INDUSTRY RESTRUCTURING MEASURES AND PRODUCTIVITY: EVIDENCE FROM THE 1980's

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Abstract

Industry Restructuring Measures and Productivity:

Evidence from the 1980s

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This paper analyzes the empirical relationship between corporate restructuring and productivity. We estimate neoclassical production functions and factor demand functions to analyze the importance of restructuring in improving resource allocation and productivity. We find, at most, restructuring may have spurred the substitution of capital for labor in some industries, helping to set the stage for increased labor productivity. However, there is little evidence that restructurings, themselves, aided in the improvement of true technological progress.

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1. Introduction

The transformation of many large American corporations has been a prominent feature of the economic landscape. The term "restructuring" takes in a great many phenomena, not only balance sheet changes--in recent years, often involving the replacement of short-term debt by long-term debt and equity, following the 1980s, when many firms sharply increased leverage--but also the more diffuse changes in the basic organization of many large firms. These latter include the divestiture of divisions, plant closings, elimination of layers of management, and outsourcing many peripheral activities (for instance, getting rid of in-house provision of support services, such as accounting, and reducing the degree of vertical integration in corporations by turning to outside providers of materials and intermediate products).

It has also been the case that a number of industries have seen significant improvements in productivity growth for the period since the early 1980s, as compared to the sluggishness of much of the 1970s. This paper attempts to examine the linkages between industry-wide indexes of restructuring and productivity growth, using data from the 1980s.

In all likelihood, substantive gains in productivity by a firm or industry are accompanied by significant changes in the structure of production, management organization, and finances. The purpose of this paper is to see whether there are systematic relationships between several broad measures of change, or restructuring, and productivity growth at the industry level. If there are, this result would suggest that tax and regulatory policies which have the effect of discouraging restructuring activities might have anti-productivity side effects. If no significant positive linkage is found between restructuring indexes and productivity growth, the policy consequences are less clear. Moreover, it can be argued that the evidence from the 1980s have

limited relevance for the 1990s.

It was noted above that there are two broad types of restructurings: financial--or balance sheet--restructurings, and real-side restructurings. Restructuring announcements are often rewarded by increases in corporate stock prices. From the point of view of corporate shareholders, then, restructurings are quite often worthwhile.[1] However, it is not true that benefits to shareholders of an individual corporation are benefits to society as a whole. A restructuring may be merely a devise to transfer income flows in a corporation from taxpayers, workers, and suppliers to shareholders, and need not involve any efficiency gains in production.

Financial restructurings by themselves obviously do not imply any improvements in production since, by definition, they are merely paper transactions. It has, however, been frequently argued that financial restructurings will spur efficiency gains. The canonical financial restructuring of the 1980s involved increasing the debt loads of corporations and concentrating equity interests in small groups, often including senior management. Dr. Johnson said the prospect of a man's being hanged "concentrates his mind wonderfully"; the increased prospect of bankruptcy connected with increased debt loads arguably spurred firms to look for new ways to improve production techniques.[2] The carrot of increased equity interest on management's part

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[1]Important issues are whether the stock price gains associated with restructuring announcements are sustained, and whether the stock price gains are justified by future earnings increases.

[2]The genesis of the famed Johnson quote may be relevant. Johnson had written the final message of a convicted clerygyman. A reader confronted Johnson with the uncharacteristic Johnsonian force of the message, whereupon Johnson denied authorship. Johnson made the

would add even more incentive to boost productivity. Of course, though, the incentives given the firm by financial restructuring are actually in the direction of reduced costs (say by reducing salaries or outsourcing) or increased revenues, not necessarily toward increased productive efficiency.

Previous research using firm-level or plant-level data has indeed found fairly significant effects from restructuring to improving profitability. Amihud (1989) provides a nice survey of the evidence for equity premiums associated with corporate restructuring. Others such as Cave and Krepps (1993), Kaplan (1989), Smith (1990), Baker and Wruck (1989) have found positive effects in terms of earnings and/or net cash flows, or displacing nonproductive workers. However, none of these studies argue that restructuring has led to greater productivity, only greater profitability, and are therefore subject to our opening criticisms.

Lichtenberg and Siegel (1990) have addressed our opening criticisms by analyzing the direct impact restructuring has productivity. Using the U.S. Census Bureau's Longitudinal research Database (LRD) and a list of LBO's provided by Morgan Stanley and Co., they link firm level productivity to restructuring. Their analysis revealed that restructuring between 1983 to 1986 significantly improved productivity, but had no significant impact in the first years of their time sample.

There are, however, several drawbacks to their approach. First, Lichtenberg and Siegel measure restructuring as the number of LBO's rather than the dollar amount of the transaction

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comment to Boswell when recounting the incident--the point being that the clerygyman's situation lent credence to Johnson's denial, not that there was an actual transformation in the condemned man (see Boswell, p. 725).

itself.[3] It is not clear that the buyout of RJR Nabisco, for example, which led to the famous book and movie *Barbarians at the Gate*, should be treated in the same way as every other LBO. Second, finding positive correlation between restructuring and productivity during the boom of 1983 to 1986 might be misleading in that it is exceedingly difficult to test whether restructuring led to higher productivity or whether both restructuring and productivity increased in response to the upswing of the business cycle. Finally, results at the firm-level or plant-level may not hold when the unit of observation is an industry.

To address these criticisms, we analyze industry-level data over a wider range of years, 1977 to 1989, and employ actual dollar transactions of restructuring from the Brookings Historical Merger Data file. By examining the data in this fashion we can better control for business cycle effects and improve on the measure of restructuring.

The next section deals with some conceptual issues, followed by an exploration of the empirical evidence. The conclusion is that, at most, restructuring may have spurred the substitution of capital for labor, helping to set the stage for a boost up in labor productivity, but there is no evidence that restructurings aided true technological progress.

2. Possible Links Between Productivity and Restructuring

The term productivity is often misused. A very common tendency is to associate productivity with the ratio of final sales of a product to employment by the final producer. The classic examples are expressing productivity changes for the auto and steel industry by changes in the ratio of unit automobile shipments to auto employment and changes in the ratio of tonnage of steel shipments to steel employment. These are valid measures of productivity growth if and

[3] As was also done more recently in McGuckin, Nguyen, and Reznek (1994).

only if two conditions are satisfied: 1. There are proportional changes in the labor input at all levels of production prior to the final shipment. 2. There are no changes in the real value of the physical product shipped.

Consider the first condition. In the auto and steel industries changes in the past decade have often been said to involve the "outsourcing" of many functions; for instance, the spinning-off of divisions which supplied parts and raw materials. Such moves would have reduced employment in the final product industries, and work to increase the commonly reported "productivity" measures. It is perfectly conceivable, however, that the spinning-off a division may mean absolutely no improvement in the actual physical production process: for instance, an auto manufacturer which spins off a division that produces batteries may still purchase the same batteries made in the same factory by the same number of workers! Clearly, the spin-off has not increased productivity in any meaningful way, even though the auto company might report a handsome increase in the ratio of vehicle assemblies to employment. Of course, the spin-off of the battery plant might spur innovation, as the managers now become owners start implementing changes, etc. However, such reasoning--which is very common in many popular discussions of restructuring--is speculative.

The second condition is rather simpler. Obviously, an automaker which increases assemblies per worker by switching to making a less-sophisticated car, or a steelmaker which increases tonnage per worker by switching from production of plate to wire rods, may not have increased productivity in any meaningful sense.

The cited studies of firm-level and plant-level manufacturing productivity and restructuring measure output by shipments. Although there are many benefits of using disaggregated data, the

possible inaccuracy of this output measure is one reason to turn to industry measures. At the two-digit industry level, government statisticians define an industry's output by its constant-dollar value-added--its constant-dollar sales less its constant-dollar purchases from outside sources. The use of constant-dollar data helps prevent the distortion of productivity data by switches in the specific mix of output. The use of value-added prevents productivity indexes from being distorted by changes in the legal relationship between different levels of the production process. For instance, in the case of the auto company spinning-off the battery plant, measuring auto output by value-added means that the spin-off reduces both the output of the auto plant (batteries are now included in purchases from outside sources, and are now an offset to sales in the calculation of value-added) and its employment.

Thinking about productivity in terms of real value-added per worker helps clarify possible connections between restructuring and productivity. It is immediately obvious that purely financial restructurings--changing the specifics of the balance sheet of a firm--have no immediate consequences for productivity, since they do not change any of the proximate determinants of productivity. The sales of a firm are not changed by a change in its balance sheet, the purchased inputs are not changed--since capital costs like interest expense are not counted as a purchase--and employment is not changed! Only if the financial restructuring provokes real-side changes does it lead to productivity changes.

Surprisingly, the immediate consequences of real-side restructurings for productivity are murky. In the course of a real-side restructuring a firm may drastically alter the level and composition of its sales and expenses. It is plausible, of course, that in general, the changes will increase the profitability of the firm undertaking them, as measured, say, by return to equity

capital. However,there is not necessarily a simple *or even a predictably-signed* relationship between changes in a firm's profitability and changes in its productivity, measuring productivity by real value-added per worker. Consider the case of our automaker spinning off the battery plant. The automaker may use the new relationship with the battery maker to cut the prices it pays for batteries (under the old captive relationship the battery plant may have been allowed to book above-market prices in the integrated firm's internal accounting). The automaker's profitability goes up, but there's no way to predict what happened to its real productivity.[4]

This discussion has tried to get across the point that there is no necessary, definitional connection between a "restructuring"--however defined--and enhanced productivity. Moreover, higher profits as a result of a restructuring, or higher share values following a restructuring mover, are not per se signals of improved productivity, much heated rhetoric to the contrary. In the next section we will look at statistical evidence to see the relationship of various measures of restructuring activity to an industry's productivity.

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[4]If the real productivity of the battery plant was higher than that of the assembly plant, the spin-off will reduce the real value-added per worker of the auto company.Conceivably, the demand of the automaker for lower battery prices could spur the battery plant to the achievement of production improvements to reduce costs. In that sense, the real-side restructuring of the auto company encourages productivity gains which benefit the economy as a whole, although they occur in a supplier rather than at the final producer. However, it is perfectly possible that the demand for lower battery prices could be met simply by the battery maker's reducing wages and benefits at its plant. In some long-term convoluted way this cost-cutting could result in some efficiency gain for the economy (high-wage workers would exit battery makers for some other industry where their productivity would justify there wages) but this would clearly not be a very smooth or predictable process.

3. Preliminary Statistical Evidence

Our aim is to explore the statistical linkages between restructuring proxies and productivity growth. The government provides value-added productivity measures at both very highly aggregated and industry levels. At times, analysts have cited improved growth in the aggregate productivity indexes--for nonfarm business as a whole, and, in particular, the sharp improvement in productivity growth in manufacturing--over the last decade as evidence supporting a positive relationship between restructuring and efficiency gains. