CORPORATE PRODUCTIVITY AND I/S INVESTMENT

SCATTERGRAM ANALYSIS

Center for Research on Information Technology and Organizations (CRITO)
Graduate School of Management
University of California, Irvine

Kenneth L. Kraemer
Debora Dunkle
Graduate School of Management
Center for Research on Information Technology and Organizations (CRITO)
University of California, Irvine

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Intercorporate Measurement Program

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About IMP

The Intercorporate Measurement Program (IMP) is an industry-university cooperative research program conducted by the Center for Research on Information Technology and Organizations (CRITO) at the University of California, Irvine. It is supported by grants from the United States National Science Foundation and IBM Corporation. The program’s earlier years were supported by grants from CSC Research and Advisory Services. Our purpose is to further the state of the art of I/S performance measurement and to improve I/S performance in practice. IMP conducts annual surveys of management practice, business value, and I/S performance in corporations. It feeds back the knowledge gained to survey participants and to IMP sponsors through publications, workshops, and client programs. For further information on the IMP Program, please contact Dr. Kenneth L. Kraemer at (714) 824-5246 or kkraemer@uci.edu.

About the Authors

Kenneth L. Kraemer specializes in the management of computing and is co-author of Managing Information Systems and ten other books on computers and information systems in organizations. Debora Dunkle specializes in survey research, data analysis and statistical modeling.
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EXECUTIVE SUMMARY

The idea of a positive relationship between I/S investment and corporate productivity continues to raise questions and doubts from information technology specialists to economists.

“There still is no evidence suggesting that investments in I/S are paying off.” (Paul Straussman, Computerworld, 1996)

“I must confess that I am having second thoughts as to whether we have reached the promised land … These doubts have caused me to rethink many of the glorious conclusions that I have long argued would be part of the sacred productivity-led recovery.” (Stephen Roach, Chief Economist at Morgan-Stanley)

The Intercorporate Measurement Program’s (IMP) data on 517 manufacturing and services firms in 20 industry sectors contradicts the above conclusions. It shows that:

- greater investment in I/S is positively and significantly linked to greater corporate productivity;
- the chief benefits of I/S investment are less in reductions of administrative overhead than in direct improvements in operations throughout the value chain.

While the data does not prove that greater I/S spending causes greater corporate productivity, the theoretical argument, based on IMP’s research, supports such a conclusion.

At any point in time, a corporation has a certain level of I/S spending and corporate productivity. Since greater I/S spending is expected to result in greater productivity as a result of automational, informational, or transformational effects, it is valid and useful to assess the payoff from I/S investment by its correlation with corporate productivity. By plotting the value for the total I/S budget per corporate employee against the value for total corporate revenue per corporate employee, and comparing this point with the paired values from other corporations in the same or similar industry, we are able to measure the payoff from a company’s I/S investment. The expectation is that the higher the investment in I/S, the higher the productivity of the corporation. 

Comparison of these values among corporations also provides a useful benchmark for assessing an individual firm’s relative position versus its competitors for a specific industry.
CORPORATE PRODUCTIVITY AND LEVEL OF I/S INVESTMENT: SCATTERGRAM ANALYSIS

I. INTRODUCTION

In a recent article in *Computerworld*, Paul Straussman argued that there still was no evidence suggesting that investments in I/S are paying off. The logic of his argument was that if I/S had payoffs, then it should show up in reduced GS&A (general, sales and administrative) expenses on the grounds that the major contribution of I/S was to the “administrative component” of organizations. Accordingly, in an analysis of 138 firms, he found that while I/S expenses as a percent of corporate revenues was increasing, the percent of revenues for GS&A was not decreasing and therefore there are no productivity gains.

The results in this special report contradict Straussman’s analysis and conclusion. Our analysis shows that greater investment in I/S is positively and significantly linked to greater corporate productivity. Moreover, our data emphasizes the need to look at I/S payoffs by industry sector. While our analysis does not prove that greater I/S spending causes greater corporate productivity, our theoretical argument and other research support such a conclusion, especially when one recognizes that these two factors are interactive.

At any point in time, a corporation has a certain level of I/S spending and corporate productivity. Greater spending for I/S is expected to result in greater productivity as a result of automational, informational, or transformational effects. Automation refers to the substitution of technology for labor and usually results in greater productivity in operations. It might also result in greater productivity in administrative (GS&A) activities, but such effects are far less likely to occur or to be noticeable. This is because the administrative ratio (GS&A as % of revenues) is low to begin with and cannot be ratcheted downward on a one-to-one basis with operations. Additionally, there are time delays in adjustments to the

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administrative ratio, as well as the possibility of task realignments where administrative staff take on operational responsibilities without changing their place in the corporation.\textsuperscript{3}

As found with automational effects, many of the major informational impacts of I/S show up in operations rather than administration. Several examples are illustrative. One example is that of inventory control. Information and inventory are substitutes for one another, meaning that detailed and timely information about inventory levels can support just-in-time logistics. The utilization of just-in-time logistics, in turn, saves money for suppliers, manufacturers, and customers by lowering needed inventories, warehousing, and staffing. Another example are yield management models used in airline, car rental, and hotel reservation systems to increase firm revenues by setting pricing in relation to demand. The transformational impacts of I/S operate in similar fashion to the automational and informational impacts just discussed in that it will directly affect operations but may not noticeably affect GS&A. By realigning corporate structure, control systems, human resource practices, and I/S to better fit with corporate strategy, firms are able to increase their effectiveness in bringing new products to market ahead of competitors, providing superior customer service and support, and optimizing their own operations as well as those of suppliers and customers in the value chain.

In summary, the impact of automational, informational, and transformational effects will not show up in GS&A expenses. However, they will show up in greater revenues and decreased costs, thereby contributing to both the top-line and the bottom-line of corporate productivity. The chief benefits of I/S investment are found more in direct improvements in operations throughout the value chain than in reductions of administrative overhead. This is why we find payoffs and Straussman does not. He is looking in the wrong place.

We argue that it is valid and useful to assess the payoff from I/S investment by its correlation with corporate productivity. We, therefore, plot the value for the total I/S budget per corporate employee against the value of total corporate revenue per corporate employee, and compare this point with the values from other corporations in the same or similar industry.

We expect that the higher the investment in I/S, the higher the productivity of the corporation. Corporate productivity can be measured in a variety of ways, and factors other than I/S investment can be associated with a given value. However, the analyses we have conducted for the past three years along with that performed by others, have consistently indicated that for many types of firms, I/S investment is associated with corporate productivity. Comparison of these values among corporations provides a useful benchmark for assessing an individual firm’s relative position in its industry.

This report provides such benchmarks for 20 industry sectors, as follows:

**Manufacturing**
- Food Processing
- Forest Products
- Printing & Publishing
- Chemicals
- Pharmaceuticals
- Petroleum & Refining
- Building Materials, Glass, and Metals
- Industrial & Farm Equipment
- Computer & Office Equipment
- Electronics & Electrical
- Automotive and Aerospace
- Instrumentation

**Services**
- Transportation Services
- Communications
- Utilities
- Wholesale Trade
- Retail
- Banking and Finance
- Insurance
- Business Services
GUIDE TO THE SCATTERGRAM

The scattergram in Exhibit 1 below is an example of the type of analysis that is produced. It is based on regression analysis. Each point on the scattergram represents a corporation and its position, and is based on that corporation’s values for total revenue per employee and for I/S budget dollars per employee.⁵

**Exhibit 1. Scattergram of Corporate Productivity and I/S Investment**

![Scattergram of Corporate Productivity and I/S Investment]

- **Corporate productivity** = $164,580 + 18.33(I/S investment)
- **correlation (r)** = .415
- **50th percentile = $183,220**
- **50th percentile = $2,651**

**Vertical and Horizontal lines.** Exhibit 1 shows I/S investment (I/S budget dollars per corporate employee) on the horizontal line and corporate productivity (total sales revenue per corporate employee) on the vertical line. The two lines intersect at the respective median values (50th percentile). Although not directly shown in Exhibit 1, the median corporate productivity is $183,220, which means that 50% of the firms earned more per employee and

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⁵ Data for the analysis is obtained from a variety of sources including the IMP survey and published accounts in *Computerworld*, *Datamation*, and *InformationWeek*. The primary source for corporate sales and revenues and number of employees in the corporation is through COMPSTAT. The data is from fiscal years 1994 and 1995.
50% of the firms earned less per employee. Similarly, the median I/S investment is $2,651, which means that 50% of the firms spent more than $2,651 per employee and 50% spent less.

**Investment Quadrants.** In order to assess the relative value of investments, we divide Exhibit 1 into four investment quadrants as shown with the circled letters, A, B, C and D. Datapoints to the left of the vertical line in Exhibit 1 represent “low I/S investment” and datapoints to the right of the vertical line as “high I/S investment”. Datapoints above the horizontal line in Exhibit 1 represent “high corporate productivity” and datapoints below the horizontal line in Exhibit 1 represent “low corporate productivity”. The resulting four investment quadrants are shown in Exhibit 2.

**Exhibit 2. Interpretation of the Four Quadrants**

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<tr>
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<th>A</th>
<th>B</th>
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<tr>
<td></td>
<td>High corporate productivity and low I/S investment</td>
<td>High corporate productivity and high I/S investment</td>
</tr>
<tr>
<td>C</td>
<td>Low corporate productivity and low I/S investment</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>Low corporate productivity and high I/S investment</td>
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</table>

A corporation can approximately be assigned to one of the four quadrants in the scattergram by locating its point on the scattergram and noting whether its average I/S budget per employee is above or below the median, and similarly whether its average total corporate revenue per employee is above or below the median. The scattergram is useful for benchmarking a corporation relative to others in a particular industry.

- *Quadrant A*, while very attractive, is shown empirically to have very few members and a company’s position in that quadrant is most likely transient.
- If a company is in *Quadrant B*, its I/S investment is paying off.
• Companies in Quadrant C may want to consider the possible benefits of increased I/S investment, especially if major competitors are showing payoff from a strategy of greater I/S investment.

• Companies positioned in Quadrant D should investigate why I/S investment might not be “paying off” in terms of corporate productivity. It is possible that the level of I/S spending has been insufficient to build an information infrastructure for the company or that spending has been poorly applied. It is also possible that a company or its I/S function is undergoing a major transition, or that its values are a statistical oddity or simply incorrect.

**Diagonal Line.** The diagonal line in Exhibit 1 describes the association between corporate productivity and I/S investment. The slope indicates how correlated these two variables are. Correlation can vary from -1.00 to +1.00. The closer the correlation is to -1.00 or +1.00, the more associated the two variables are. A correlation of ‘0’ means that the two variables are not associated. For the kind of data and the number of companies used in the analyses, an appropriate assumption for these graphs is that corporate productivity is associated with I/S investment if the correlation is .30 or higher.

An equation \[\text{corporate productivity} = 164,580 + 18.33 \times \text{(I/S investment)}\] is provided in Exhibit 1 which describes the diagonal line on the scattergram. If one were to replace the ‘x’ (I/S investment) with a corporation’s value for I/S expenditure per corporate employee and then solve the equation, the value of ‘y’ (corporate productivity) would equal what would be expected as the total revenue per corporate employee given the level of I/S investment currently measured for that corporation. A particular firm can compare itself with all firms, with manufacturing or services firms, with one of the 20 industry sectors, or with all of these.

Calculating the difference between actual revenue per employee and the expected value (the calculated ‘y’) may provide additional information about a corporation. For example, a negative value may indicate that there is a “potential productivity loss” that needs investigation. A positive difference, that is, a corporate revenue per employee greater than expected by the equation, indicates that I/S investments appear to be paying off.
Qualitative Assessment. The quantitative analysis indicated by the scattergram is not the final word on “good” or “bad” I/S investments. Rather it is one piece of evidence (a red or green light) indicating a corporation’s “successful” or “problematic” investment in I/S. A major complementary piece of evidence is the assessment of the Business Value of IT investment by the heads of major business units in the firm who are customers of the I/S unit. This qualitative assessment can be very helpful in understanding where senior executives see payoffs from I/S and where they do not. We include this assessment as part of the IMP annual survey and is covered in other IMP reports.
II. I/S INVESTMENT AND CORPORATE PRODUCTIVITY

GROSS COMPARISONS

Exhibit 3 displays the relationship between corporate productivity and I/S investment for 279 manufacturing firms and 238 services firms. The regression equation and correlation are statistically significant (indicating that there is an association between the two variables) for manufacturing and services firms.

Exhibit 3. Corporate Productivity and I/S Investment


Corp. Productivity = $98,936 + 44.03 (I/S investment)  Corp. Productivity = $239,074 + 12.82 (I/S investment)
correlation = .597 (variance explained = 35.6%) correlation = .322 (variance explained = 10.4%)

These two gross characterizations are useful in that they show that the association between I/S investment and corporate productivity is higher in manufacturing than in services. This is indicated by the slope of the diagonal line for manufacturing versus services.
INDUSTRY AND SECTOR COMPARISONS

Exhibit 4 shows a finer breakdown of manufacturing and services firms by industry sector and also shows the reason why industry sector is important. The graphs on the left hand side of Exhibit 4 depict the relative location of industry sectors for manufacturing and services. We have plotted the various industry sectors by each sector’s mean value for I/S budget dollars per corporate employee and mean value for total revenue per corporate employee.
The resulting spread of the industry sectors in Exhibit 4, especially the spread in services, points to the fact that there are considerable differences among the various industries.

In these scattergrams we have maintained the ‘x’ and ‘y’ intersections of Exhibit 3 to indicate the relative location of the various industries by sector across the quadrants. It is important to note that the points highlighted on the left hand side of Exhibit 4 do not indicate the actual spread of each of the industry sectors. In addition, further analysis by industry sectors reveals that industries are more apt to be clustered within a range than dispersed. Examples of this clustering are shown in the graphs on the right hand side of Exhibit 4.

Analysis by industry sector complements overall industry analysis by noting the differing ranges of I/S investment dollars and corporate productivity dollars, thus pointing out considerable variations among industry sectors. In addition, sector analysis allows us to study industry sectors within the context of the four quadrants. For example, manufacturers of forest products and metals are almost all clustered in Quadrant A, while chemical and pharmaceutical manufacturers are all clustered in Quadrant B. Shifting to services, we can see that entertainment, business, and healthcare firms are primarily grouped in Quadrant C, and that communication services is found in Quadrant D. This clustering by industry means that both corporate productivity and I/S investment form a range of values that is specific to an industry. Again, the importance of these findings is that “industry” or “peer group” analysis provides the more accurate reading of a corporation’s association of I/S investment with corporate productivity.

It seems clear from this analysis that different industry sectors may be better or worse at gaining productivity from their I/S investments. For those in Quadrants C and D, there may be “missed opportunities”, poor planning, or a need for re-engineering to gain results. Additionally, it just may be that certain industry environments require careful consideration of other critical success factors that might inhibit full payoff (i.e., the competitive entertainment and communications industries).

Consequently, to assess a corporation’s performance, it is best to compare it within its own industry and, therefore, against its direct competitors. One can also compare a corporation
with firms that are not located in one’s own industry, but are otherwise similar. In addition, one could also benchmark a particular firm with corporations that are “leaders” regardless of industry.
### III. INDUSTRY SECTOR SCATTERGRAMS

We have constructed 20 scattergrams by industry sector, which we have listed below. Each scattergram contains a list of all of the corporations that are included in that chart, the regression equation, and the correlation.

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<td>Exhibit 16. Instrumentation</td>
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Exhibit 5. Food Processing, 1995

expected corporate productivity = $138,224.65 + 56.54 (i/s investment per employee)
correlation = .615 (variance explained = 37.9%)
Exhibit 6. Forest Products, 1995

expected corporate productivity = $198,004.60 + 48.47 (I/S investment per employee)
correlation = .332 (variance explained = 11%)

Avery Dennison  Manville Sales Corp.
Bemis Co., Inc.  MacMillan Bloedel
Boise Cascade Corp.  The Mead Corp.
Bowater  Rayonier
Champion International Corp.  Simpson Investment Co.
Chesapeake Corp.  Sonoco Products
Gaylord Container Corp.  Stone Container Corp.
Georgia-Pacific  Temple-Inland, Inc.
International Paper Co.  Union Camp Corp.
James River Corp. of Virginia  Westvaco Corp.
Jefferson Smurfit  Weyerhaeuser Inc.
Kimberly Clark  Willamette Industries

expected corporate productivity = $89,189.04 + 36.05 (i/s investment per employee)
correlation = .568 (variance explained = 32.3%)

Advance Publications Inc.  
Banta Corp.  
R.R. Donnelley & Sons Co.  
Dow Jones & Co.  
EW Scripps Co.  
Freedom Communications  
Gannett Co., Inc.  
Hearst Corp.  
Journal Communications Inc.  
K III Holdings  
Knight-Ridder, Inc.  
McGraw-Hill, Inc.  
MediaNews Group Inc.  
New York Times Co.  
Reynolds and Reynolds Co.  
Time Warner Inc.  
Times Mirror Co.  
Tribune Co.  
Washington Post Co.
Exhibit 8. Chemicals, 1995

expected corporate productivity = $175,762.18 + 32.34 (i/s investment per employee)
correlation = .529 (variance explained = 28%)

Air Products and Chemicals, Inc.  Hercules Inc.
Avon Products, Inc.  Hoechst Celanese Corp.
Cabot  IMC Global
Colgate-Palmolive  MA Hanna Corp.
The Dial Corp.  Monsanto Co.
Dow Chemical Co.  Morton International Inc.
DuPont Co.  Occidental Petroleum Corp.
Ethyl Corp.  Olin Corp.
FMC Corp.  PPG Industries
GAF Corp.  Procter & Gamble
Geon  Rohm and Haas Co.
The B.F. Goodrich Co.  Sherwin-Williams Co.
W.R. Grace & Co.  Union Carbide Corp.
Hercules Inc.  Witco Corp.
Exhibit 9. Pharmaceuticals, 1995

expected corporate productivity = $140,436.06 + 20.30 (i/s investment per employee)
correlation = .563 (variance explained = 31.7%)

Abbott Laboratories
American Home Products Corp.
Bristol Myers Squibb Co.
Johnson & Johnson
Eli Lilly & Co.
Mallinckrodt Medical, Inc.
Merck & Co.
Pfizer Inc.
Rhone Poulenc Rorer, Inc.
Schering-Plough Corp.
Warner-Lambert Co.
Exhibit 10. Petroleum and Refining, 1995

expected corporate productivity = $370,705.77 + 56.12 (i/s investment per employee)
correlation = .667 (variance explained = 44.5%)

- Amoco
- Ashland Oil
- Atlantic Richfield Co.
- Chevron Corp.
- Exxon Corp.
- Kerr-McGee Corp.
- Mobil Corp.
- Phillips Petroleum Co.
- Quaker State
- Shell Oil
- Sun Co., Inc.
- Texaco Inc.
- Unocal Corp.
expected corporate productivity = $177,466.76 + 12.77 (i/s investment per employee)
correlation = .179 (variance explained = 3.2%)

Alumax, Inc.  Harsco Corp.  Reynolds Metals Co.
ALCOA  Illinois Tool Works Inc.  Snap-On Tools Corp.
Armco, Inc.  Inland Steel Industries  The Stanley Works
Armstrong World Industries  Kohler Co.  Trinova Corp.
Asarco, Inc.  LTV Corporation  USG Corp.
Ball Corporation  Maxxam, Inc.  USX Corp.
Bethlehem Steel Corp.  Owens-Corning  3M Company
Corning Corporation  Owens-Illinois  
Crane  Parker Hannifin Corp.  
Crown Cork & Seal Co. Inc.  Phelps Dodge Corporation  
Gillette Co.  Premark International  
Goodyear Tire Co. 

I/S Intercorporate Measurement Program
expected corporate productivity = $88,120.19 + 31.38 (I/S investment per employee)
correlation = .699 (variance explained = 48.9%)

expected corporate productivity = $67,087.49 + 26.68 (i/s investment per employee)
correlation = .596 (variance explained = 35.6%)

Apple Computer Inc.  NCS
Cray Research  Pitney Bowes Inc.
Data General Corp.  Seagate Technology Inc.
Dell Computer Corp.  Storage Technology Corp.
Digital Equipment Corp.  Sun Microsystems Inc.
Hewlett-Packard Co.  Tandem Computers Inc.
IBM  Unisys Corp.
Intergraph Corp.  Wang Laboratories
expected corporate productivity = $133,492.98 + 14.89 (i/s investment per employee)
correlation = .552 (variance explained = 30.5\%)
Exhibit 15. Automotive and Aerospace, 1995

Corporate Productivity (50th percentile = $158,733.69)

$I/S$ Investment (50th percentile = $3,309.10)

expected corporate productivity = $123,005.66 + 18.88 ($I/S$ investment per employee)

correlation = .50 (variance explained = 25.2%)

Allied-Signal Inc.        Lockheed Corp.
Amsted Industries Inc.    Loral Corp.
Arvin Industries Inc.     Mascotech Inc.
Boeing                  McDonnell Douglas Corp.
Borg Warner Automotive Inc.    Navistar International Corp.
Chrysler Corp.                         Northrop-Grumman
Dana Corp.                          Paccar, Inc.
Eagle Picher Industries Inc.    Rockwell International Corp.
Eaton Corp.                               Sequa Corp.
Echlin Inc.                                Sundstrand Corp.
Federal-Mogul Corp.                   Teledyne, Inc.
Ford Motor Corp.                         Textron Corp.
Gencorp Inc.                                         Thiokol Corp.
General Dynamics                         TRW
General Motors                               United Technologies Corp.
Exhibit 16. Instrumentation, 1995

expected corporate productivity = $117,266.31 + 13.15 (i/s investment per employee)
correlation = .487 (variance explained = 23.7%)

Bausch & Lomb, Inc.  Mark IV Industries, Inc.
Baxter International  Medtronic Inc.
Beckman Instruments Inc.  Polaroid Corp.
Becton, Dickinson & Co.  Raytheon Co.
Eastman Kodak  Tektronix Inc.
Honeywell, Inc.  Thermo Electron Corp.
Johnson Controls, Inc.  United States Surgical
Litton Industries  Xerox
Exhibit 17. Transportation Services, 1995

expected corporate productivity = $80,125.56 + 18.60 (i/s investment per employee)
correlation = .611 (variance explained = 37.3%)

American Airlines  Norfolk Southern Corp.
American President Companies  Northwest Airlines, Inc.
Burlington Northern, Inc.  The Pittston Co.
Caliber Systems  Roadway Services, Inc.
Consolidated Freight  Ryder System, Inc.
CSX Corp.  Union Pacific Corp.
Federal Express Corp.  United Parcel Service
GATX Corp.  USAir Group
Kansas City Southern Industries  Yellow Freight Systems
expected corporate productivity = $108,805.43 + 9.08 (i/s investment per employee)
correlation = .781 (variance explained = 61%)

Alltel Corp.
Ameritech Corp.
AT & T
Bell Atlantic Corp.
Bell South Corp.
GTE Service Corp.
MCI Communications Corp.
Nynex Corp.
Pacific Telesis Group
SBC Communications
Sprint Corporation
US West Communications
Exhibit 19. Utilities, 1995

expected corporate productivity = $426,290.34 + 2.61 (i/s investment per employee)
correlation = .145 (variance explained = 2.1%)

Allegeny Power System
American Electric Power
Carolina Power & Light Co.
Central & Southwest Corp.
CMS Energy Corp.
Coastal Corp.
Columbia Gas System
Commonwealth Edison
Consolidated Edison of New York
Consolidated Natural Gas Co.
Dominion Resources Inc.
DTE Energy (Detroit Edison)
Duke Power Co.
Enron Corp.
Enery Servies
Florida Power & Light
General Public Utilities Corp.
Kansas City Power & Light
New York State Electric & Gas
Niagara Mohawk Power Corp.
Northeast Utilities
Northern States Power Co.
ONEOK
Pacific Enterprises
Pacific Gas & Electric Co.
Pacificorp
PanEnergy
Pinnacle West Capital Corp.
Public Service Electric & Gas
SCE Corp.
Sonat, Inc.
The Southern Co.
Transcanada Pipeline
WMX Technologies, Inc.
Exhibit 20. Wholesale Trade, 1995

\[
\text{expected corporate productivity} = 249,174.10 + 65.36 \times (\text{i/s investment per employee})
\]

correlation = .604 (variable explained = 36.4%)

Ace Hardware
Alco Standard Corp.
Anixter International
Avnet, Inc.
Certified Grocers of California
Commercial Metals Co.
Fleming Companies Inc.
Genuine Parts Co.
Earle M. Jorgensen
Kaman Corp.
Mars, Inc.
McKesson Corp.
MicroAge Inc.
SuperValu Stores, Inc.
Sysco Corp.
United Stationers
Exhibit 21. Retail Trade, 1995

\[
\text{Corporate Productivity (50th percentile = $119,310.38)}
\]

\[
\text{I/S Investment (50th percentile = $661.16)}
\]

expected corporate productivity = $-85,896.90 + 44.44 (i/s investment per employee)

correlation = .606 (variance explained = 36.7%)

Albertson, Inc.  |  K Mart Corp.  |  Publix Super Markets Inc.
American Stores Co.  |  Kroger Co.  |  Safeway Inc.
Aramark Group Inc.  |  The Limited, Inc.  |  Sears, Roebuck & Co.
Dayton Hudson Corp.  |  The May Department Stores  |  Toys R Us, Inc.
Federated Department Stores  |  Meijer, Inc.  |  Venture Stores Inc.
Food Lion, Inc.  |  Montgomery Ward  |  Wal-Mart Stores, Inc.
J.C. Penney Co.  |  Payless Cashways  |  F.W. Woolworth Co.
Penn Traffic Co.
Exhibit 22. Banking and Finance, 1995

expected corporate productivity = $135,154.96 + 12.71 (i/s investment per employee)
correlation = .779 (variance explained = 60.6%)
Exhibit 23. Insurance, 1995

expected corporate productivity = $324,213.41 + 34.80 (i/s investment per employee)

correlation = .310 (variance explained = 9.6%)

Aetna Life & Casualty  
Aid Association for Lutherans  
Alexander & Alexander  
Allmerica Financial Group  
American International Group  
American National Insurance  
Aon Corp.  
Automobile Club of So. Calif.  
Chubb & Son  
Erie Insurance Group  
Guardian Life  
John Hancock  
Johnson & Higgins  
Kemper Corp.  
Liberty Mutual Group  
Loews Corp.  
Metropolitan Life Ins. Co.  
NAC Reinsurance  

New York Life Ins. Group  
Old Republic International  
Principal Financial Group  
The Prudential Ins. Co.  
Reliance Group Holdings  
Sammons Enterprises Inc.  
State Farm Mutual Ins.  
USF&G Corp.
expected corporate productivity = $51,111.93 + 27.51 (i/s investment per employee)
correlation = .853 (variance explained = 72.8%)
APPENDIX: FIRMS INCLUDED IN SCATTERGRAMS

Manufacturing Firms

3M Co.  
A. O. Smith Corp.  
Abbott Laboratories  
Advance Publications Inc.  
Air Products and Chemicals Inc.  
Allied-Signal Inc.  
Alumax Inc.  
ALCOA  
American Home Products  
American Standard  
Ametek Inc.  
Amoco  
AMP, Inc.  
Amsted Industries Inc.  
Analog Devices  
Anheuser Busch Cos Inc.  
Apple Computer Inc.  
Armo Inc.  
Armstrong World Industries  
Arvin Industries Inc.  
Asarco Inc.  
Ashland Oil  
Atlantic Richfield Co.  
Avery Dennison  
Barnett Banks, Inc.  
Battelle Memorial Institute  
Bausch & Lomb, Inc.  
Baxter International  
Beckman Instruments Inc.  
Becton, Dickinson & Co.  
Berkline & Co., W.R.  
Bowman  
Boise Cascade Corp.  
Borden, Inc.  
Borg Warner Automotive Inc.  
Bristol Myers Squibb Co.  
Browning Corp.  
Burlington Industries  
Cabot  
Campbell Soup Co.  
Cardinal Inc.  
Caterpillar Inc.  
Champion International Corp.  
Chesapeake Corp.  
Chevron Corp.  
Chrysler Corp.  
Cincinnati Milacron Inc.  
Coca-Cola Enterprises, Inc.  
Colgate Palmolive  
Collins & Aikman Corp.  
Coltech Industries  
ConAgra  
Continental Grain Co.  
Cooper Industries Inc.  
Corning Corp.  
CPC International Inc.  
Crande  
Cray Research  
Crown Cork & Seal Co. Inc.  
Cummins Engine Co. Inc.  
Cyprus Mines Co.  
Dana Corp.  
Danaher Corp.  
Data General Corp.  
Dean Foods Inc.  
Deere & Co.  
Dell Computer Corp.  
Digital Equipment  
Dole Food Co. Inc.  
Donnelley (R.R.) & Sons Co.  
Dover Corp.  
Dow Chemical Co.  
Dow Jones & Co.  
Dresser Industries, Inc.  
DSC Communications  
DuPont Co.(E.L. du Pont de Nemours)  
Eagle Picher Industries Inc.  
Eastman Kodak  
Eaton Corp.  
Echlin Inc.  
Emerson Electric Co.  
Ethyl Corp.  
EW Scripps Co.  
Exxon Corp.  
Farmland Industries Inc.  
Federal-Mogul Corp.  
Fieldcrest Cannon  
Fibigge International Inc.  
FMC Corp.  
Ford Motor Co.  
Freedom Communications GAF Corp.  
Gannett Co. Inc.  
Gaylord Container Corp.  
Gencorp Inc.  
General Dynamics  
General Electric  
General Mills, Inc.  
General Motors  
General Signal Corp.  
Geon  
Georgia-Pacific  
Gillette Co.  
Gold Kist Inc.  
Goodrich Co. (The B.F.)  
Goodyear Tire  
Goodyear-Welt Co., W.R.  
Great American Mgmt & Innovation  
Harnischfeger Industries, Inc.  
Harris Corp.  
Harsco Corp.  
Heart Corp.  
Hercules Inc.  
Hershey Foods Corp.  
Hewlett-Packard Co.  
Hoechst Celanese Corp.  
Honeywell Inc.  
Huber (J.M.) Corp.  
IBM  
Illinois Tool Works Inc.  
IMC Global  
Inco Industries  
Ingersoll-Rand Co.  
Inland Steel Industries, Inc.  
InSulco Corp.  
Intel Corp.  
Interco  
Intergraph Corp.  
International Multifoods Corp.  
International Paper Co.  
Interstate Bakeries  
James River Corp.  
Jefferson Smurfit  
Johnson & Johnson  
Johnson Controls, Inc.  
Journal Communications Inc.  
JR Simplot Co.  
K III Holdings  
Kerr-McGee Corp.  
Kimberly-Clark Corp.  
Knight-Ridder, Inc.  
Kohler Co.  
Land O'Lakes  
Lennox International Inc.  
Levi Strauss & Co.  
Lilly (Eli) & Co.  
Litton Industries  
Lockheed Corp.  
Loral Corp.  
LSI Logic Corp.  
LTV Corp.  
MA Hanna Corp.  
Magneteck Inc.  
Malinckrodt Medical, Inc.  
Manville Sales Corp.  
Mark IV Industries Inc.  
Marmon Group Inc.  
Masco Corp.  
Mascotew Inc.  
Mayax Inc.  
Maytag Corp.  
McCormick & Co. Inc.  
McDermott International Corp.  
McDonnell Douglas Corp.  
McGrath-Hill, Inc.  
Mead Corp., The  
MediaNews Group Inc.  
Medtronic Inc.  
Merck & Co.  
Milliken & Co.  
Mobil Corp.  
Monsanto Co.  
Morton International Inc.  
Motorola Inc.  
Nabisco Foods  
NACCO Industries  
National Computer Systems  
National Service Industries  
Navistar International Corp.  
New York Times Co.  
Nortek, Inc.  
Nortel  
Northrop-Grumman  
Occidental Petroleum Corp.  
Olin Corp.  
Orby Energy Co.  
Owens-Corning  
Owens-Illinois  
Paccar, Inc.  
Parker Hannifin Corp.  
Pentair Inc.  
PepsiCo, Inc.  
Pfizer Inc.  
Phillips Dodge Corp.  
Phillips Petroleum Co.  
Pillsbury Foods  
Pitney Bowes Inc.  
Polaroid Corp.  
PPG Industries  
Premark International Inc.  
Procter & Gamble  
Quaker Oats  
Quaker State  
Ralston Purina Co.  
Raytheon Co.  
Raymonds and Reynolds Co.  
Reynolds Metals Co.  
Rhone Poulenc Rorer, Inc.  
Rockwell International Corp.  
Rohm and Haas Co.  
Sara Lee Corp.  
Schering-Plough Corp.  
Seagate Technology Inc.  
Sealy Holdings  
Sequor Corp.  
Shaw Industries Inc.  
Shell Oil  
Sherwin-Williams Co.  
Simpson Investment Co.  
Snap-On Tools Corp.  
Sonoco Products  
Springs Industries Inc.  
SPX Corp.  
Stanley Works (The)  
Steelcase Inc.  
Stone Container Corp.  
Storage Technology Corp.  
Sun Co., Inc.  
Sun Microsystems Inc.  
Sundstrand Corp.  
Tandem Computers Inc.  
Tektronix Inc.  
Telenet Inc.  
Temple-Inland, Inc.  
Tenneco Inc.  
Texaco Inc.  
Texas Instruments Inc.  
Textron Corp.  
Thermo Electron Corp.  
Thiokol Corp.  
Time Warner Inc.  
Times Mirror Co.  
Timken Co.  
Triarc Cos. Inc.  
Tribune Co.  
Trinova Corp.  
TRW, Inc.  
Tyco Laboratories  
Tyson Foods Inc.  
Union Camp Corp.  
Union Carbide Corp.  
Unisys Corp.  
United States Surgical  
United Technologies Corp.  
Unocal Corp.  
USG Corp.  
USX Corp.  
Varian  
VF Corp.  
Vulcan Materials  
Wang Laboratories  
Warner-Lambert Co.  
Washington Post Co.  
Westinghouse Electric Corp.  
Westvaco Corp.  
Weyerhaeuser Inc.  
Whirlpool Corp.  
Whitman Corp.  
Willamette Industries  
Witco Corp.  
WL Gore & Associates Inc.  
Xerox
Services Firms
Ace Hardware Corp.
ADVO
Aetna Life & Casualty
Aid Assoc. for Lutherans
Albertsons, Inc.
Alco Standard Corp.
Alexander & Alexander
Alleghany Corp.
Allegheny Power System
Allamerica Financial Group
ALLTEL Corp.
American Electric Power
American Express Co.
American Financial Corp.
American General Corp.
American International Group
American National Insurance
American President Companies
American Stores Co.
Ameritech Corp.
AMR (American Airlines)
Anixter International
Aon Corp.
Apria Healthcare Group
Aramark Group Inc.
Arthur Andersen & Co.
ATA & T
Automatic Data Processing
Auto Club of So. Calif.
Avnet Inc.
Banc One Corp.
Bank of Boston Corp.
BankAmerica Corp.
Bankers Trust New York
Barnett Banks, Inc.
 Battelle Memorial Institute
Bear, Stearns & Co. Inc.
Bechtel Group Inc.
Bell Atlantic Corp.
BellSouth Corp.
Boatmen's Bancshares Inc.
Booz Allen & Hamilton
Borg-Warner Corp.
Burlington Northern, Inc.
Caliber Systems, Inc.
Capital Cities/ABC, Inc.
Cardinal Health Inc.
Carolina Power & Light
CBS, Inc.
Central & Southwest Corp.
Certified Grocers of Calif.
Chase Manhattan Corp.
Chemical Banking Corp.
Chubb & Son
CIGNA Corp.
Chubb & Son
Chemical Banking Corp.
Chase Manhattan Corp.
Certified Grocers of Calif.
Central & Southwest Corp.
CMS Energy Corp.
Coastal Corp.
Columbia Gas System
Columbia HCA Healthcare
Comdisco Inc.
Comernia Inc.
Commercial Metals Co.
Commonwealth Edison
Computer Associat. Int'l
Computer Sciences Corp.
Consolidated Edison of New York
Consolidated Freight
Consolidated Natural Gas
Continental Cablevision
Coopers & Lybrand
Corestates Financial Corp.
Cox Enterprises Inc.
CSX Corp.
Day & Zimmermann Inc.
Dayton Hudson Corp.
Dean Witter Discover
Deloitte & Touche
Deluxe Corp.
Dominion Resources Inc.
DTE Energy (Detroit
Edison
Duke Power Co.
Dun & Bradstreet Corp.
Edison International
EDS Corp.
EG&G Inc.
Enron Corp.
Entergy Corporation
Equitable Life Assurance
Erie Insurance Group
Ernst & Young
Federal Express Corp.
Federated Department Stores
FHP International Corp.
First Bank System Inc.
First Chicago Corp.
First Data Corp.
First Interstate Bancorp
First of America Bank Corp.
First Security Info. Tech.
First Tennessee National
First Union Corp.
Firstar Corp.
Fleet/Norstar Financial
Fleming Companies Inc.
Fluor
Food Lion, Inc.
Foster Wheeler Corp.
PFL
GATX Corp.
Genuine Parts Co.
GPU
Great Western Financial
GTE Service Corp.
Guardian Life
Habiburton Co.
Harcourt General Inc.
Harrs Bankcorp Inc.
Household International
Houston Industries Inc.
Ingram Industries Inc.
Interpublic Group of Cos.
ITT Corp.
J.C. Penney Co.
J.P. Morgan & Co.
John Hancock Mutual Life Insurance
Johnson & Higgins
Jotjensen (Earl M.)
Jostens, Inc.
K Mart Corp.
Kaman Corp.
Kansas City Power & Light
Kansas City Southern Industries
Kemper Corp.
KeyCorp
KPMG Peat Marwick
Kroger Co.
Liberty Mutual Group
Limited, Inc., The
Loews Corp.
MacAndrews & Forbes
Holding
Maritz Inc.
Mas Inc.
Marsh & McLennan Cos.
Marshall & Ilsley Corp.
May Department Stores
MCJ Communications
McKesson Corp.
Meijer Inc.
Mellon Bank Corp.
Melville Corp.
Meridian Bancorp Inc.
Merrill Lynch & Co.
Metropolitan Life Insurance
Co.
MicroAge Inc.
Microsoft Corp.
Montgomery Ward
Morrison Knudsen Corp.
NAC Re Corporation
National City Corp.
NationsBank Corp.
New York Life Insurance Group
New York State Electric and Gas
Niagara Mohawk Power Corp.
Norfolk Southern Corp.
Northeast Utilities
Northern States Power Co.
Northwest Airlines
Norwest Corp.
Nynex Corp.
Opco Corp.
Old Republic International
Omnicom Group Inc.
ONEOK
Pacific Enterprises
Pacific Gas and Electric
Global Televises Group
Pacificare Health Systems
Pacificorp
Paine Webber Group, Inc.
PanEnergy
Payless Cashways
Pepin Traffic Co.
PHH Corp.
Pinnacle West Capital
Pittston Co., The
PNC Financial Corp.
Price Waterhouse LLP
Principal Financial Group
Prudential Insurance Co.
Public Service Electric and Gas
Publix Super Markets Inc.
Pulte Corp.
Reliance Group Holdings
Roadway Services, Inc.
Ryder System Inc.
Safeway Inc.
Sammons Enterprises Inc.
SBC Communications
Science Applications
International Corporation
Sears, Roebuck & Co.
ServiceMaster Partnership
Sonat, Inc.
Southern Co., The
Sprint Corp.
St. Paul Companies Inc.
State Farm Mutual Ins.
Suntrust Banks Inc.
Super Valu Stores Inc.
Sverdrup Corp.
SySCO Corp.
Tenet Healthcare Corp.
Torchmark
Tower Perrin
Toys R Us, Inc.
Transamerica Corp.
Transcanada Pipeline
Travelers (The)
UBJ Financial Corp.
Union Pacific Corp.
United Parcel Service of America
United Stationers
US Bancorp
US West Communications
USAir Group
USIFG Corp.
Venture Stores Inc.
Viacom Inc.
Wachovia Corp.
Wal-mart Stores, Inc.
Walt Disney Co., The
Wells Fargo & Co.
Winn-Dixie Stores, Inc.
WMX Technologies Inc.
Woolworth Co.(F.W.)
Yellow Freight Systems
Young & Rubicam Inc.
Center for Research on Information Technology and Organizations (CRITO)

University of California, Irvine
Suite 320, Berkeley Place North
Irvine, CA  92697-4650
714.824.5246
kkraemer@uci.edu