Sources and Consequences of Downsizing in U.S. Manufacturing

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Abstract: Using U.S. Census of Manufacturing data covering the period from 1967 to 1997, I analyze some of the causes and consequences of downsizing in manufacturing. I do find strong evidence that average establishment size has declined in manufacturing. The econometric results on the determinants of downsizing find considerable support for the hypotheses that foreign competition pushes establishments to downsize and that falling profits put pressure on enterprises to downsize. However, my findings reject the notions that unions are an effective impediment to downsizing and that faster information-technology capital formation leads to downsizing. With regard to the effects of downsizing, I find, first, that where downsizing has occurred it has not contributed to productivity, contrary to what is frequently conjectured. Second, nevertheless, it has contributed to increased profits. Third, it has also tended to depress wages and workers' total compensation. Fourth, this implies that the central effect of downsizing has been a transfer of income from labor to capital. Fifth, curiously, despite its stimulus to profits, downsizing has been associated with a decline in stock prices.

1. Introduction

There has been much discussion of "downsizing" in the press. In this paper, using Census of Manufacturing data, I explore whether such a pattern has characterized U.S. manufacturing over the period from 1967 to 1997. I do find evidence of a decline in average establishment size over this period. Moreover, regression to the mean has also occurred, with large establishments tending to become smaller (or to being replaced by smaller enterprises) and small establishments tending to expand, with the overall tendency being movement toward the middle. The obvious question is what developments are responsible for these movements? This paper explores empirically some of the influences that may account for changes in average establishment size within this sector.

Several hypotheses will be explored. First, is there any evidence that more technologically advanced industries, as evidenced by R&D intensity, were more apt to downsize. Second, has the rapid increase of computerization over the last two decades reduced economies of scale and induced a reduction in establishment size? Or does it suggest that the efficient enterprise size has moved toward the middle, leading to a decline in the variation of enterprise size within industry? Third, as some have argued, are industries with growing international competitive pressures more likely to downsize? Does this influence show up primarily in import competition or export competition?

Fourth, does downsizing reflect the fact that unions have declined in power and can therefore

not protect their workers to the degree that they did before? Fifth, has a decline in profitability -- perhaps itself a reflection of increased foreign competition -- lead to greater pressure to reach the most efficient enterprise size? Does this increased pressure show up as downsizing or as regression to the mean?

The econometric results shown here on the determinants of downsizing in manufacturing find considerable support for the idea that foreign competition pushes establishments to downsize and for the hypothesis that falling profits put pressure on them to downsize. However, my findings reject the notions that unions are an effective impediment to downsizing and that faster information-technology capital formation leads to downsizing. Indeed, the evidence, if anything, indicates that unionized industries are *more* apt to downsize -- perhaps, to get rid of more expensive union labor. Moreover, the growth in information-technology capital does appear to have a significant negative effect on changes in the overall dispersion of employment among different size classes.

I next explore some potential consequences of downsizing. First, I investigate whether there is any evidence that the act of downsizing increases the productivity of establishments. Second, as just noted, I find that reduced profitability was associated with a lag with reductions in average establishment size. Here, I explore whether downsizing is associated with higher profitability of firms I also consider the effects of downsizing on average share prices of manufacturing stocks.

Third, I look into the effects of downsizing on both employee compensation and unit labor costs. Downsizing might be a weapon in reducing wages, particularly if it reduces the relative employment of more senior employees or higher paid jobs. Reductions in establishment size might also lower wages simply through the well-documented employer size effect on wages: namely, that *ceteris paribus*, larger establishments pay higher wages (see, for example, Masters, 1969, Mellow, 1981, and Idson, 1999).

There are two sets of arguments that might give a rationale for these effects. The first is based on international competition. As noted above, I find here that increased international competition is a proximate cause of downsizing in manufacturing. It may be that intensified competition from abroad changes relative demands and supplies in the U.S. market, which in turn requires some establishments and industries to contract while others expand. One implication is that downsizing should raise the average productivity of labor -- that is, ridding yourself of redundant labor should reduce labor input without reducing output. As a result, labor productivity and, consequently, total factor productivity should be rising faster in industries which have displaced relatively more workers.

The second derives from the notion that the “social contract” between owners and workers has broken down. According to this argument, owners of capital have become less generous toward labor. Whereas previously at least large corporations entered into a kind of "social contract" with their workers -- one that offered rent sharing and considerable job security -- capital has unilaterally broken that contract and demanded more of the rents for itself. Labor is thus faced with a choice between lower wages and fewer jobs, the latter being used as a threat to achieve the former.

Many studies documented sizable and persistent interindustry wage differentials (see, for example, Dickens and Katz, 1987; and Krueger and Summers, 1987 and 1988). These studies found that some industries tend to pay all their workers, not just the occupational groups in short supply, more than other industries do. The most convincing explanation appears to be rent sharing. Suppose that managers were inclined to share rents with their workers and that only certain industries had large rents to distribute, perhaps because only they enjoyed market power. Then employees fortunate enough to work in these industries would enjoy higher wages across the board. One question is whether such rents been squeezed or eliminated due to downsizing.

Another implication of this downsizing scenario is that the level of stock prices should display a permanent increase, and therefore the stock market should enjoy a transition period -- perhaps lasting for several years -- during which price appreciation is extraordinarily high. That is just what has happened during the 1990s. Here too one might expect that stock prices appreciated more in industries that downsized more.

While the material that follows sheds light on a wide variety of related issues, the central story that emerges is rather simple and dramatic. First, on average, where downsizing has occurred in the manufacturing sector it has not contributed to productivity, contrary to what is frequently conjectured. Second, nevertheless, it has contributed to increased profits. Third, it has also tended to depress wages and workers' total compensation. Fourth, this implies that the central effect of downsizing has been a transfer of income from labor to capital. Fifth, curiously, despite its stimulus to profits, downsizing by a firm has been associated with a decline in the price of its stocks, perhaps because investors take downsizing as management's response to prospects of trouble ahead. This picture of the consequences of downsizing is not something I had expected, but the evidence provides strong support for this interpretation of the phenomenon.

The remainder of the paper is organized as follows. The next part (Section 2) reviews the pertinent literature. Descriptive statistics on changes in the size distribution of establishments in manufacturing are presented in Section 3. A decomposition analysis is developed in Section 4 to

separate out the effects on changes over time in average establishment size within total manufacturing of (1) rising or falling establishment sizes within industries and (2) shifts in manufacturing employment toward industries with smaller or larger establishment sizes. Section 5 shows time trends of variables that affect changes in average establishment size and these factors are formally analyzed in Section 6. Likewise, Section 7 shows time trends of variables that may be affected by downsizing in manufacturing and this set of factors is formally analyzed in Section 8. Concluding remarks are made in Section 9.

2. Literature Review

As far as I could ascertain from a rather extensive literature search, while there is a large literature on changes in the size distribution of firms, there are relatively few papers or books on the economic determinants of downsizing *per se*.[1] In contrast, there is a relatively extensive literature on the economic effects of downsizing (as we shall see below).

There are few exceptions. Krepps and Candell (1997) found that increases in industry-level import competition, merger activity, and declines in industry demand explain a large fraction of layoffs and plant closures by firms or plants that are subject to inefficiency (as they measure it). Brynjolfsson, Malone, Burbaxani, and Kambil (1994), using industry-level data on average establishment size derived from County Business Patterns and computer investment over the period 1976 to 1989, reported econometric evidence that investment in information technology is significantly associated with subsequent decreases in the average size of firms. Kumar, Rajan, and Zingales (1999) found cross-industry evidence for 1991-1992 that more R&D intensive industries generally have larger average firm size. White (2001) found evidence for the U.S. economy as a whole that average firm size grew over the 1980s and 1990s. He speculated that one reason for this trend was the rising importance of exports in the U.S. economy, since the development of foreign markets involves sunk costs and thus scale.

As noted above**,** there is now a fair size literature on some of the economic consequences of downsizing. Two papers looked at the effects of downsizing on productivity. Baily, Bartelsman, and Haltiwanger (1996) looked into the issue of why average labor productivity declines during recessions and increases during booms. One of their findings is that plants that are permanently downsizing account disproportionately in procyclical productivity. In other words, they found that productivity tends to decline in plants that are downsizing -- at least, during aggregate downswings. Collins and Harris

[1] A large number of papers use Gilbrat's "law of proportionate effect" to explain changes in the size distribution of enterprises over time. These include Ijiri and Simon (1977), Hart and Oulton (1996), and Sutton (1997), and Sutton (Chapters 10-12, forthcoming). A model of the evolution of the size distribution of firms based on firm selection due to efficiency of production is developed by Jovanovic (1982).

(1999) also used the methodology developed by Baily, Bartelsman, and Haltiwanger (1996) to investigate the effects of downsizing on productivity trends in the U.K. motor vehicle industry over the period 1974-1994. They found that productivity growth was indeed higher in those plants that successfully downsized, but that those plants that were unsuccessful at downsizing tended to have among the worst productivity growth record. Unsuccessful downsizers accounted for a significant part of the overall decline in productivity after 1989 in the U.K. motor vehicle industry.

Gordon (1996) was among the first to argue that downsizing could reduce wages and salaries. He contended that that a critically important source of falling wages has been U.S. corporations' increasingly aggressive stance with their employees, their mounting power to gain the upper hand in those struggles, and the shifts in the institutional environment that this mounting power has helped foster. Two papers provided some evidence on this. Cappelli (2000) looked at the relationship between both job losses associated with shortfalls in demand and downsizing and subsequent financial performance. His results indicated, among other things, that downsizing reduces labor costs per employee. Espahbodi, John, and Vasudevan (2000) examined the performance of 118 firms that downsized between 1989-93. They found that operating performance improved significantly following the downsizing, and, in particular, these firms were able to reduce labor costs.

Several papers looked into how stock prices reacted to downsizing. The evidence is mixed. Abowd, Milkovich, and Hannon (1990) used an event study methodology to investigate whether human resource decisions of firms (such as staffing) announced in the Wall Street Journal between 1980 and 1987 discernibly affected either the level or variation of shareholder return. However, they found no consistent pattern of increased or decreased valuation in response to any of five categories of announcements of staff reduction, even after controlling for the likely effect of such announcements on total compensation costs.[2] In a similar study, Abraham (1999) also used an event study methodology to assess the effects of layoff announcements on shareholder returns. The Wall Street Journal was used to identify 368 firms that announced layoffs. In 1993 or 1994. The results showed that layoff announcements induced a decrease in the shareholder returns of the firms that made the announcements. Farber and Hallock (1999) generally found negative effects on stock prices as a result of announcements of reductions in force for a sample of 1176 large firms over the 1970-1997 period.

Worrell, Davidson, and Sharma (1991) tested the reaction of the securities' market to announcements of 194 layoffs. The argued that investors reacted negatively to layoff announcements

[2] On the other hand, announcements of permanent staff reductions were associated with significant increases in the variation of abnormal total shareholder return around the announcement date.

attributable to financial reasons. They found that negative preannouncement reactions occurred when negative hints about firms preceded announcements, and announcements of large or permanent layoffs elicited stronger negative responses than other announcements. Gombola and Tsetsekos (1992) argued that that a permanent plant closing provides evidence about an entire firms' financial condition –- in particular, that out-of-date plants could not be sold and the firms did not have any other alternatives. Unless investors already knew the true value of the plant, a closing announcement should be following by a negative stock price reaction. They found confirmation of this in their data analysis. Caves and Krepps (1993) also examined how the stock market reacted to announcements of corporate downsizing between 1987 and 1991. Using disaggregated manufacturing industries data from 1967-86, they found that evidence shareholders came to react positively to downsizings that involved white-collar layoffs and related reorganizations.

3. Changes in the Size Distribution of Establishments in Manufacturing

The first question of interest is whether downsizing has occurred in manufacturing. I explore the subject using U.S. Census of Manufacturing data on establishments over the period 1967-97.[3] The Census of Manufacturing data begin in 1967 and are complete through 1992. Some additional data are available for 1997 on average establishment size by two-digit industry.[4] This source includes data on single establishment and multi-establishment firms. Establishments are classified into industries by their main product.

According to data from the Census of Manufacturing, the average establishment size in total manufacturing has fallen rather sharply over time, from 60.5 employees in 1967 to 45.7 employees in 1992, followed by a slight increase to 46.5 employees in the boom year 1997 (see Table 1). The change has been fairly continuous over time, though it accelerated a bit in the period between 1987 and 1992. (Over the entire 1967-1992 period, average establishment size fell at an average annual rate of 1.12 percent; between 1987 and 1992, it fell at an annual rate of 1.54 percent).

Table 1 also shows changes in average establishment size by 2-digit SIC manufacturing

[3] Three other datasets were also looked at: (1) Enterprise Statistics on firms over the period 1958-92; (2) Enterprise Statistics on establishments over the period 1958-92 ; and (3) Computstat data on firms over the period 1978-97. The patterns were very similar among the four data sources and here I show results only for the Census of Manufacturing.

[4] The 1997 Census of Manufacturing shifted from the old SIC industry classification to the new NAICS (North American Industrial Classification System). As a result, size distributions of establishments in 1997 are not directly comparable to those of earlier years. However, some bridge tables were provided for 1997 by the U.S. Census Bureau based on the old SIC scheme.

industries over the same period. Of the 20 industries, 17 experienced reductions in average establishment size from 1967 to 1992; the other three experienced increases. Of the 16 industries with data available through 1997, 13 show a decline in average establishment size and three show an increase. Within the group showing declines, the most notable are electronics and other electrical equipment, primary metals, and leather and leather products, whose average establishment size fell by about half over the period. On the other hand, food and tobacco products both experienced substantial increases in their average establishment sizes. It is also of interest that durable good industries experienced greater declines in their average establishment size -- -26 percent between 1967 and 1992 -- than did nondurables (-16 percent). Finally, the rate of decline of average establishment size accelerated (or the rate of increase declined) in the1987-1992 period compared to 1967-87 in 14 of the 20 industries. This is particularly true of durables.

I also introduce the so-called co-worker mean in the case of Census of Manufacturing establishment data. The co-worker mean is the weighted average of average establishment size by size class with the percentage of total employment in the size class used as the weight.[5] The co-worker mean can be defined formally by using the following notation:

N_{jt} = number of establishments in industry j at time t.

N_{jkt} = number of establishments in size class k in industry j at time t.

E_{jt} = number of employees in industry j at time t.

E_{jkt} = number of employees in size class k in industry j at time t.

$p_{jkt} = E_{jkt}/E_{jt}$ = share of total manufacturing employment in size class k in industry j at time t.

$e_{jt} = E_{jt}/N_{jt}$ = average number of employees per establishment in industry j at time t.

Then the co-worker mean c_{jt} for industry j at time t is given by:

(1) $c_{jt} = S\, p_{jkt} e_{jt}$,

The reason for using the co-worker mean is that the size distribution of establishments (and firms) is highly skewed (see Figures 1 and 2). In other words, most businesses are small but most employees work in large businesses. The average establishment (or firm) size tells us about the average business but not about the average worker. The co-worker mean is a closer reflection of the experience of the average employee in an industry in terms of the size of business he (or she) is working in. Results are shown in Table 2.

It is first of note that the co-worker mean is, as expected, much larger than the average. For 1967, the co-worker mean for total manufacturing is 1,424, compared to an average establishment size of 60.5. This means that the typical manufacturing worker in 1967 was employed in an establishment of about 1,500 workers. However, like the average establishment size, the co-worker mean also shows a significant downward trend between 1967 and 1992.[6] Over this period, the co-worker mean fell by 37 percent, compared to a 25 percent decline for average establishment size over the same years. The co-worker mean, like average establishment size, fell in every period except 1982-1987, when it essentially remained unchanged.

Of the 20 industries, all but one experienced a reduction in its co-worker mean between 1967 and 1992. The most notable declines occurred in rubber and plastic products (65 percent), lumber and wood products (56 percent), primary metals (50 percent), and fabricated metal products (49 Percent). Leather and leather products underwent a modest increase in its co-worker mean (7 percent).

Table 3 provides a summary of the number of industries downsizing and upsizing by Census period. The Census of Manufacturing data on average establishment size show a clear pattern: Average establishment size in total manufacturing fell steadily from 1967 until the 1992-1997 boom. However, even though average establishment size in all manufacturing declined in every five-year period (until 1992-97), there were always some "upsizing" industries. Of the 116 observations in all (five census periods with 20 industries and the last census period with 16), downsizing occurred in 73 cases while upsizing occurred in the other 43. So while downsizing was the most common occurrence, there were plenty of exceptions.

There are also interesting differences by period. Manufacturing industries were less likely to downsize during 1967-72 and 1982-87, when the overall decline in manufacturing employment was low, than during 1972-1977 and 1987-1992 when manufacturing employment fell rapidly. In this respect, the 1977-82 period is a bit of an anomaly, since it ended in a deep recession but the tendency to downsize was weak. Perhaps the cheap dollar of the 1977-80 period helped manufacturing.

Results are shown in Panel B of Table 3 for the co-worker mean for Census of Manufacturing establishments. The downsizing pattern was much stronger for individual industries on the basis of the co-worker mean than the simple mean. Of the 100 observations in all (five census periods with 20 industries), downsizing occurred in 78 percent of the cases (compared to 63 percent of the cases on the basis of the simple mean).

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[5] This measure was also used by Davis, Haltiwanger, and Schuh (1996). See their book for more discussion.
[6] The co-worker mean could not be computed for 1997.

Table 4 and Figures 1 and 2 show dramatic changes in the overall size distribution of manufacturing establishments based on Census of Manufacturing data over the period 1967 to 1992. The percentage of establishments in all size classes above 19 employees has declined over time, and particularly so for establishments of 1,000 employees or more, while the proportion in size classes 5-9 and 10-19 have increased. However, interestingly, the percentage of establishments in the size class with less than five employees has also fallen.

Even more dramatic is the change in the size distribution of employment. The share of total employment in establishments of 2,500 employees or more has plummeted almost in half, from 19.6 percent in 1967 to 10.6 percent in 1992. The share of total employment in size class 1,000-2,499 has also fallen sharply, from 13.2 percent to 10.6 percent. The proportion of employment in size class 500-999 has also declined somewhat. In contrast, the share of total employment in all the smaller size classes has risen.

The last two lines of Table 4 show two measures of the overall dispersion of employment by size class within total manufacturing: The first is the coefficient of variation, defined as the standard deviation divided by the mean. The second is the Gini coefficient, which is an index that ranges from zero (all establishments are in a single size class) to one (maximum dispersion of establishments by size class). Both measures show a moderate decline in the degree of dispersion of employment by size class between 1967 and 1992. Moreover, according to both indices, this decline in dispersion was continuous, except for the period from 1972 and 1977. These results indicate that, concomitant with downsizing in manufacturing, there has been a tendency towards regression to the mean. In particular, larger establishments have contracted both in terms of number and share of total employment.

We next turn to dispersion of employment at the two-digit industry level, calculated from the Census of Manufacturing data on establishments (see Table 5). It is first of note that the degree of dispersion varies considerably across industries. In 1992, for example, the coefficient of variation ranged from a low of 1.86 in paper and allied products to a high of 4.66 in industrial machinery and equipment. In that same year, the Gini coefficient (which, it will be recalled, is bounded between zero and one) ranged from 0.602 in stone, glass, and clay products to 0.863 in transportation equipment. Between 1967 and 1992, the coefficient of variation fell in 16 of 20 industries, while the Gini coefficient declined in 18 of 20 industries. The industry level data from this source thus provide very strong evidence that regression to the mean was the predominant pattern in terms of the size distribution of employment by employee size class.

4. Decomposition Analysis

Changes over time in average establishment size within total manufacturing may be attributable to a combination of three effects: (1) rising or falling establishment sizes within industries; (2) relative growth in the number of establishments in industries in which smaller or larger establishments are typical; and (3) shifts in manufacturing employment toward industries with smaller or larger establishment sizes. Obviously, these three effects are not independent. I will provide one decomposition, based on the first two effects (since it provides the most straightforward algebra), to assess their relative importance.

There are two main results. First, there was a marked shift in the distribution of establishments and employment away from low-tech industries toward medium-tech and high tech activities. Second, over the entire period of our study, average establishment size in total manufacturing declined by 14.8 employees, and all of this was attributable to decreasing average establishment sizes within industries (the "within industry" effect). Shifts in the distribution of establishments among industries contributed almost nothing.

Using the notation introduced in the last section, let us add the following symbols:

N_t = number of establishments in all manufacturing at time t.

$s_{jt} = N_{jt}/N_t$ = share of total manufacturing establishments in industry j at time t.

E_t = number of employees in all manufacturing at time t.

$e_t = E_t/N_t$ = average number of employees per establishment in all manufacturing at time t.

$e_{jt} = E_{jt}/N_{jt}$ = average number of employees per establishment in industry j at time t.

With this notation, it is obvious that:

(2) $e_t = S\ s_{jt}e_{jt}$,

from which is follows that:

(3) $\Delta e_t = S\ (\Delta s_t)e_{jt} + S\ s_{jt}\ \Delta e_j$

where Δs_j = is the change in s over the period and Δe is the change in e over the period. Alternative choices of weights are available for the decomposition: beginning-of-the-period, end-of-the-period, and average period weights. The last set, given by $(e_{j1} + e_{j2})/2$ and $(s_{j1} + s_{j2})/2$, has the advantage of allowing an exact decomposition. Our results are therefore shown only for average period weights.[7]

Before showing the decompositions, it is first of interest to see how the distribution of the number of establishments and employment among manufacturing industries has changed over time. As

[7] Results using the other two sets of weights involve second-order terms.

shown in Table 6, there has been a clear shift in the distribution of establishments away from low-tech industries toward medium-tech and high tech ones. The share of total establishments in food and kindred products fell almost by half between 1967 and 1992, and the share in textiles, apparel, lumber and wood products, chemicals, and stone, clay, and glass also noticeably declined. In contrast, the proportion of establishments in printing and publishing increased by over five percentage points, and the proportion in both industrial machinery and rubber and miscellaneous plastics products by over two percentage points. Increases were also found in fabricated metal products, electronics and electrical equipment, transportation equipment, and instruments and related products. Over this period, the total number of manufacturing establishments grew by 21 percent.

Changes in the distribution of employment among two-digit manufacturing industries are roughly similar. Relatively large declines of the share of total manufacturing employment are found in textiles and apparel, leather and leather products, and stone, glass, and clay products, as well in primary metals and electronics and electrical equipment. Interestingly, the share employed in food products remained relatively unchanged. Relatively large increases occurred in printing and publishing, rubber and plastic products, and instruments and related products, and as well as in lumber and wood products. Between 1967 and 1992, total employment in manufacturing fell by 8.3 percent.

The decomposition is shown in Table 7. Over the whole 1967-92 period, the average establishment size in total manufacturing declined by 14.8 employees. More than all of the decline (107 percent) was due to declines in average establishment sizes within industries (the "within industry" effect). That is to say, the within-industry component by itself would have caused overall average employment by establishment to decline by 15.9, in comparison to the actual decline of 14.8. Shifts in the distribution of establishments among industries (the "between industry" effect) contributed virtually nothing to the change in the average size within total manufacturing (actually, they slightly favored industries with above average establishment size.)

As we look across five-year periods, the only notable departure from this pattern is in 1967-72. During this period, the average establishment size in manufacturing fell by 2.8 employees. If the distribution of establishments across industries had remained constant over the period, the average size would have fallen by much more--4.9 employees. However, industries with above-average establishment sizes grew in relative terms, and this “between industries” effect led to an increase in the average establishment size in manufacturing of 2.0 employees.

Thus, changes in establishment size on the industry level accounted for almost the entire change in average establishment size in total manufacturing over the entire period, and for most subperiods as

well. In the next section, when we look for causes of changes in average establishment size in manufacturing, we can therefore comfortably focus on developments within 2-digit industries.

4. Factors Affecting Downsizing in Manufacturing

In this section I consider the factors responsible for changes in the size distribution of establishments within manufacturing industries. Corresponding to the hypotheses outlined in the Introduction, I group the variables into four sets. First, for the effects of technology on downsizing, I use (2) the ratio of research and development (R&D) expenditures to GDP; and (3) the number of scientists and engineers engaged in R&D as a share of total employment. These are relatively standard measures of technological activity.

Figure 3 shows the relationship (or, rather, the apparent lack thereof) between changes in R&D investment (by two different measures) and establishment size for total manufacturing by Census period. It should be noted at the outset that this figure (like the next three) is meant only to provide some general indications about trends. The statistical relation between downsizing and these other variables is based on formal regression analysis involving pooled cross-sectional time-series data for the 20 two-digit SIC industries. There does not seem to be a clear correspondence between downsizing and R&D activity. R&D expenditures as a share of net sales increased during the upsizing years 1958-1963 and 1963-1967, and then fell off over the next three periods, as downsizing replaced upsizing. However, R&D activity then picked up after 1982, while downsizing continued. In contrast, the number of scientists and engineers employed in R&D per employee rose almost continuously over time since the 1958-1963 period – through both upsizing and downsizing periods.

Second, I consider the annual growth in the ratio of various measures of *information technology (IT) capital*, such as office, computing, and accounting equipment (or OCA), as a ratio to total employment. These IT variables are used because computers (and information technology in general) may play a particularly important role in affecting changes in establishment and company size, as was suggested in the Introduction. As shown in Figure 4, the growth of both OCA per worker was largest during 1963-67 (an upsizing period), 1972-77 and 1977-82 (both downsizing periods), and 1992-97 (another upsizing period). In sum, there is no obvious correlation, positive or negative, in the data.

Third, the intensification of international competition, as measured by the change in the ratio of manufacturing exports to total manufacturing output and the change in the ratio of manufacturing imports to total manufacturing output over the period, may also affect changes in the average size of

establishments. Industries competing in international product markets and those competing against imports may be forced to reduce their size in order to cut costs, as I suggested above.

As shown in Figure 5, the change in export intensity was at its highest point over the 1987-92 period (a significant downsizing period) and next highest in 1972-77 and 1977-82 (also downsizing periods). Import intensity grew most rapidly over the 1982-87 period (also a downsizing period), followed by 1967-72 (another downsizing period) and 1992-97 (an upsizing period).

The fourth factor is the unionization rate. Greater unionization might also reduce the degree of downsizing by restricting the flexibility of employers to restructure the workplace substantially with the advent of new technology. The average unionization rate in total manufacturing has been falling rather steadily over time, at least from the 1960s (the earliest data available.), while over these years, the pace of downsizing of establishment size has been increasing (see Figure 6). However, changes in average establishment size do not show the same steady trend over time.

5. Regression Analysis of Downsizing in Manufacturing

The regressions use pooled time series, cross-sectional data, consisting of 20 industry observations in each of the six or seven five-year time periods. I estimate a fixed-effects model, in which the average establishment size in an industry is an unchanging function of the *levels* of these variables, plus an industry-specific effect that is constant over time. Our regression uses the first difference of this equation (actually, the percentage change in mean establishment size on the industry level), so that the industry-specific constant should wash out. (However, I will still test explicitly for the existence of industry effects below). The error terms are assumed to be independently distributed, but may not be identically distributed; so I use the White (1980) procedure for a heteroskedasticity-consistent covariance matrix in the estimation.

Table 8 shows results for the case where the dependent variable is the percentage change in average *establishment* size as measured in the Census of Manufacturing. There are, of course, general issues of timing, dynamics, and causality when considering the factors that influence changes in business size (and also about the effects of business size change on other factors such as productivity growth). In Table 8 it should be noted that the change in average establishment size, like most of the variables in the table, is entered contemporaneously. The reason is that our data, which are typically entered as percentage changes,(usually) come at five-year intervals. This means that, if we were to lag the data in order to reduce any potential bias from simultaneity, we would generally be looking for the effects, say, of changes in an independent variable between 1972 and 1977 on changes in the dependent variable

between 1977 and 1982. That seems rather a long lag and, indeed, our experiments with lagged variables generally turned up meager correlations. (For this same reason, good instruments are not available.)

With regard to the effects of technological progress on downsizing, I find that (the five-year average of) industry R&D spending as a percentage of net sales has a consistently negative effect on the growth of average establishment size. A rise in R&D spending is thus associated with a reduction in establishment size. However, its coefficient is not significant in any of the cases. This result is mildly consistent with the first hypothesis in the Introduction.[8]

In contradistinction to the second hypothesis, there is no evidence whatsoever that computer intensity has increased more rapidly in industries that have downsized more. In fact, the coefficient of the growth rate of OCA per worker is essentially zero but not significant (specification 3).[9]

With regard to the trade variables, the change in the ratio of imports to total output has a uniformly negative coefficient that is significant at the five percent level in four cases and at the one percent level in one case. They indicate that import competition tends to induce downsizing, perhaps via important effects on cutting costs. Likewise, changes in export orientation (as measured by the ratio of exports to total output) have a uniformly positive coefficient that is significant at the one percent level in four cases and at the ten percent level in one. This finding also strongly suggests that competition for foreign markets induces establishments to cut costs by downsizing. Both sets of results are strongly supportive of the third hypothesis.

The unionization rate, somewhat surprisingly, has a consistently negative coefficient, which is significant at the five percent level in all cases. Thus, in contradistinction to the fourth hypothesis, the evidence indicates that unionized companies are *more* apt to cut back plant size than non-unionized ones. Part of this effect may emanate from the higher wages paid to unionized workers and the consequent pressure on firms to reduce labor costs. As we shall see in the next section, this explanation is consistent with the finding that labor costs fall relatively in downsizing industries.

In Specification 4, I include the lagged profit rate as an additional independent variable and, in Specification 5, I include the lagged profit share (see the Data Appendix for details on measurement).[10]

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[8] The regressions were repeated using the number of scientists and engineers engaged in R&D per 1000 employees as the measure of R&D intensity instead of R&D spending. The coefficient of this variable is also negative but also not significant in any case (results not shown).

[9] The coefficient of the growth rate of the sum of OCA and communications equipment (OCACM) per worker is also positive but not significant, as is that of the growth rate of computer equipment alone (results not shown).

[10] This is the one case in which it makes sense to include a lagged value of the independent variable, since it is likely

The coefficients of both variables are positive. The former is significant at the five percent level and the latter at the ten percent level. The results suggest that lower profitability in one period leads companies to reduce their plant size in the succeeding period (the fifth hypothesis) – perhaps, because low profitability may lead to greater pressure to reach the most efficient enterprise size by "trimming fat."

The best fit, as measured by the adjusted R^2 statistic and the standard error of the regression is provided by the fourth specification. This equation includes R&D expenditures as a share of net sales, the change in both export and import intensity, the unionization rate, and the lagged profit rate. Also, as shown in the second specification, introducing period dummy variables has little effect on the estimated coefficient values or their significance levels. The only notable change is that the coefficient of the change in export intensity falls and its significance level also declines from the one percent to the ten percent level.[11]

I next look at changes in the dispersion of employment among size classes by two-digit industry. I use the pooled cross-sectional data set from the Census of Manufacturing for 20 industry observations

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that firms react slowly to a fall in profitability.

[11] We also tested formally for the presence of period and industry effects. The results are as follows:

F-tests
Table 5.9

	F-Statistic	Critical F-Value (.05 level)	Reject Null Hypothesis?
Specification 1			
Add period dummies	1.5664	2.30	No
Add industry dummies	0.8867	1.70	No
Add period and industry dummies	0.9588	1.65	No
Specification 2			
Add period dummies	2.6805	2.30	Yes
Add industry dummies	1.3047	1.70	No
Add period and industry dummies	1.5283	1.65	No

In only one instance is the addition of the full set of period dummy variables or industry dummy variables statistically significant. This is the case of the addition of period dummy variables to Specification 2, for which the F-statistic is significant at the five percent level (but not the one percent level).

In other variants, we included the average period unemployment rate and the annual growth of economy-wide GDP (in constant dollars) as independent variables instead of period dummy variables. In neither case is the variable statistically significant. Because the results for both period and industry effects are so weak, we have ignored these effects in the subsequent regression analysis.

in 1967-72, 1972-77, 1977-82, 1982-87, and 1987-92.[12] As before, the error terms are assumed to be independently distributed but may not be identically distributed; so I again use the White procedure for a heteroskedasticity-consistent covariance matrix in the estimation (see White, 1980).

The only significant variables in these regressions turn out to be our measures of growth in IT investment per worker. Their coefficients are negative, indicating that greater investment in computers reduces dispersion in employment by size class within an industry.

The results of our regressions are shown in Table 9. The first dependent variable is the change in the Gini coefficient (CHNGGINI) and the second is the change in the coefficient of variation (CHNGCV). The only significant variable in these two regressions is the growth in OCA per worker.[13] Their coefficient is negative, indicating that greater investment in OCA leads to a smaller dispersion in employment by size class within an industry. The coefficients of the change in the import share are all positive but not significant, while those of the change in the export share are of mixed sign but again not significant. The lagged profit share and the lagged profit rate have positive but insignificant coefficients (results not shown).

Since OCA investment is not a significant determinant of downsizing, but does have a significant effect on dispersion, it is possible that its main effect could be to reduce the shares of employment in both very small and very large establishments—that is, to promote regression toward the mean. However, as we see in the third column of Table 9, the growth of OCA per worker actually has a positive and significant effect on the share of total employment in establishments of 19 employees or less (CHEST20). As in the case of changes in overall dispersion, none of the other variables is statistically significant.

On the other hand, the growth in OCA per worker is negatively and significantly associated with the change in the share of employment in establishments of 1000 employees or more. However, none of the other variables proves significant.

6. Effects of Downsizing in Manufacturing

I begin, as in the last section, with some descriptive statistics. Figure 7 displays the change in average establishment size, and the average rates of TFP and labor productivity growth for total manufacturing by Census period. There are no clear connections between productivity and size, at least

[12] Employment distribution by size class for two-digit SIC manufacturing industries is not yet available for 1997.

[13] The growth of OCACM per worker is also significant but since the latter result is very similar to the former, it is not

at the level of total manufacturing. Productivity (both TFP and labor productivity) growth was very high during the first upsizing period of 1958-1963 but much lower during the second upsizing period, 1963-1967. Downsizing occurred during the 1977-1982 period, when productivity growth was very low, but also continued during the 1982-1987 period, when productivity grew very rapidly. Productivity growth was also quite high in the 1992-1997 period, when average establishment size gained.

I next show the change in average establishment size and the change in both the average rate of profit and the average profit share for total manufacturing from the preceding Census period (see Figures 8 and 9). There appears to be a somewhat direct relation between the three sets of statistics, at least at the level of total manufacturing. Changes in both the profit rate and the profit share were highest during 1987-92, when establishments experienced pronounced downsizing, and lowest during the 1967-72, a period of modest downsizing.

Figure 10 shows trends in the average market value of firms in total manufacturing. The data are from the University of Chicago's CRSP Market Capitalization database, which includes a sample of firms in almost all two-digit industries. Average market value is computed as the ratio of the total market capitalization in a two-digit manufacturing industry divided by the number of firms in that industry. The average market value is deflated by the CPI. The index is somewhat imperfect, since it does not correct for mergers, acquisitions, or divestitures.

Stock values fluctuate much more widely than do the other industry level variables. During the first downsizing period, 1967-72, it rose by only 14 percent and during the next downsizing period, 1972-77, it fell precipitously, by 43 percent (this was true for the S&P 500 index as well). Between 1977 and 1982, another downsizing period, average market value in manufacturing inched up by 3 percent. However, during the next two periods, 1982-87 and 1987-92 during which average firm size fell, average market values rose by 37 and 32 percent, respectively. In the 1992-97 period, when average establishment size increased very modestly, the average stock valuation in manufacturing boomed (as it did for the S&P 500 index), more than doubling in value. If anything, it appears that stock values rise faster during upsizing periods than during downsizing.

The last variable of interest is the change in average employee pay. This is defined in two ways: first, as average wages and salaries per full-time equivalent employee (FTEE); and, second, as the average employee compensation, including wages and salaries and employee benefits per FTEE. Both wages and salaries and employee compensation are deflated by the CPI to obtain employee pay in constant dollars.

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shown.

Figure 11 shows the percentage change in the latter for the Census of Manufacturing periods (changes in wages and employee compensation are highly correlated). Here we do see a somewhat closer correspondence between patterns of upsizing and downsizing and the growth in pay than between changes in average size and the preceding set of variables. During the two upsizing periods of 1958-1963 and 1963-1967, there were robust gains in pay, with average compensation rising by 13.9 and 6.6 percent, respectively. During the first downsizing period, 1967-1972, average compensation growth continued at a brisk pace (10.5 percent) but in the next downsizing period, 1972-77, the growth in average compensation fell off by 6.0 percent. Over the next three periods, all characterized by downsizing, gains in average employee compensation declined to -2.6 percent, then rebounded to 6.4 percent but subsequently collapsed to 1.2 percent. During the 1992-1997 period, when average establishment size rose slightly, the growth in average compensation once again recovered -- to 2.2 percent.

7. Regression Analysis of the Effects of Downsizing in Manufacturing

I next turn to regression analysis to analyze the effects of downsizing on these various variables. I once again use the pooled cross-sectional data set, consisting of 20 industry observations in each of the six or seven five-year time periods. As before, the error terms are assumed to be independently distributed but may not be identically distributed and I use the White procedure for a heteroschedasticity-consistent covariance matrix in the estimation (see White, 1980).

A few words should again be said about timing, dynamics, and causality when considering the effects of changes in business size on factors such as productivity growth and profitability. In Section 5, on the causes of downsizing, I generally entered the variables contemporaneously (with the exception of profitability, which was entered with a lag of one period). For example, the change in export intensity was assumed to affect changes in average business size over the same period (say, 1977-1982). The main reason is that the data typically cover five-year periods, so that entering an independent variable with a one-period lag would suggest that an event five to ten years prior to the current period would induce changes in average business size. The lag seems rather long to us and experiments with lagged variables did not generally produce significant results.

On the other hand, it is quite likely that a change in average business size over one period might cause changes to some other factor in the subsequent period – for example, real wages. In this case, the independent variable – changes in business size – measures an event that occurs over one period and its consequences may be felt in the next period. Moreover, in two cases – for both changes in profitability

and changes in the profit share – independent variables used in Section 5 become the dependent variable here. This is not inconsistent. For example, a change in profitability in one period might induce changes in business size (either contemporaneously or with a lag), and changes in business size in one period might subsequently induce changes in profitability in the next period. In addition, for these two variables, the inclusion of lagged changes in business size as an independent variable prevents simultaneity bias from arising in the equations used here and the corresponding equations in the section of causes of downsizing.

A. Productivity growth. Results are shown in Table 10 for the first of our dependent variables, TFP growth. The first variable of interest is the constant term, which is interpreted as the pure rate of technological progress. Its value ranges from 0.9 percent to 1.5 percent per year. These values are typical for most estimations of TFP growth in manufacturing.

The next variable of interest is industry R&D expenditures as a percent of net sales. A large literature, beginning with Mansfield (1965), has now almost universally established a positive and significant effect of research and development expenditures (R&D) on productivity growth (see Griliches, 1979 and 1992, and Mohnen, 1992, for reviews of the literature). Following Griliches (1980) and Mansfield (1980), we can intepret the coefficient of this variable is interpreted as the rate of return of R&D, under the assumption that the (average) rate of return to R&D is equalized across sectors. The coefficient of the ratio of R&D expenditures to net sales is significant in all specifications, at either then ten or five percent level. The estimated rate of return to R&D ranges from 0.22 to 0.32. These estimates are about average for previous work on the subject (see Mohnen, 1992, for example, for a review of previous studies).[14]

I next consider the effects of international trade on TFP growth. The change in import intensity has a positive coefficient, which is generally significant at the ten percent level (once at the five percent level). These results are consistent with the predictions of Hypothesis 3 (on the causes of downsizing) and indicate that import competition has an important effect on plant-level efficiency and tends to increase overall industry productivity. On the other hand, the change in export intensity has a negative coefficient but the coefficient is not significant.

I next look at the effects of changes in the size distribution of establishments on productivity growth. As suggested in the Introduction, downsizing may be a mechanism that increases establishment productivity as unnecessary labor is shed. Moreover, we would expect that the effects of downsizing on

[14] The coefficient of the number of full-time equivalent scientists and engineers engaged in R&D per employee is also significant in every case, typically at the one percent level. The tables present results using R&D expenditures

efficiency would occur with a lag, since there are immediate adjustment costs associated with any major restructuring of an establishment.

However, the results (shown in specification 2) do not indicate any direct association of lagged changes in average establishment size with industry productivity. Indeed, the coefficients are (perversely) negative, though, as I indicated, not statistically significant.[15]

On the other hand, lagged changes in the dispersion of employment among different manufacturing size classes has a negative effect on TFP growth (specifications 3 and 4). The coefficients are significant at the ten percent level for the change in the Gini coefficient and at the five percent level for the change in the coefficient of variation. This result is what we would expect, since as inefficient large establishments and inefficient small ones are eliminated from the industry, overall dispersion in employment should fall and overall productivity within the industry should rise. This result is also consistent with the argument that as plants move away from the downward and upward sloping portions of the average cost curve toward the flat bottomed middle, overall efficiency in the industry should increase, as well as productivity.

Unfortunately, this result is not as clean-cut as we would like, since, as shown in the last two regressions (specifications 5 and 6), lagged changes in the share of employees working in small establishments (less than 20 employees) is positively related to TFP growth, as are lagged changes in the share of employees employed in very large establishments (1,000 or more). However, in this case, while the coefficients of these two variables are positive, both coefficients are insignificant.

I also used the annual rate of labor productivity growth as the dependent variable. In this case, I include one additional independent variable, the rate of growth of total capital per worker, since increases in capital intensity will, *ceteris paribus*, raise labor productivity. The results are very similar to those for TFP growth (these are not shown in a table). The coefficient of R&D intensity remains significant (at the five or ten percent level), and the estimated rate of return to R&D falls in the range 0.23 to 0.33. The coefficient of the change in the share of imports in total sales remains positive and significant at the five or ten percent level.

The coefficients of lagged changes in average establishment size are now positive but, again, not statistically significant (t-ratios of 0.13 and 0.42, respectively). The coefficient of the lagged change in the Gini coefficient is, as before, negative but in this case not significant (a t-ratio of 1.55), while the

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because it is more conventional.

[15] Regression results (not shown) also indicate that contemporaneous changes in average establishment size do not have any significant effect on TFP growth.

coefficient of the lagged change in the coefficient of variation is also negative and significant at the five percent level. The coefficients of both the lagged change in the share of employees working in establishments of less than 20 employees and the lagged change in the share of employees working in establishments of 1,000 or more employees remain positive but not statistically significant (t-ratios of 0.94 and 1.51, respectively).

B. Profitability and market value. I next investigate the effects of downsizing on both profitability and the market value of companies. I use the same sample as in the analysis of productivity trends. There is less of a theoretical basis for the choice of possible determinants of firm profitability and stock valuation than there is of productivity growth. However, we might expect that profitability within an industry would depend on, among other things, the unionization rate, the degree of import penetration, and the concentration ratio.

The first dependent variable is the change in the average industry profit rate between the previous period and current period (see Table 11). This is essentially a fixed effect model, where the average profit rate of an industry is a function of the levels of these variables and an industry-specific effect. Our regression uses the first difference of this equation, so that the industry effect should, in principle, wash out.[16] In the first specification, I include only the unionization rate for the industry and its change in import intensity. The coefficient of the unionization rate is negative, as expected, and significant at the one percent level. The coefficient of the change in import intensity is, also as expected, negative but not significant.

In the next specifications, I add variables reflecting changes in the size distribution of establishments. I do find, as predicted that downsizing has a positive effect on profitability. The coefficient of the percentage change in average establishment size lagged one period is negative and significant at the five percent level (see specification 2).

I also find that changes in the dispersion of employment among different manufacturing size classes are positively associated with changes in profitability. The coefficient of the lagged change in the Gini coefficient is positive and significant at the ten percent level, while the coefficient of the lagged change in the coefficient of variation is positive and significant at the five percent level. The results indicate that as establishment size "regresses to the mean", overall industry profitability rises. On the other hand, neither the lagged change in the share of employees working in small establishments nor that in the share of employees employed in very large establishments is statistically significant.

[16] We also tested for the existence of industry effects, as well as period effects. On the basis of F-tests, we could not reject the null hypothesis of no industry (or period) effects at the five percent level

It is also of note that when variables reflecting changes in the size distribution of employment within the industry are added to the regression, the coefficient of the unionization rate remains negative and significant, though the significance level drops to the five or ten percent level. The coefficient of the period change in import intensity also remains negative but it not significant in any specification.[17]

Our next dependent variable is the change in the profit share within an industry between the previous and current period. This is also a fixed effect model, where the average profit share of an industry is a function of the levels of various variables and an industry-specific effect. The results are shown in Table 12. They are similar to those for the change in the average profit rate within the industry but less robust. As in the profit rate regressions, the coefficient of the unionization rate is negative and the coefficient of the change in import intensity is negative but, in this case, neither is statistically significant. The coefficient of the percentage change in average establishment size lagged one period is negative, as before, but is not statistically significant (see specification 2).

As in the profit rate regressions, the coefficient of the lagged change in the Gini coefficient is positive and the coefficient of the coefficient of variation lagged one period is positive. However, neither is statistically significant (specifications 4 and 5). Moreover, neither the lagged change in the share of employees working in small establishments nor that in the share of employees in very large establishments is statistically significant.

The third dependent variable in this group is the percentage change in the average market value of firms within an industry, deflated by the CPI. In the case of stock market valuation, there is little theory to guide us. I did use the same two independent variables as in the analysis of the change in the profit rate and the change in the profit share. While the coefficients of the change in import intensity proved statistically insignificant, I do find that unionization is a powerful explanatory variable. Its coefficient is uniformly negative and significant at the one percent level (see Table 12). The stock market appears to put a negative valuation on the presence of unions, presumably because of their negative impact on the profit rate.

Our major finding is that the coefficient of the percentage change in mean employment per establishment is positive and significant at the one percent level. In other words, contrary to popular belief, downsizing is associated with a **drop** in stock values, not a rise. This result holds only for the contemporaneous change in mean employment size. None of the other variables measuring changes in

[17] In other specifications, we included the period average Gini coefficient as a measure of the degree of concentration of the industry (since we lacked data on the four-firm or eight-firm concentration ratio). The coefficient of the variable, however, is not statistically significant.

the size distribution of establishments within the industry is statistically significant (specifications 3 through 6).

This regression finding on the relation between changes in the market valuation of firms and downsizing does not establish the direction of causation. It is possible that firms downsize when their stock values fall, thus creating a positive correlation between changes in average market value and changes in establishment size. It is also possible that when a firm gets into trouble, both its stock value falls and it downsizes in response to falling profits. It may also be true that the market does not reward downsizing -- that is, when layoffs occur, investors take it as a sign of trouble and try to sell off the company's stock.[18]

C. Employee compensation.. The next variable of interest is the change in employee remuneration. This measured by the percent change in employee compensation, including wages, salaries, and fringe benefits, per Full-Time Equivalent Employee (FTEE).[19] This is another fixed effect model, where average employee remuneration is posited to be a function of the levels of various variables and an industry-specific effect. Our regressions essentially use the first difference of this equation, so that the industry effect should fall out.

There are not too many other independent variables for the analysis. Ideally, one would like to control for changes in the average human capital or skill level of employees within an industry. However, these data are not available. I do, however, have information on the degree of unionization within an industry. This will allow us to control for the well-documented wage differential between union and non-union workers (see, for example, Lewis, 1963 and 1986). I also control for the concentration ratio of the industry, using the period average Gini coefficient. This accords with numerous findings in the literature that more concentrated industries, *ceteris paribus*, pay higher wages than those that are less concentrated ones (see, for example, Weiss, 1966, and Pugel, 1980).

The results are shown in Table 14. The unionization rate, as predicted, has a uniformly positive effect on the change in average earnings, but it is not statistically significant in any case. The concentration ratio also has the predicted positive association with earnings growth and is statistically significant at the five or ten percent level in all cases but one.

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[18] We did try to test for reverse causation by regressing the percent change in average establishment size on TFP growth, R&D intensity, the unionization rate, the change in export and import intensity, the growth in total industry employment, the lagged profit rate, and the percent change in the average market value of firms within an industry lagged one period. We find that the coefficient of the last of these variables is uniformly negative, though not statistically significant. This result is unexpected, since it suggests that when the stock value of a firm declines, it responds (after a lag) by increasing employment rather than decreasing it.

[19] The results are very similar for the percent change in wages and salaries per FTEE and are not shown here.

The main finding is that the percentage change in the average number of employees per establishment has a positive effect on wage growth. The coefficient is significant at the one percent level (specification 2). These results establish that downsizing leads to a reduction in average remuneration. The coefficient of the percentage change in the average number of employees per establishment lagged one period is also positive and significant at the one percent level (specification 3). The result that there is a positive and significant association between change in establishment size and wage growth survives the inclusion of both period and industry effects (the coefficient remains significant at the five or one percent level).

I also find that changes in the dispersion of employment among different size classes within manufacturing is positively associated with wage growth. The coefficient of the change in the Gini coefficient and that of the change in the coefficient of variation are both significant at the five percent level (specifications 4 and 5). The results indicate that regression to the mean in terms of establishment size (that is, a reduction in the dispersion of employment across size classes) is associated with a decline in wage growth. Moreover, an increase in the share of total employment in both very small and very large establishments appear to be associated with a reduction in wage growth (specifications 6 and 7). The coefficient of the change in the share of employment in very small establishments has the expected negative sign (smaller establishments provide lower compensation) and is significant at the ten percent level. The coefficient of the change of the share of employment in very large establishments is now positive but insignificant.

The last variable of interest is the annual change in unit labor cost. Unit labor cost is defined as employee compensation (in 1992 dollars) to output (also in 1992 dollars). It is thus the ratio of real compensation per worker to labor productivity. Its change over time thus reflects changes in employee compensation and changes in labor productivity. The results for this variable are shown in Table 15.

The key result is that the coefficients of the percentage change in mean number of employees per establishment are positive and significant at the five percent level. Thus, downsizing leads to reductions in unit labor costs. The main mechanism is through a reduction in pay, rather than an increase in productivity. The coefficient of the percentage change in the average number of employees per establishment lagged one period is also positive but significant at only the ten percent level. On the other hand, changes in the dispersion of employment among different size classes within manufacturing do not seem to bear directly on unit labor costs.

The unionization rate, as expected, is positively related to changes in unit labor costs (through its positive effect on wages), but its coefficient is not statistically significant in any case. The concentration ratio also has a positive association with changes in unit labor costs, since, as found above, more concentrated industries tend to experience higher growth in employee remuneration. Its coefficient is significant at the one percent level in seven of the eight cases and at the five percent level in the other. Expenditures on R&D, in contrast, lead to reductions in unit labor costs --- mainly through their impact on productivity. The coefficient of this variable is significant at the five percent level in six of the seven cases and at the ten percent level in the other.

8. Conclusions

I find some strong support for most of the hypotheses on the sources of downsizing in manufacturing. With regard to the first hypothesis, I find that industry R&D spending as a percentage of net sales has a consistently negative effect on the growth in mean establishment size, though the coefficient is not significant. There is therefore some modest support for the view that the new technology that grows out of R&D investment has been making smaller industrial units more viable, that is, reducing economies of scale. This result seems to conflict with that of Kumar *et. al.* (1999). On the other hand, R&D intensity does not appear to affect the dispersion of employment among different size classes, except the share of employment in very large establishments, where the effect is negative though again not significant

In contradistinction to the second hypothesis, the growth of OCA (and OCACM) per worker has an essentially zero effect on changes in average establishment size. These results do not support the argument that information technology may lead to downsizing on the establishment level. This result appears at variance with that reported by Brynjolfsson *et. al.* (1993). However, the growth in OCA (and OCACM) per worker does appear to have a significant negative effect on changes in the overall dispersion of employment among different size classes. In fact, it is the only consistently significant variable. The results support the argument that greater investment in OCA (and OCACM) leads to less dispersion in employment by size class within an industry. Interestingly, the growth of OCA (and OCACM) per worker is positively related to the change in the share of employment in very small establishments, but negatively related to the change in the share of employment in very large establishments. These results suggest that information technology reduces economies of scale at the establishment level.

With regard to the third hypothesis, the change in imports as a share of total sales has a

uniformly negative effect on growth in establishment size, and its effect is uniformly significant. These results might be interpreted as meaning that import competition tends to induce downsizing, perhaps by forcing establishments to get rid of unnecessary layers of management and staff. Likewise, the change in export intensity has a consistently very significant negative effect on the growth in establishment size. These latter results suggest that competition for foreign markets induces firms to cut costs and therefore to downsize, in contradistinction to White (2001)'s conjecture. On the other hand, increases in import or export intensity do not affect the overall dispersion of employment by size class or the share of employment in either small or large establishments.

In contrast to the fourth hypothesis, the unionization rate has a consistently negative effect on the change in establishment size; and it is uniformly significant. The evidence, if anything, indicates that unionized industries are *more* apt to downsize -- perhaps, to get rid of more expensive union labor. Unionization, moreover, appears to be unrelated to changes in the dispersion of employment by size class.

The lagged profit share and lagged profit rate have positive and significant effects on the changes in average establishment size. The results suggest that lower profitability in one period leads companies to downsize in the succeeding period, as predicted by the fifth hypothesis. However, profitability is not significantly related to changes in the overall dispersion of establishments by size class.

In brief, this econometric study of the determinants of downsizing in manufacturing finds considerable support for the idea that foreign competition pushes firms to downsize and for the hypothesis that falling profits put pressure on firms to downsize. However, my findings reject the notions that unions are an effective impediment to downsizing and that faster information-technology capital formation leads to downsizing. Indeed, the evidence, if anything, indicates that unionized industries are *more* apt to downsize -- perhaps, to get rid of more expensive union labor. Indeed, this result is consistent with the finding of a *negative* effect of downsizing on employee compensation. Moreover, the growth in information-technology capital does appear to have a significant negative effect on changes in the overall dispersion of employment among different size classes.

With regard to the consequences of downsizing, the first topic of interest is the effect of downsizing on industry level productivity growth. The results do not indicate that lagged changes in average establishment size have any direct association with industry productivity. Indeed, the coefficient is (perversely) negative, though not statistically significant. This result is broadly consistent with the findings of Baily, Bartelsman, and Haltiwanger (1996) and Collins and Harris (1999) that downsizing was generally associated with a lowering of productivity growth.

On the other hand, lagged changes in the dispersion of employment among different manufacturing size classes have a negative effect on TFP growth, with coefficients that are significant at the five or ten percent level. This result suggests that as inefficient small and large establishments are eliminated from the industry, overall dispersion in employment falls and overall industry productivity increases. This result is also consistent with the argument that as plants move toward the flat bottomed middle part of the average cost curve, overall efficiency in the industry should increase, as well as productivity.

I also find, as in most previous studies on productivity, that the coefficient of the ratio of R&D expenditures to net sales is significant. The estimated rate of return to R&D ranges from 0.22 to 0.32. The change in import intensity also has a positive coefficient, and its coefficient is significant at the five or ten percent level. These results are consistent with the argument that import competition increases plant-level efficiency and overall industry productivity.

I next investigated the effects of downsizing on profitability. Here I find very strong effects. The coefficient of the lagged percentage change in average establishment size is negative and statistically significant. The result supports the hypothesis that downsizing leads to increased profitability. I also find that changes in the dispersion of employment among different size classes are positively associated with changes in profitability. These results indicate that as establishment size "regresses to the mean" within an industry, overall industry profitability rises. When the regressions are replicated for the change in the average profit share within an industry, the signs of these variables remain unchanged but are generally less significant. I also find that the unionization rate has a negative effect on the average industry profit rate, and its coefficient is highly significant, indicating that the presence of unions in an industry reduces profitability.

The next topic of interest is the effect of downsizing on the percentage change in the average market value of firms within an industry. I find that the coefficient of the percentage change in mean employment per establishment is positive and highly significant. Contrary to popular belief, downsizing is associated with a **fall** in stock values, not a rise. This result holds only for the contemporaneous change in mean employment size. This result is also consistent with some of the previous literature on the subject which found a negative relation between downsizing and stock price changes (see Worrell, Davidson, and Sharma, 1991; Gombola and Tsetsekos, 1992; Abraham, 1999; and Farber and Hallock, 1999). This regression finding does not establish the direction of causation -- whether downsizing leads to falling stock values or falling stock values induce firms to downsize. Putting these results together, it appears that low profitability leads firms to downsize and this increases profitability. However, investors

seem likely to interpret downsizing as an indicator of low profits and the possibility that the firm is in trouble and therefore its stock price falls.

Unionization is also found to be negatively related to market value gains, and its coefficient is highly significant. The results suggest that the stock market puts a negative valuation on the presence of unions, presumably because of their depressing effect on the profit rate.

The final topic considered is the effect of downsizing on the growth in employee costs. I find that the change in the average number of employees per establishment has a positive effect on the growth in both average wages and salaries and average employee compensation, with highly significant coefficients. These results confirm the hypothesis that downsizing leads to a reduction in average employee remuneration. I also find that a decrease in the dispersion of employment among different size classes within manufacturing is negatively related to the growth in both wages and salaries and total employee compensation. The results indicate that regression to the mean in terms of establishment size is associated with a decline in the growth of average employee remuneration. I also find that the concentration ratio has the predicted positive association with earnings and compensation growth and is generally statistically significant in the case of changes in employee compensation. The unionization rate, as expected, is positively associated with the growth in employee compensation but, surprisingly, is not statistically significant.

As a consequence, downsizing leads to reductions in unit labor costs. Similar findings were reported by Cappelli (2000) and Espahbodi, John, and Vasudevan (2000). However, changes in the dispersion of employment across size classes do not seem to affect unit labor costs. R&D expenditures tend to lower unit labor costs through their effect on productivity. Industry concentration is also positively associated with increases in unit labor costs, mainly through its association with wage increases.

In brief, the econometric evidence indicates that where downsizing has occurred in the manufacturing sector it has not contributed to productivity, contrary to what is frequently conjectured. Second, it has nevertheless served to increase profits. Third, it has also tended to depress wages and workers' total compensation. As a consequence, downsizing both at the establishment and firm level led to reductions in unit labor costs. Fourth, as this implies, a central effect of downsizing, apparently, has been a transfer of income from labor to capital. Fifth, curiously, despite its stimulus to profits, downsizing by a firm has been associated with a decline in the price of its stocks, perhaps because investors take downsizing as management's response to prospects of trouble ahead.

The disappointing finding that cutting the labor force is not a surefire way to increase the

competitiveness of American enterprises or an effective way of raising output per worker which, in the last analysis, is the key to enhancement of standards of living, is in itself obviously important for evaluation of downsizing. The failure to add to productivity, taken in conjunction with its enhancement of profits, raises an obvious question. How can it have achieved the latter without at the same time accomplishing the former? If not from higher productivity, from where do the increased profits of the downsizers come?

The data support the answer to this question that was just suggested. They indicate that downsizing firms end up spending *less money on wages relative to output*. That is, while downsizing firms do not get more output per labor *hour*, they do obtain more output per labor *dollar*. That is just another way of saying that downsizing is profitable at least partly because it is an effective way to hold down wages.

