	35.5	48.4	41.4	54.5
3562	2.2	22.7	27.1	34.2	46.4
3564					10.7
3568	65.7	79.6	101.2	122.1	136.8
3569		4.8	6.3	7.4	9.5
3589			33.7	31.5	32.6
3622				13.6	16.5
3674					4.4
3713	4.1	9.0	11.0	8.0	11.3
3743			48.2	58.9	71.6
3791			25.3	28.9	42.1
3795	75.3	101.6	115.3	131.7	205.8
3829					3.2
Total	\$ 812.7	\$1,306.8	\$1,676.7	\$2,104.3	\$2,615.0

GENERAL ELECTRICESTIMATED VALUE OF SHIPMENTS IN CURRENT DOLLARS
(in millions)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
3761	\$ 188.5	\$ 205.9	\$ 292.6	\$	\$
3484	38.0	74.2	48.9	58.8	42.4
3489	14.2	24.9	5.8	6.7	8.3
2751	6.5	8.1	10.1		
2821	33.1	32.3	57.2	121.2	147.4
2822	72.2	89.9	92.3	143.4	192.7
3079	36.3	41.9	55.5	72.4	77.6
3229	13.9	15.5	16.6	21.1	29.8
3264	12.3	13.6			
3321	11.6	12.8	16.8	15.2	19.4
3325	6.8	7.1	9.1	12.8	15.9
3357	182.2	202.2	186.0	253.0	254.0
3443	31.5	52.9	68.2	73.2	91.7
3469			5.8	7.1	8.5
3499	13.7	15.2	25.1	31.1	38.0
3511	208.6	364.4	582.8	781.2	784.6
3545	21.4	36.3	42.6	53.7	60.9
3559	9.0	13.3	18.0		
3561	10.1	11.8	13.8	16.6	21.8
3566	4.4	9.6	16.9	21.4	19.1
3567	23.4	28.5	29.3	36.8	45.3
3569	52.9	67.4	95.0	111.7	142.4
3573	198.8	283.7	58.1	41.3	62.7
3585	67.2	79.2	136.2	152.5	124.0
3589	11.1	2.9			
3599	3.3	3.8	4.6	5.6	6.4
3825	26.8	30.0	45.1	61.0	77.4
3612	148.0	257.2	321.7	386.1	429.6
3613	175.9	275.4	359.0	379.2	418.4
3621	270.9	304.7	459.7	621.3	628.6
3622	145.1	144.2	192.3	296.0	330.0
3629	22.9	26.1	42.3	60.8	90.2
3631	37.2	61.3	56.5	80.1	100.9
3632	256.5	424.0	408.5	533.7	559.7
3633	262.4	415.5	373.6	486.6	625.5
3634	63.8	91.2	119.5	141.5	165.2
3639	91.4	194.4	258.1	174.9	213.6

(continued next page)

GENERAL ELECTRIC
(continued)

ESTIMATED VALUE OF SHIPMENTS IN CURRENT DOLLARS
(In Millions)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
3641	\$ 260.9	\$ 294.1	\$ 407.0	\$ 472.7	\$ 645.3
3645	16.1	15.5	17.4	34.6	39.4
3643	40.6	47.5	57.3	67.9	80.6
3651	106.1	128.8	231.0	360.6	424.3
3662	212.9	314.3	478.2	537.9	645.0
3671	68.1	85.5	93.0	87.1	91.2
3673			2.3	2.8	3.3
3674	23.0	28.7	52.7	61.5	78.6
3679	59.2	98.8	172.8	139.7	113.2
3691	16.4	16.7	35.1	52.7	85.5
3693	42.3	47.3	55.0	80.8	157.8
3699	24.8	54.3	62.4	81.1	105.9
3724	375.5	493.2	778.8	1,027.6	907.9
3714				21.1	28.3
3728	110.5	126.3	121.6	177.6	202.8
3743	164.9	312.9	298.6	11.8	14.3
3829				66.7	63.5
3822	34.7	39.0	45.1	63.3	64.6
3873	43.1	50.3	60.9	49.0	68.6
3999			4.7	5.7	8.3
Total	\$4,371.0	\$6,074.6	\$7,497.7	\$8,660.2	\$9,660.4

W. R. GRACEESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2022	\$	\$ 9.0	\$ 12.7	\$ 15.8	\$ 20.3
2035		63.5	78.5	115.1	
2065		29.5	53.0	71.3	38.7
2066	17.2	19.2	14.7	23.3	28.2
2082		100.4			
2092		52.1	82.4	102.6	139.5
2099			60.6	72.9	
2295	6.6	7.8	9.6	11.4	13.8
2337		4.4	7.1	11.5	
2641	3.9	4.2	5.3	6.5	7.8
2643	24.8	34.1	41.8	83.3	93.3
2661	2.8	3.2	3.9	4.9	5.5
2819	53.2	75.6	84.1	129.3	158.5
2821	47.3	86.1	130.8	215.5	278.3
2822	14.4	16.4	18.5	28.7	48.2
2841	37.9	46.0	53.9	85.1	122.2
2842	9.6	12.3	14.9	27.0	35.4
2869	92.5	100.7	126.1	242.6	301.9
2873	10.1	12.3	25.5	53.2	63.3
2874	65.7	80.2	110.8	210.2	229.2
2875	4.9	11.2	14.0	38.8	46.6
2899	25.2	35.6	65.3	91.3	116.2
3079	10.1	14.0	21.6	52.3	53.3
3144			10.4	19.2	21.7
3171			3.3	3.5	6.6
3272		4.7	5.8	7.4	8.5
3293	12.4	13.5	16.8	23.9	33.2
3295	9.2	11.6	8.7	10.1	14.2
3296			4.2	5.4	6.9
3341	18.3	19.6			
3533					17.2
3551	2.2	2.5	3.1	3.7	4.5
3555			10.3	7.5	9.7
3579		5.3	7.5	9.8	10.9
3714			13.7	15.8	21.2
3792			3.6	4.1	
3861		4.3	5.9		
Total	\$ 468.3	\$ 879.3	\$1,128.4	\$1,803.0	\$1,954.8

B. F. GOODRICH
ESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2241	\$ 4.9	\$ 5.5			
2296	97.8	102.0	\$ 137.0	\$ 155.4	\$ 182.0
2399	3.5	4.4			
2821	118.2	188.3	253.3	350.3	458.5
2822			73.9	114.8	128.5
2869	39.6	43.2	54.0	91.0	113.3
3011	278.3	359.7	438.4	545.0	594.0
3021	67.7	94.9	36.1		
3041	8.4	16.5	35.2	36.1	56.7
3069	39.8	47.2	45.8	62.9	29.2
3293	1.8	1.9	2.4	6.0	7.4
3728	7.6	15.2	23.7	29.0	35.3
Total	\$ 667.6	\$ 878.8	\$1,099.8	\$1,390.5	\$1,604.9

MINNESOTA MINING AND MANUFACTURING COMPANY

ESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2641	\$ 313.5	\$ 349.8	\$ 430.7	\$ 544.5	\$ 657.0
2649	20.3	25.2	27.9	36.3	45.2
2821	14.2	37.7	40.9	67.4	196.5
2834			44.7	55.8	69.4
2851	8.6	9.5	11.6	23.1	49.1
2891	14.0	59.8	18.7	52.3	53.0
2893				7.3	8.6
2899	41.9	44.5	59.4	83.0	96.9
3079	6.1	11.6	18.5	24.1	29.1
3231	4.9	6.3	11.8	8.0	9.5
3264	24.6	27.1	32.8	37.2	40.2
3281	2.5	3.0	4.1	4.6	5.7
3291	31.0	31.5	32.6	27.1	34.8
3295	6.1	7.7	13.0	15.2	14.2
3479	1.9	1.8	2.5	3.0	4.1
3555	4.4	8.0	24.1	26.4	24.3
3579	2.2	2.6	7.5	4.9	5.5
3651	37.5	34.1	46.2	49.9	63.6
3672					4.7
3679	4.7	13.3	18.2	19.0	25.2
3842			3.3	3.6	4.2
3861	85.1	121.3	169.9	193.2	181.3
3993	<u>6.5</u>	<u>9.1</u>	<u>19.2</u>	<u>24.4</u>	<u>25.3</u>
Total	\$ 630.0	\$ 803.9	\$1,037.6	\$1,310.3	\$1,647.4

TRWESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
3079	\$ 6.1	\$ 7.0	\$ 9.2	\$ 12.1	\$ 14.5
3321		2.1	2.8	11.4	14.6
3361				10.2	12.3
3357	19.2	25.9	38.5	54.2	54.4
3369		2.3	2.9	3.6	3.7
3399			4.4	6.0	6.6
3423	20.3	23.8	31.4	28.2	61.7
3452	28.6	36.2	54.0	71.8	80.0
3471	2.6	3.0			
3494	39.7	49.0	62.7	95.5	112.1
3541		5.0	5.4	7.6	12.9
3544			5.0	5.7	6.2
3545		45.4	53.3	73.9	91.4
3559	2.3	2.7			
3561		8.9	17.3	20.7	27.2
3562	31.0	52.3	69.2	91.1	129.9
3592	11.6	13.4	19.5	21.4	28.3
3612	2.5	5.6	6.2	8.0	18.7
3622	6.5	6.5	8.4	13.6	20.6
3629		15.8	20.0	27.4	28.9
3643		23.7	27.4	38.8	42.2
3662	310.6	379.4	335.0	385.1	490.1
3674	20.3	22.6	30.5	32.3	43.6
3679	90.4	117.8	187.9	196.8	260.0
3714	139.8	182.6	233.2	301.0	375.2
3724	48.4	56.4	97.4	105.3	147.5
3825	7.1	8.0	11.3	15.3	23.2
3964	1.8	2.1	2.8	6.0	7.3
Total	\$ 788.8	\$1,097.5	1,335.0	\$1,643.0	\$2,113.1

UNION CARBIDE
ESTIMATED VALUE OF SHIPMENTS
(in millions of dollars)

<u>SIC#</u>	<u>1965</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>	<u>1976</u>
2299	\$ 4.7	\$ 5.4	\$ 5.1	\$	\$
2515	6.8	7.8			
2643	11.0	18.6	30.4	77.8	93.3
2813	79.3	117.8	113.2	188.5	240.6
2819	72.6	86.4	102.1	185.8	257.5
2821	179.7	182.9	294.2	471.5	540.3
2834	4.3	4.9			
2869	594.5	669.0	738.6	1,243.1	1,586.4
3079	54.5	62.9	89.4	116.7	140.6
3313	255.7	237.7	312.7	562.5	566.3
3356	116.2	120.9			
3479	3.8	3.6	7.6	15.0	20.3
3549	2.3	5.2	6.3	3.8	4.1
3559	47.3	55.9	75.7	95.7	151.6
3585	23.4	27.6	37.6	40.7	52.2
3623	7.1	3.5	4.3	11.1	12.4
3624	112.4	115.5	147.0	218.9	243.5
3629	3.5	4.0	4.4		
3679	12.5	22.8	54.6	63.5	83.9
3691					13.2
3692	<u>105.2</u>	<u>119.9</u>	<u>182.3</u>	<u>209.4</u>	<u>283.4</u>
Total	\$1,696.8	\$1,872.3	\$2,205.5	\$3,504.0	\$4,289.6