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Data Appendix: Definitions and Sources

1. NIPA employment data: Full-time equivalent employees (FTEE) equals the number of employees on full-time schedules plus the number of employees on part-time schedules converted to a full-time basis. FTEE is computed as the product of the total number of employees and the ratio of average weekly hours per employee for all employees to average weekly hours per employee on full-time schedules. Persons engaged in production (PEP) equals the number of full-time and part-time employees plus the number of self-employed persons. Unpaid family workers are not included. Figures are from the Bureau of Economic Analysis, National Income and Product Accounts (NIPA), available on the Internet.

2. NIPA employee compensation: Employee compensation includes wages and salaries and employee benefits. Figures are from the Bureau of Economic Analysis, NIPA, available on the Internet.

3. Capital stock figures are based on chain-type quantity indexes for net stock of fixed capital in 1992$, year-end estimates. Equipment and structures, including information technology equipment, are for the private (non-government) sector only. Information processing and related equipment includes: (a) computers and peripheral equipment; (b) other office and accounting machinery; (c) communication equipment; (d) instruments; and (e) photocopy and related equipment. Source: U.S. Bureau of Economic Analysis, Fixed Reproducible Tangible Wealth, Internet. For technical details, see U.S. Department of Commerce, Bureau of Economic Analysis, *Fixed Reproducible Tangible Wealth in the United States, 1925-89*, (Washington, DC: U.S. Government Printing Office), January, 1993.

4. Total factor productivity growth (TFPGRTH) for sector j is defined as:

$$TFPGRTH_j = p_j = Y^*_j - a_jL^*_j - (1 - a_j)K^*_j,$$

where Y^*_j is the annual rate of output growth, L^*_j is the annual growth in labor input, and K^*_j is the annual growth in capital input in sector j, and a_j is the average share of employee compensation in GDP over the period in sector j (the Tornqvist-Divisia index).We measure output using GDP in constant dollars, the labor input using Full-Time Equivalent Employees (FTEE) or Persons Engaged in Production (PEP) and the capital input by the fixed non-residential net capital stock (1992 dollars).

5. Research and development expenditures performed by industry include company, federal, and other sources of funds. Company-financed R&D performed outside the company is excluded. Industry series on R&D and full-time equivalent scientists and engineers engaged in R&D per full-time equivalent employee run from 1957 to 1997. Source: National Science Foundation, Internet. For technical details, see National Science Foundation, *Research and Development in Industry*, (Arlington, VA: National Science Foundation), NSF96-304, 1996.

6. Export and import data. Sources: U.S. input-output data for years 1947, 1958, 1963, 1967, 1972, 1977, 1982, 1987, 1992, and 1997 provided on computer tape, diskette, or the Internet by the Bureau of Economic analysis. GDO is gross domestic output (net sales).

7. Percent of labor force covered by unions. Estimates for 1953-83 are the annual average number of dues paying members reported by labor unions. Estimates for 1983-1997 are annual averages from the Current Population Survey. Data exclude numbers of professional and public employee associations. Sources: (a) U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics*

1978, Bulletin 2, (Washington, DC: U.S. Government Printing Office), 1979; (c) U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics 1989*, Bulletin 23, (Washington, DC: U.S. Government Printing Office), 1990; and (d) Eva E. Jacobs, Editor, *Handbook of U.S. Labor Statistics*, Second Edition, (Lanham, MD: Bernan Press), 1998. sources for the industry level data include in addition to the above: Kokkelenberg and Sockell (1985); Hirsch and Macpherson (1993), accompanying data files; and Bureau of Labor Statistics, Office of Employment Projections, Output and Employment data base.

8. Profit share and profit rate. Data are from the Bureau of Economic Analysis' National Income and Product Accounts and Net Stock of Fixed Reproducible Tangible Capital accounts, provided on the Internet. Key:

PBT: Corporate profits before tax.
PI: Proprietors' income.
PTI: Gross Property-type income, defined as the sum of corporate profits, the profit portion of proprietors' income, rental income of persons, net interest, capital consumption allowances, business transfer payments, and the current surplus of government enterprises less subsidies. Proprietors' income includes both labor income and a return on capital. The labor portion is estimated by multiplying the number of self- employed workers by the average employee compensation of salaried workers. The profit portion is the residual part of proprietors' income.
CCCA: Corporate Capital Consumption Allowance
NCCA: Noncorporate Capital Consumption Allowance
GDP: Current dollar Gross Domestic Product.
COMP: Compensation of employees, which consists of wage and salary accruals, employer contributions for social insurance, and other labor income.
NNI: Net national income, defined as COMP+PTI-CCCA-NCCA.
NETK: Current-cost net stock of fixed reproducible tangible non-residential private capital stock.

Net profit rate, private economy = (PTI-CCCA-NCCA) / NETK
Net profit share = (PTI-CCCA-NCCA) / NNI

Table 1 Average Number of Employees per Establishment For Two-Digit SIC Manufacturing Industries, 1967-1997

SIC	Industry	1967	1992	1997	Percentage Change 1967-92	Percentage Change 1967-97
20	Food and kindred products	50.7	72.3	74.8	42.4	47.4
21	Tobacco products	228.3	333.3	NA	46.0	NA
22	Textile mill products	131.2	104.7	91.3	-20.2	-30.4
23	Apparel and other textile products	51.4	42.7	35.4	-17.0	-31.1
24	Lumber and wood products	15.1	18.3	20.6	21.6	36.9
25	Furniture and fixtures	42.5	40.4	43.3	-4.9	1.9
26	Paper and allied products	108.5	97.6	NA	-10.0	NA
27	Printing and publishing	27.1	22.8	24.6	-15.9	-9.3
28	Chemicals and allied products	71.3	70.7	66.3	-0.9	-7.0
29	Petroleum and coal products	75.3	53.9	49.4	-28.5	-34.4
30	Rubber and misc plastics products	80.0	57.2	61.4	-28.5	-23.3
31	Leather and leather products	89.2	49.6	NA	-44.4	NA
32	Stone, clay, and glass	37.9	28.8	30.8	-23.8	-18.6
33	Primary metal industries	187.4	101.8	110.3	-45.6	-41.1
34	Fabricated metal products	48.9	37.4	40.8	-23.6	-16.6
35	Industrial machinery & equipment	49.2	32.2	35.1	-34.5	-28.7
36	Electronic & electrical equipment	175.1	85.0	92.5	-51.4	-47.2
37	Transportation equipment	245.1	145.9	126.1	-40.5	-48.6
38	Instruments and related products	88.5	79.9	NA	-9.8	NA
39	Miscellaneous industries	30.1	21.5	21.8	-28.6	-27.4
	Non-Durables	56.0	47.0	NA	-16.0	NA
	Durables	61.8	44.7	NA	-27.6	NA
	All Manufacturing Industries	60.5	45.7	46.5	-24.5	-23.2

Source: Author's computations from the Census of Manufacturing, 1967-1997.

Table 2 Co-Worker Mean Number of Employees per Establishment For Two-Digit SIC Manufacturing Industries, 1967-1997

SIC	Industry	1967	1972	1977	1982	1987	1992	Percentage Change 1967-92
20	Food and kindred products	507.1	501.5	401.0	339.4	321.7	328.4	-35.2
21	Tobacco products	534.5	620.9	603.9	244.9	572.3	402.3	-24.7
22	Textile mill products	352.8	320.7	310.8	303.2	208.6	194.9	-44.8
23	Apparel and other textile products	365.2	318.0	316.8	234.5	284.0	290.1	-20.6
24	Lumber and wood products	755.7	468.9	540.1	370.0	341.4	333.8	-55.8
25	Furniture and fixtures	604.2	403.4	485.9	472.4	454.0	471.5	-22.0
26	Paper and allied products	300.3	275.8	273.4	260.0	234.0	204.1	-32.0
27	Printing and publishing	1523.2	1690.3	1258.1	1073.5	1039.2	923.8	-39.3
28	Chemicals and allied products	1004.3	876.2	812.7	721.0	737.8	717.7	-28.5
29	Petroleum and coal products	791.7	753.6	719.9	583.8	516.8	460.3	-41.9
30	Rubber and misc plastics products	833.9	670.4	603.8	417.7	365.8	296.4	-64.5
31	Leather and leather products	252.8	227.4	222.9	248.3	245.7	269.8	6.7
32	Stone, clay, and glass	707.5	645.7	630.1	467.9	376.7	309.4	-56.3
33	Primary metal industries	837.5	817.4	823.7	702.9	521.6	416.0	-50.3
34	Fabricated metal products	739.0	761.0	671.6	522.4	490.5	373.6	-49.4
35	Industrial machinery & equipment	1481.8	1467.0	1331.0	1265.4	1169.3	1038.9	-29.9
36	Electronic & electrical equipment	767.1	768.4	721.4	655.3	587.7	546.0	-28.8
37	Transportation equipment	1190.1	1218.6	1250.4	1103.4	1146.8	1090.9	-8.3
38	Instruments and related products	1208.6	1335.6	1292.9	1230.6	932.1	683.0	-43.5
39	Miscellaneous industries	759.4	787.7	682.5	452.2	507.5	533.2	-29.8
	All Manufacturing Industries	1424.9	1181.0	1145.6	1043.2	1046.9	900.8	-36.8

Source: Author's computations from the Census of Manufacturing, 1967-1997.

Table 3. Number of Two-Digit Manufacturing Industries Upsizing and Downsizing by Census Period, 1967-1997

Period	Change in Average Size: Total Manufacturing	Number of Industries Downsizing	Number of Industries Upsizing
A.Census of Manufacturing Mean Establishment Size			
1967-72	-4.7%	11	9
1972-77	-8.5%	18	2
1977-82	-3.1%	14	6
1982-87	-3.5%	11	9
1987-92	-7.4%	14	6
1992-97	1.7%	5	11
TOTAL	-23.2%	73	43
B. Census of Manufacturing Establishments: Co-Worker Mean[a]			
1967-72	-17.1%	13	7
1972-77	-3.0%	16	4
1977-82	-8.9%	19	1
1982-87	0.4%	15	5
1987-92	-14.0%	15	5
1992-97	---		
TOTAL[b]	-36.8%	78	22

Source: Author's computations from the Census of Manufacturing, 1967-1997. Census of Manufacturing data on average-establishment size are missing for five industries in 1997. Industries in which average size changes by less than by less than 0.1 percent are excluded from the tabulation.

a. The co-worker mean is the employment-weighted average establishment size.
b. 1967-1992

Table 4. Size Distribution of Establishments and Employment, In Total Manufacturing, Census of Manufacturing, 1967-1992

Size Class by Number of Employees	1967	1972	1977	1982	1987	1992
A. Establisments						
1 to 4	38.4%	35.9%	40.1%	32.5%	32.6%	34.8%
5 to 9	12.9%	14.9%	13.7%	17.2%	17.5%	17.8%
10 to 19	13.6%	14.0%	13.8%	16.4%	16.3%	15.3%
20 to 49	16.0%	16.0%	14.7%	16.1%	16.1%	15.3%
50 to 99	8.2%	8.2%	7.6%	7.9%	7.9%	7.6%
100 to 249	6.5%	6.7%	6.1%	6.1%	6.1%	5.9%
250 to 499	2.5%	2.6%	2.4%	2.3%	2.2%	2.1%
500 to 999	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
1,000 to 2,499	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%
2,500 or more	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
All establishments	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Memo:						
20 or more	35.0%	35.2%	32.5%	33.9%	33.7%	32.1%
1,000 or more	0.8%	0.7%	0.6%	0.5%	0.5%	0.4%
B. Employment						
1 to 4	1.1%	1.1%	1.2%	1.2%	1.3%	1.3%
5 to 9	1.4%	1.7%	1.7%	2.3%	2.4%	2.6%
10 to 19	3.1%	3.4%	3.6%	4.4%	4.5%	4.6%
20 to 49	8.3%	8.7%	8.7%	9.8%	10.2%	10.4%
50 to 99	9.4%	9.9%	10.1%	10.7%	11.1%	11.6%
100 to 249	16.6%	17.9%	18.0%	18.4%	19.1%	19.8%
250 to 499	14.5%	15.4%	15.6%	15.3%	15.4%	15.9%
500 to 999	12.8%	13.1%	13.5%	12.7%	12.3%	12.5%
1,000 to 2,499	13.2%	12.5%	11.8%	11.4%	10.7%	10.6%
2,500 or more	19.6%	16.2%	15.7%	13.7%	13.0%	10.6%
All establishments	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Memo:						
Under 20	5.6%	6.2%	6.5%	7.9%	8.2%	8.5%
1,000 or more	32.8%	28.7%	27.5%	25.2%	23.7%	21.2%
Average size	60.5	57.7	52.8	51.1	49.4	45.7
Standard deviation	287.3	254.5	240.2	225.3	221.9	197.7
Coefficient of variation	4.75	4.41	4.55	4.40	4.50	4.33
Gini coefficient	0.828	0.815	0.824	0.799	0.794	0.796

Source: Author's computations from the Census of Manufacturing, 1967-1992.

Table 5. Dispersion of Employment by Employee Size Class for Establishments, Two-Digit Manufacturing Industries, Census of Manufacturing Data, 1967-1992

SIC	Industry	Coefficient of Variation			Gini Coefficient		
		1967	1992	Change, 1967-1992	1967	1992	Change, 1967-1992
	All Manufacturing Industries	4.75	4.33	-0.42	0.828	0.796	-0.032
20	Food and kindred products	2.72	2.49	-0.23	0.745	0.762	0.017
21	Tobacco products	2.80	2.79	-0.01	0.796	0.755	-0.041
22	Textile mill products	2.20	1.81	-0.39	0.715	0.641	-0.074
23	Apparel and other textile products	2.24	2.31	0.07	0.697	0.692	-0.005
24	Lumber and wood products	3.39	2.51	-0.88	0.773	0.743	-0.030
25	Furniture and fixtures	3.00	3.05	0.05	0.775	0.771	-0.004
26	Paper and allied products	1.99	1.86	-0.13	0.682	0.654	-0.029
27	Printing and publishing	4.92	4.38	-0.53	0.814	0.775	-0.039
28	Chemicals and allied products	3.95	3.83	-0.12	0.833	0.796	-0.037
29	Petroleum and coal products	3.48	3.01	-0.46	0.818	0.823	0.005
30	Rubber and misc plastics products	3.58	2.34	-1.23	0.799	0.691	-0.107
31	Leather and leather products	1.78	2.21	0.43	0.702	0.727	0.025
32	Stone, clay, and glass	3.27	2.40	-0.87	0.771	0.602	-0.169
33	Primary metal industries	3.58	2.85	-0.74	0.818	0.677	-0.140
34	Fabricated metal products	3.35	2.68	-0.67	0.762	0.648	-0.114
35	Industrial machinery & equipment	4.85	4.66	-0.18	0.842	0.781	-0.062
36	Electronic & electrical equipment	3.42	3.31	-0.11	0.836	0.791	-0.045
37	Transportation equipment	4.32	4.78	0.46	0.902	0.863	-0.039
38	Instruments and related products	4.36	3.73	-0.62	0.855	0.841	-0.014
39	Miscellaneous industries	3.40	3.27	-0.13	0.780	0.775	-0.004

Source: Author's computations from the Census of Manufacturing, 1967 and 1992.

Table 6. Distribution of Establishments and Employment by Two-Digit Manufacturing Industries, Census of Manufacturing Data, 1967-1992

SIC	Industry	Establishments 1967	Establishments 1992	Employment 1967	Employment 1992
20	Food and kindred products	10.7%	5.6%	9.1%	8.9%
21	Tobacco products	0.1%	0.0%	0.4%	0.2%
22	Textile mill products	2.3%	1.6%	5.1%	3.6%
23	Apparel and other textile products	8.6%	6.2%	7.5%	5.8%
24	Lumber and wood products	12.1%	9.7%	3.1%	3.9%
25	Furniture and fixtures	3.3%	3.1%	2.4%	2.8%
26	Paper and allied products	1.9%	1.7%	3.5%	3.7%
27	Printing and publishing	12.4%	17.6%	5.7%	8.8%
28	Chemicals and allied products	3.9%	3.2%	4.7%	5.0%
29	Petroleum and coal products	0.6%	0.6%	0.8%	0.7%
30	Rubber and misc plastics products	2.1%	4.3%	2.9%	5.3%
31	Leather and leather products	1.2%	0.5%	1.8%	0.6%
32	Stone, clay, and glass	5.1%	4.4%	3.3%	2.8%
33	Primary metal industries	2.2%	1.8%	7.1%	3.9%
34	Fabricated metal products	9.0%	9.8%	7.4%	8.0%
35	Industrial machinery & equipment	12.4%	14.5%	10.3%	10.3%
36	Electronic & electrical equipment	3.5%	4.6%	10.4%	8.5%
37	Transportation equipment	2.5%	3.0%	10.1%	9.7%
38	Instruments and related products	1.5%	3.1%	2.2%	5.4%
39	Miscellaneous industries	4.6%	4.6%	2.3%	2.2%
	Non-Durables	43.9%	41.4%	41.5%	42.7%
	Durables	56.1%	58.6%	58.5%	57.3%
	Total	100.0%	100.0%	100.0%	100.0%
Total Number (in 1,000s)		305.7	370.9	18,492	16,949

Source: Author's computations from the Census of Manufacturing, establishments, 1967-1997.

Table 7. Decomposition of the Change in Average Establishment Size In Total Manufacturing by Period, 1967-1992

Decomposition	1967-72	1972-77	1977-82	1982-87	1987-92	1967-92
A. Employment per Establishment						
Actual Change	-2.82	-4.89	-1.64	-1.79	-3.66	-14.80
Within Industry	-4.85	-4.68	-1.43	-1.25	-3.65	-15.86
Between Industry	2.03	-0.21	-0.21	-0.53	-0.02	1.06
B. Percentage Decompostion						
Actual Change	100%	100%	100%	100%	100%	100%
Within Industry	172%	96%	87%	70%	100%	107%
Between Industry	-72%	4%	13%	30%	0%	-7%

Source: Authors' computations from the Census of Manufacturing, establishments, 1967-1997.

Table 8. Regressions of Percentage Change in Mean Number of Employees Per Establishment from the Census of Manufacturing on Selected Variables

Independent Variables	Specification (1)		(2)		(3)		(4)		(5)	
Constant	0.054	*	0.069	*	0.055	*	0.031		0.029	
	(2.20)		(2.29)		(2.00)		(1.12)		(1.03)	
Ratio of Industry R&D to Net Sales (period average)	-0.367		-0.413		-0.367		-0.237		-0.274	
	(0.91)		(0.97)		(0.90)		(0.59)		(0.68)	
		*				*		*		*
Period Change in Ratio of Exports to Gross Output	-1.740	*	-1.391	#	-1.741	*	-1.809	*	-1.754	*
	(3.23)		(1.73)		(3.19)		(3.38)		(3.28)	
								*		
Period Change in Ratio of Imports to Gross Output	-0.321	*	-0.358	*	-0.321	*	-0.355	*	-0.291	*
	(2.42)		(2.39)		(2.41)		(2.69)		(2.19)	
Unionization Rate (period average)	-0.136	*	-0.150	*	-0.136	*	-0.129	*	-0.131	*
	(2.25)		(2.10)		(2.24)		(2.17)		(2.18)	
Growth in OCA per Worker					-0.01					
					(0.02)					
Proft Rate (1-period lag)							0.099	*		
							(1.99)			
Profit Share (1 period lag)									0.119	#
									(1.75)	
Period Dummy Variables	No		Yes		No		No		No	
R^2	0.18		0.22		0.18		0.21		0.20	
Adjusted R^2	0.15		0.15		0.14		0.17		0.17	
Standard error	0.0964		0.0964		0.0969		0.0953		0.0955	
Sample Size	116		116		116		116		116	

Note: The sample consists of pooled cross-section time-series data, with observations on each of the 20 manufacturing industries in 1967-72, 1972-77, 1977-82, 1982-87, 1987-92, and 1992-97 (16 industries). The coefficients are estimated using use the White procedure for a heteroschedasticity-consistent covariance matrix. The absolute value of the t-statistic is shown in parentheses below the coefficient estimate. See the Data Appendix for sources. Key:

OCA: net stocks of office, computer and accounting machinery.

Unionization Rate: share of employees covered by union contracts.

Profit share: ratio of net profits to net national income, averaged over the period.

Profit rate: ratio of net profits to net capital stock, averaged over the period.

 # Significant at the 10% level (two-tailed test)

*** Significant at the 5% level (two-tailed test)**

**** Significant at the 1% level (two-tailed test)**

Table 9. Regressions of the Change in the Dispersion of Employment On Selected Variables

Independent Variables	Dependent Variable			
	CHNGGINI	CHNGCV	CHNGEST20	CHNGEST1000
Constant	0.008	-0.056	-0.001	0.004
	(0.84)	(0.59)	(0.19)	(0.32)
Ratio of Industry R&D to Net Sales (period average)	0.021	0.268	-0.060	-0.294
	(0.15)	(0.20)	(0.66)	(1.50)
Period Change in Ratio of Exports to Gross Output	-0.008	0.156	-0.001	0.043
	(0.04)	(0.09)	(0.01)	(0.16)
Period Change in Ratio of Imports to Gross Output	0.007	0.460	0.046	0.004
	(0.16)	(1.09)	(1.59)	(0.01)
Unionization Rate (period average)	-0.022	0.127	0.001	-0.031
	(1.01)	(0.61)	(0.70)	(1.04)
Growth in OCA per Worker	-0.095 *	-0.671 *	0.042 *	-0.089 *
	(3.19)	(2.31)	(2.11)	(2.10)
R^2	0.11	0.07	0.08	0.08
Adjusted R^2	0.06	0.02	0.03	0.03
Standard error	0.0311	0.302	0.0205	0.0440
Sample Size	100	100	100	100

Note: The sample consists of pooled cross-section time-series data, with observations on each of the 20 manufacturing industries in 1967-72, 1972-77, 1977-82, 1982-87, and 1987-92. The coefficients are estimated using use the White procedure for a heteroschedasticity-consistent covariance matrix. The absolute value of the t-statistic is shown in parentheses below the coefficient estimates. See the Data Appendix for sources and the footnote to Table 8 for key. Establishment size data are from the Census of Manufacturing.

1) CHNGGINI: Change in the Gini coefficient for the average number of employees per establishment by industry size class.

2) CHNGCV: Change in the coefficient of variation for the average number of employees per establishment by industry size class.

3) CHNGEST20: Change in the percentage of employment in size classes 19 or less.

4) CHNGEST1000: Change in the percentage of employment in size classes 1000 or more.

 # Significant at the 10% level (two-tailed test)
*** Significant at the 5% level (two-tailed test)**
**** Significant at the 1% level (two-tailed test)**

Table 10. Regressions of TFP Growth on Downsizing Variables

Independent Variables	(1)		(2)		(3)		(4)		(5)		(6)	
Constant	0.013	*	0.012	*	0.009		0.009		0.010	#	0.015	*
	(2.61)		(2.00)		(1.55)		(1.53)		(1.70)		(2.49)	
Ratio of Industry R&D to Net Sales (period	0.255	*	0.247	#	0.221	#	0.221	#	0.273	#	0.324	*
	(2.03)		(1.79)		(1.72)		(1.79)		(1.69)		(2.01)	
Period Change in Ratio Exports to Gross Output	-0.297		-0.322		-0.178		-0.157		-0.307		-0.365	
	(1.47)		(1.43)		(0.08)		(0.68)		(1.39)		(1.56)	
Period Change in Ratio Imports to Gross Output	0.079	#	0.079	#	0.082	#	0.090	*	0.072	#	0.078	#
	(1.92)		(1.68)		(1.81)		(1.99)		(1.70)		(1.70)	
Percent Change in Mean Employment Per Establishment (1 period lag)			-0.032									
			(0.82)									
CHGINI (1 period lag)					-0.241	#						
					(1.91)							
CHNGCV (1 period lag)							-0.027	*				
							(2.00)					
CHEST20 (1 period lag)									0.322			
									(1.51)			
CHEST1000 (1 period lag)											0.148	
											(1.57)	
R^2	0.056		0.066		0.095		0.098		0.087		0.085	
Adjusted R^2	0.032		0.027		0.056		0.060		0.049		0.046	
Standard error	0.0361		0.0392		0.0386		0.0384		0.038 7		0.038 8	
Sample Size	120		100		100		100		100		100	
Period	1967-97		1972-97		1972-97		1972-97		1972-97		1972-97	

Note: The sample consists of pooled cross-section time-series data, with observations on each of the 20 manufacturing industries. The full set of Census periods is: 1967-72, 1972-77, 1977-82, 1982-87, 1987-92, and 1992-97 (16 industries). Actual periods for each regression are indicated. The coefficients are estimated using use the White procedure for a heteroschedasticity-consistent covariance matrix. The absolute value of the t-statistic is shown in parentheses below the coefficient estimate. See the Data Appendix for sources and notes to Tables 8 and 9 for the key. In addition,

1) TFP Growth: average annual rate of total factor productivity growth, based on full-time Equivalent Employees (FTEE) and net capital stock.

 # Significant at the 10% level (two-tailed test)

*** Significant at the 5% level (two-tailed test)**

**** Significant at the 1% level (two-tailed test)**

Table 11. Regressions of the Change in the Profit Rate on Downsizing Variables

Independent Variables	Specification (1)		(2)		(3)		(4)		(5)		(6)	
Constant	0.025		0.022		0.025		0.029		0.020		0.021	
	(1.36)		(1.12)		(1.21)		(1.45)		(0.95)		(1.00)	
Unionization Rate (Period Average)	-0.136	* *	-0.127	*	-0.104	#	-0.118	#	-0.107	#	-0.109	#
	(2.77)		(2.11)		(1.73)		(1.97)		(1.77)		(1.78)	
Period Change in Ratio of Imports to Gross Output	-0.097		-0.123		-0.076		-0.101		-0.090		-0.072	
	(1.06)		(1.27)		(0.80)		(1.06)		(0.92)		(0.74)	
Percent Change in Mean Employment Per Establishment (1 period lag)			-0.183	*								
			(2.29)									
CHGINI (1 period lag)					0.430	#						
					(1.68)							
CHNGCV (1 period lag)							0.061	*				
							(2.26)					
CHEST20 (1 period lag)									0.381			
									(0.94)			
CHEST1000 (1 period lag)											-0.049	
											(0.26)	
R^2	0.065		0.084		0.061		0.082		0.043		0.034	
Adjusted R^2	0.049		0.055		0.032		0.054		0.013		0.004	
Standard error	0.0801		0.0807		0.0817		0.0808		0.0825		0.0829	
Sample Size	120		100		100		100		100		100	
Period	1967-97		1972-97		1972-97		1972-97		1972-97		1972-97	

Note: See the notes to Table 10 for a description of the sample and estimation technique. See notes to Tables 8 and 9 for definition of variables. In addition:

1) Change in Profit rate: change in the ratio of net profits to net capital stock between the current period and the previous period.

 # Significant at the 10% level (two-tailed test)
*** Significant at the 5% level (two-tailed test)**
**** Significant at the 1% level (two-tailed test)**

Table 12. Regressions of the Change in the Profit Share on Downsizing Variables

Independent Variables	Specification (1)	(2)	(3)	(4)	(5)	(6)
Constant	0.029	0.028	0.029	0.031	0.026	0.025
	(1.64)	(1.41)	(1.44)	(1.57)	(1.31)	(1.25)
Unionization Rate	-0.065	-0.064	-0.052	-0.069	-0.054	-0.058
(Period Average)	(1.34)	(1.09)	(0.89)	(1.00)	(0.91)	(0.99)
Period Change in Ratio of	-0.054	-0.083	-0.057	-0.069	-0.065	-0.046
Imports to Gross Output	(0.60)	(0.87)	(0.61)	(0.74)	(0.69)	(0.49)
Percent Change in Mean Employment		-0.100				
Per Establishment (1 period lag)		(1.28)				
CHGINI			0.179			
(1 period lag)			(0.72)			
CHNGCV				0.030		
(1 period lag)				(1.16)		
CHEST20					0.221	
(1 period lag)					(0.56)	
CHEST1000						-0.158
(1 period lag)						(0.88)
R^2	0.016	0.027	0.016	0.024	0.014	0.019
Adjusted R^2	0.005	0.010	0.007	0.007	0.003	0.010
Standard error	0.0791	0.0791	0.0795	0.0792	0.0796	0.0794
Sample Size	120	100	100	100	100	100
Period	1967-97	1972-97	1972-97	1972-97	1972-97	1972-97

Note: See the notes to Table 10 for a description of the sample and estimation technique. See notes to Tables 8 and 9 for definition of variables. In addition:

1) Change in Profit Share: change in the ratio of net profits to GDP between the current period and the previous period.

 # Significant at the 10% level (two-tailed test)
*** Significant at the 5% level (two-tailed test)**
**** Significant at the 1% level (two-tailed test)**

Table 13. Regressions of the Percentage Change in the Average Market Value of Firms on Downsizing Variables

Independent Variables	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
Constant	0.632	**	0.615	**	0.669	**	0.445	**	0.449	**	0.457	**	0.449	**
	(5.97)		6.00		(5.49)		(4.06)		(4.06)		(4.18)		(4.06)	
Unionization Rate	-1.195	**	-1.010	**	-1.439	**	-0.891	**	-0.881	**	-0.856	**	-0.871	**
(Period Average)	(3.92)		(3.41)		(3.79)		(2.94)		(2.92)		(2.86)		(2.87)	
Percent Change in Mean Employment Per Establishment			1.702	**										
			(3.97)											
Percent Change in Mean Employment Per Establishment (1 period lag)					-0.006									
					(0.01)									
CHGINI							-0.477							
							(0.34)							
CHNGCV									0.040					
									(0.27)					
CHEST20											-2.691			
											(1.25)			
CHEST1000													0.258	
													(0.25)	
R^2	0.115		0.218		0.130		0.082		0.095		0.095		0.081	
Adjusted R^2	0.108		0.204		0.112		0.063		0.077		0.076		0.062	
Standard error	0.502		0.477		0.551		0.448		0.445		0.445		0.448	
Sample Size	120		116		100		100		100		100		100	
Period	1967-97		1967-97		1972-97		1967-92		1967-92		1967-92		1967-92	

Note: See the notes to Table 10 for a description of the sample and estimation technique. See notes to Tables 8 and 9 for definition of variables. In addition:

1) Change in Market Value: percentage change in the average market value of firms within the industry between the current period and the previous period. Source: CRSP database.

 # Significant at the 10% level (two-tailed test)
*** Significant at the 5% level (two-tailed test)**
**** Significant at the 1% level (two-tailed test)**

Table 14. Regressions of the Percentage Change in Average Employee Compensation on Downsizing Variables

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	-0.135	-0.158 #	-0.112	-0.115	-0.116	-0.107	-0.137
	(1.61)	(1.94)	(1.32)	(1.39)	(1.41)	(1.28)	(1.62)
Unionization Rate	0.059	0.069	0.002	0.073	0.058	0.067	0.061
(Period Average)	(1.27)	(1.52)	(0.04)	(1.58)	(1.26)	(1.43)	(1.29)
Concentration	0.208 #	0.243 *	0.191 #	0.182 #	0.188 #	0.175	0.211 #
Ratio	(1.90)	(2.28)	(1.73)	(1.69)	(1.75)	(1.60)	(1.91)
Percent Change in Mean Employment Per Es tablishment		0.183 **					
		(2.82)					
Percent Change in Mean Employment Per Establishment (1 period lag)			0.191 **				
			(2.93)				
CHGINI				0.474 *			
				(2.20)			
CHNGCV					0.050 *		
					(2.25)		
CHEST20						-0.633 #	
						(1.88)	
CHEST1000							0.049
							(0.31)
R^2	0.057	0.130	0.125	0.103	0.105	0.091	0.058
Adjusted R^2	0.038	0.102	0.091	0.075	0.077	0.063	0.029
Standard error	0.0692	0.0669	0.0631	0.0679	0.0679	0.0684	0.0696
Sample Size	100	100	80	100	100	100	100
Period	1967-92	1967-92	1972-92	1967-92	1967-92	1967-92	1967-92

Note: See the notes to Table 10 for a description of the sample and estimation technique. See notes to Tables 8 and 9 for definition of variables. In addition:
1) Percentage change in average employee compensation within the industry between the current and preceding period.
 # Significant at the 10% level (two-tailed test)
*** Significant at the 5% level (two-tailed test)**
**** Significant at the 1% level (two-tailed test)**

Table 15. Regressions of the Annual Growth in Unit labor Costs On Downsizing Variables

Independent Variables	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
Constant	-0.141	**	-0.144	**	-0.156	**	-0.143	**	-0.142	**	-0.139	**	-0.141	**
	(3.17)		(3.31)		(2.91)		(3.17)		(3.15)		(3.05)		(3.15)	
Industry R&D / Net	-0.393	*	-0.340	*	-0.356	#	-0.398	*	-0.394	*	-0.391	*	-0.401	*
Sales (period avg.)	(2.38)		(2.09)		(1.81)		(2.38)		(2.37)		(2.35)		(2.39)	
Unionization Rate	0.022		0.027		0.040		0.021		0.022		0.022		0.021	
(Period Average)	(0.95)		(1.21)		(1.28)		(0.88)		(0.95)		(0.97)		(0.90)	
Concentration	0.164	**	0.167	**	0.178	*	0.166	**	0.164	**	0.161	**	0.163	**
Ratio	(2.65)		(2.77)		(2.39)		(2.66)		(2.64)		(2.56)		(2.63)	
Percent Change in Mean			0.076	*										
Employment Per Establishment			(2.39)											
Percent Change in Mean Employment					0.066	#								
Per Establishment (1 period lag)					(1.79)									
CHGINI							-0.037							
							(0.35)							
CHNGCV									-0.001					
									(0.14)					
CHEST20											-0.049			
											(0.30)			
CHEST1000													-0.029	
													(0.38)	
R^2	0.104		0.156		0.136		0.106		0.105		0.105		0.106	
Adjusted R^2	0.076		0.120		0.090		0.068		0.067		0.068		0.068	
Standard error	0.0329		0.0321		0.0357		0.0330		0.0331		0.0331		0.0331	
Sample Size	100		100		80		100		100		100		100	
Period	1967-92		1967-92		1972-92		1967-92		1967-92		1967-92		1967-92	

Note: See the notes to Table 10 for a description of the sample and estimation technique. See notes to Tables 8 and 9 for definition of variables. In addition:
1) Unit Labor Cost: Employee compensation in 1992$ per unit of output in 1992$.
 # Significant at the 10% level (two-tailed test)
*** Significant at the 5% level (two-tailed test)**
**** Significant at the 1% level (two-tailed test)**

Figure 1. Size Distribution of Establishments by Number of Employees, 1967-1992
(Census of Manufacturing Data)

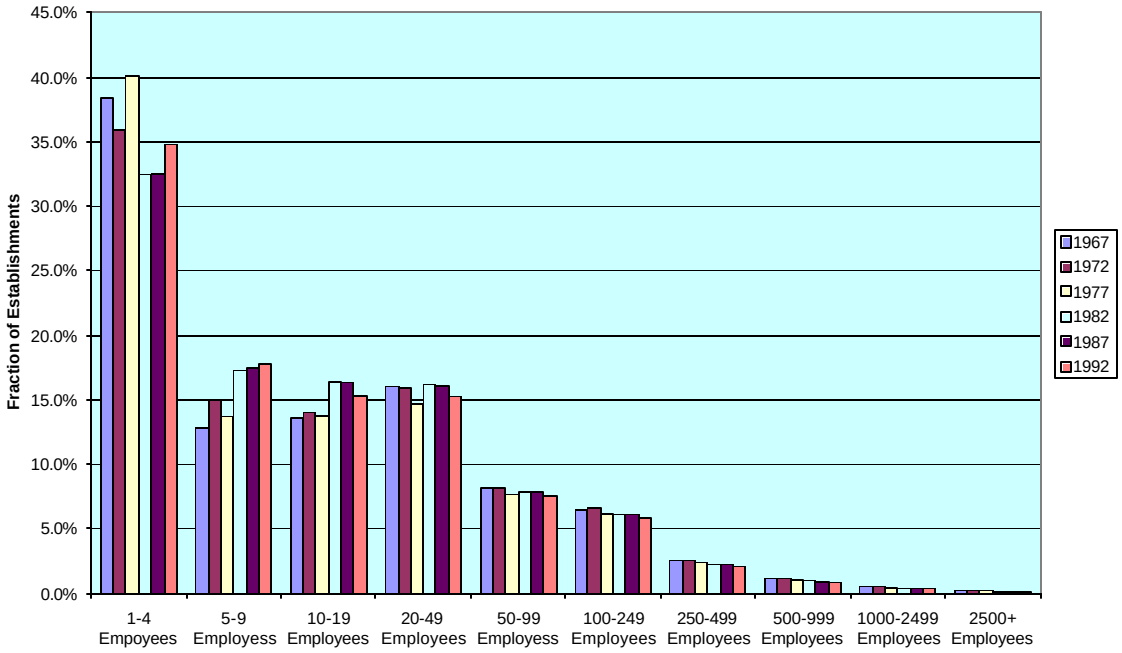

Figure 2. Size Distribution of Employment by Size of Establishment in number of Employees, 1967-1992
(Census of Manufacturing Data)

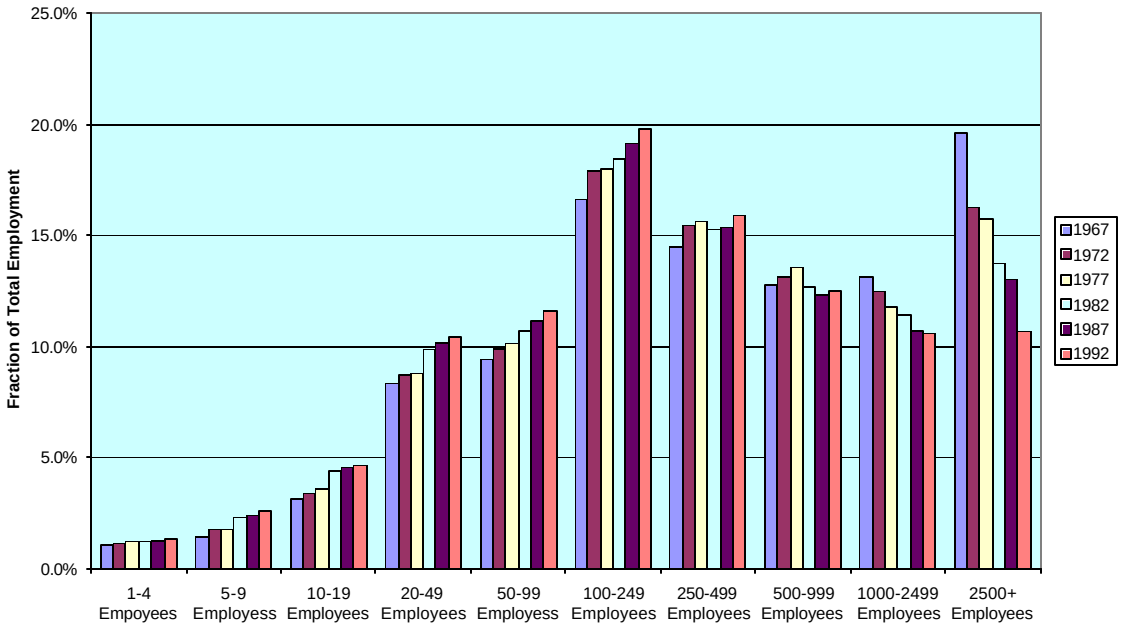

Figure 3. Change in Average Establishment Size and R&D Intensity, Total Manufacturing, 1967-1997

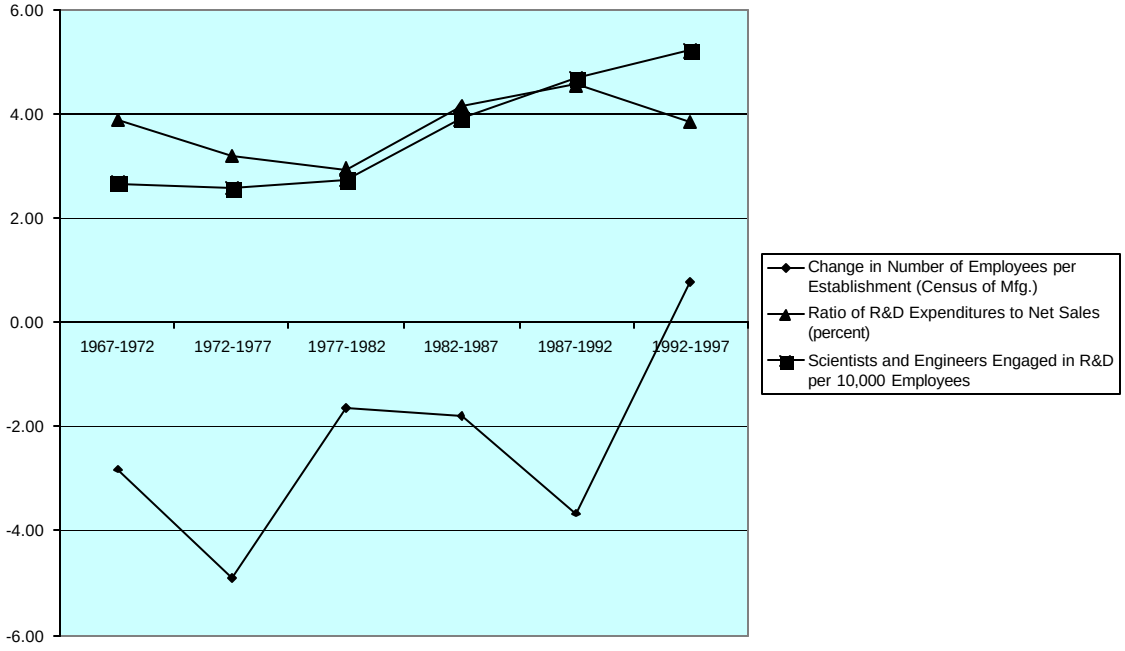

Figure 4. Change in Average Establishment Size and the Growth in OCA Intensity, Total Manufacturing, 1967-1997

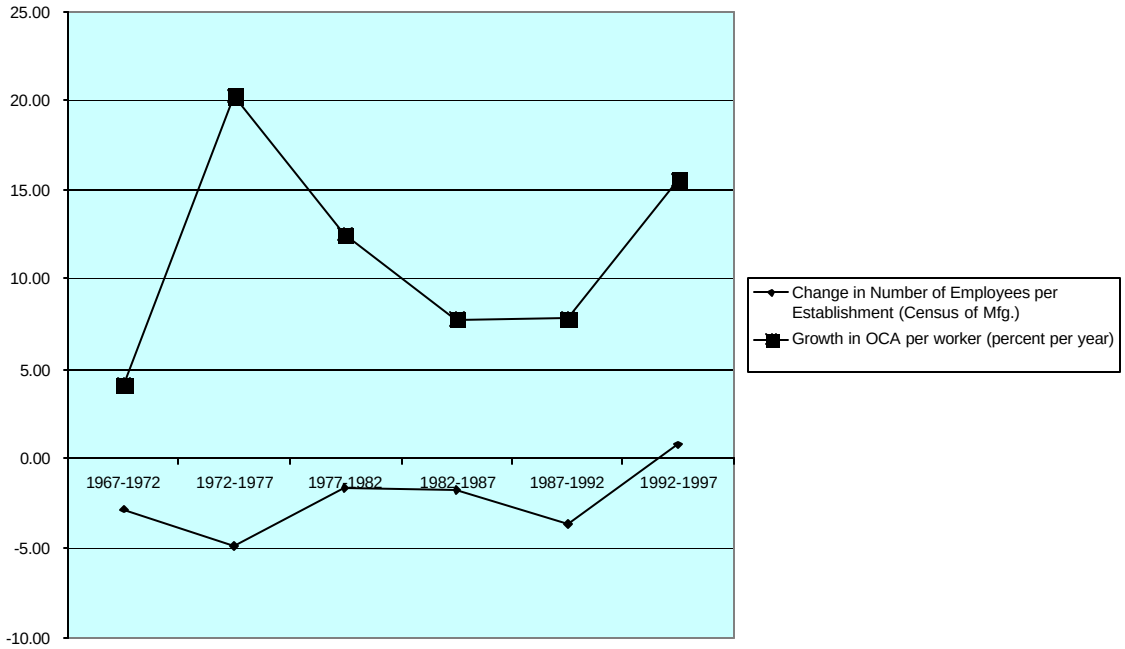

Figure 5. Change in Average Establishment Size and the Change in Export and Import Intensity, Total Manufacturing, 1967-1997

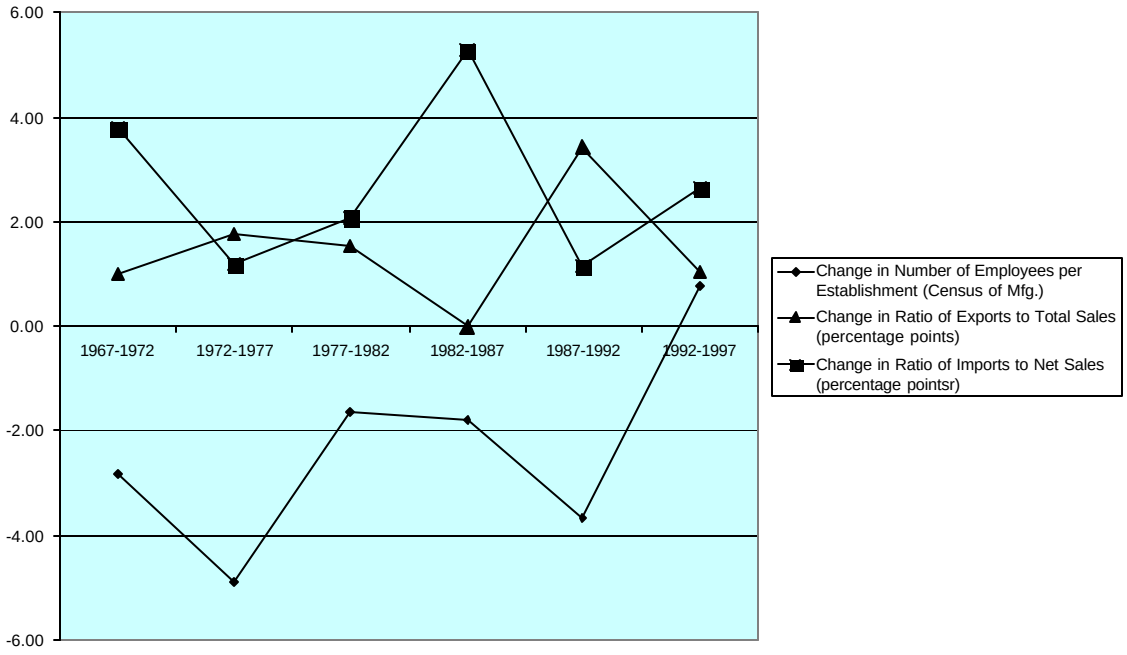

Figure 6. Change in Average Establishment Size and Union Density, Total Manufacturing, 1967-1997

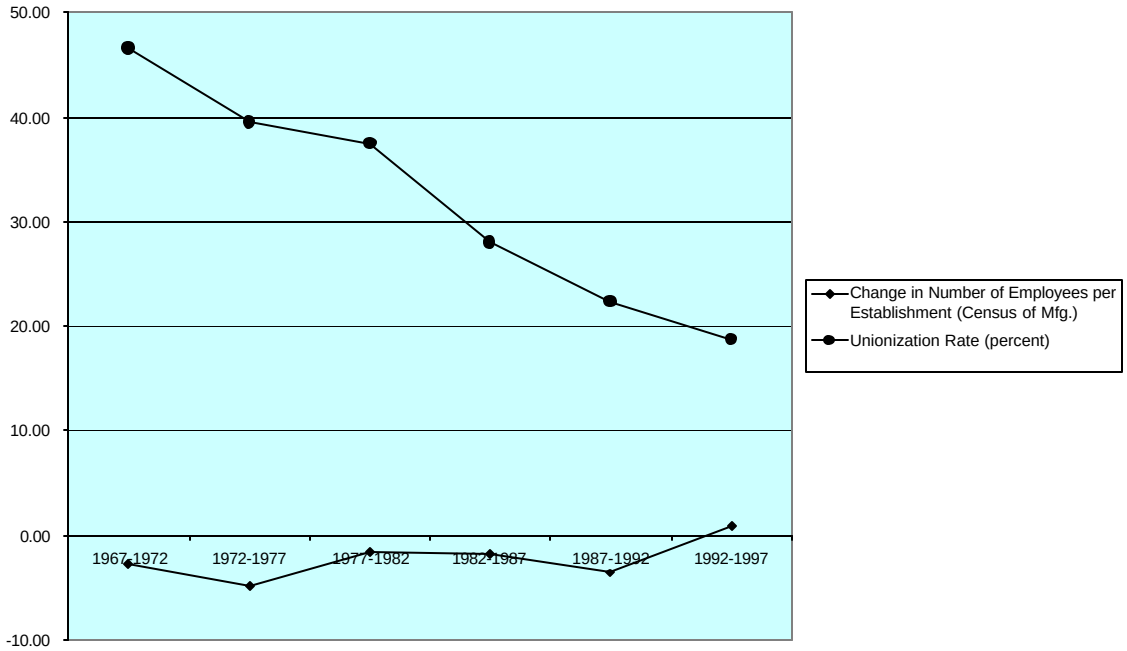

Figure 7. Changes in Average Establishment Size and TFP and Labor Productivity Growth, Total Manufacturing, 1967-1997

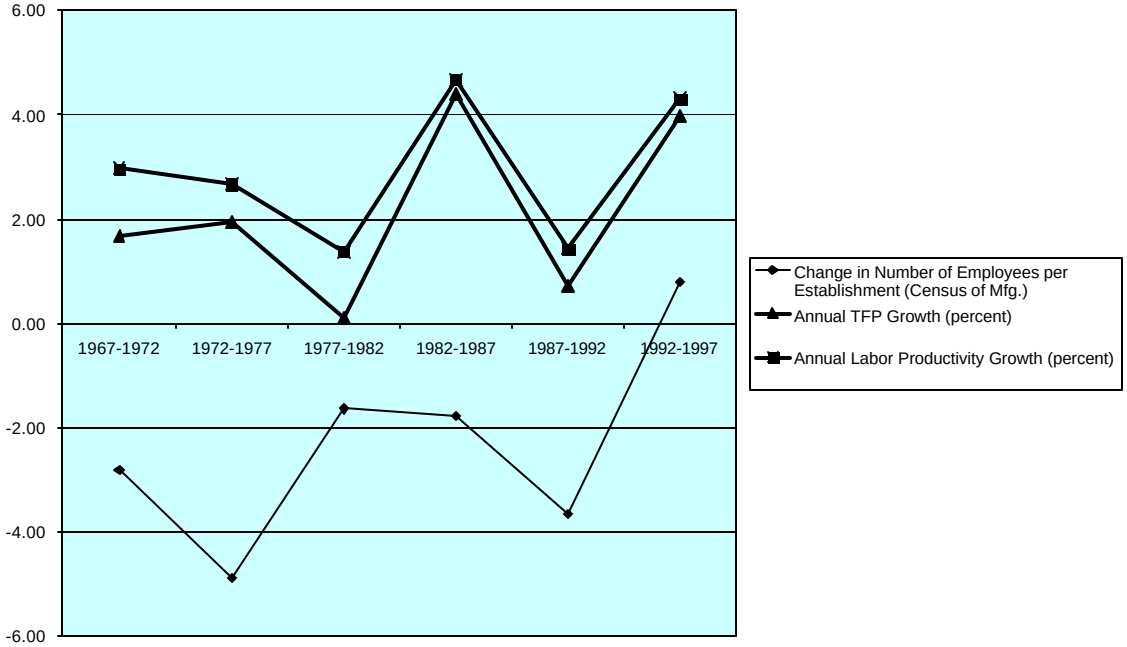

Figure 8. Change in Average Establishment Size and Profitability, 1967-1997

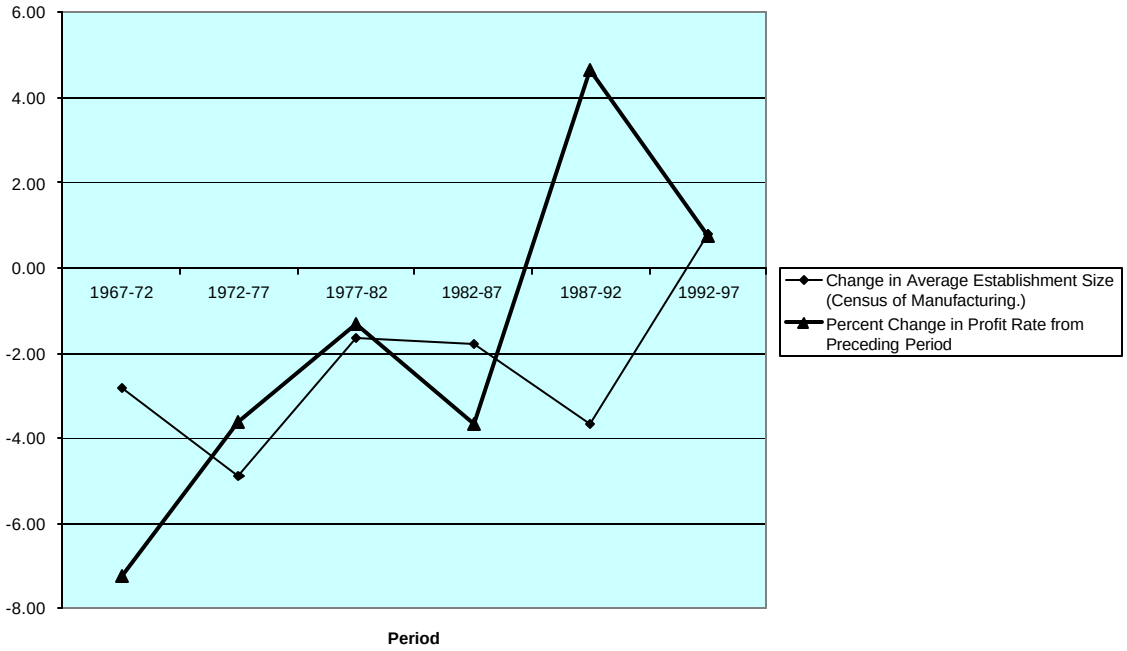

Figure 9 Change in Average Establishment Size and the Profit Share, 1967-1997

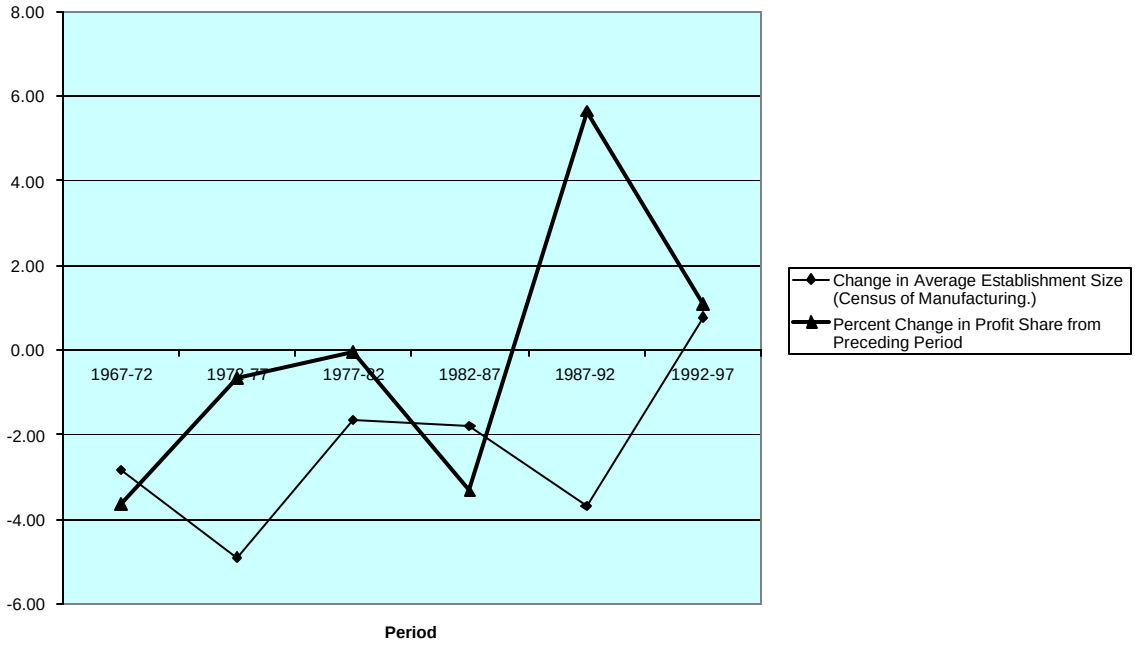

Figure 10. Change in Average Enterprise Size and Stock Market Valuation, 1967-1997

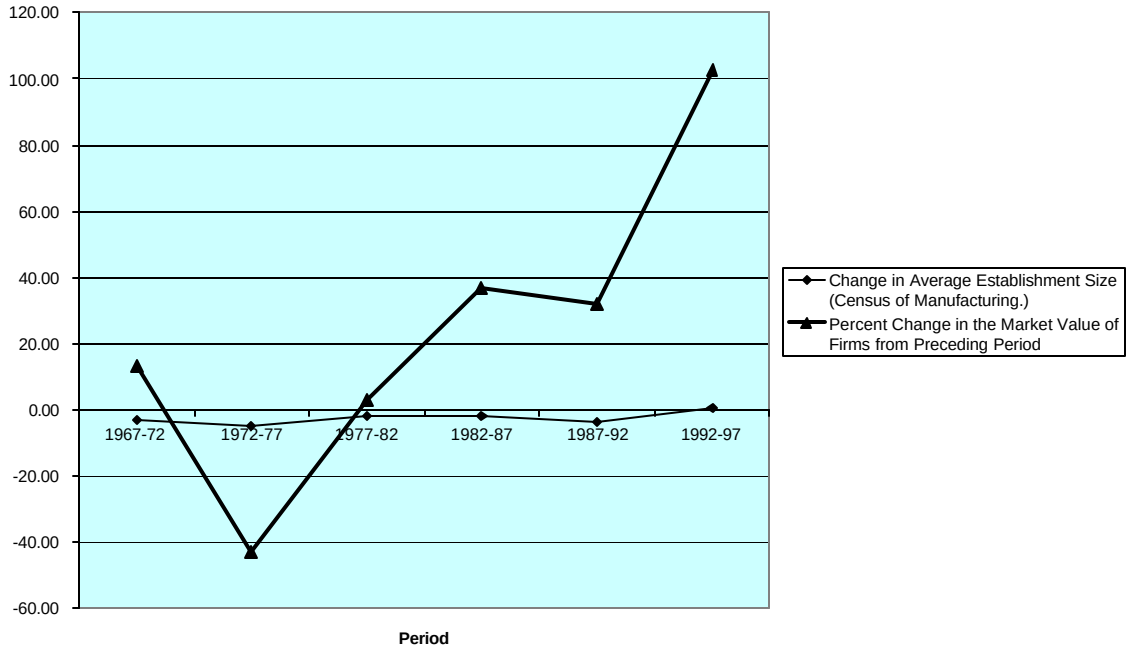

Figure 11. Change in Average Establishment Size And Employee Compensation, 1967-1997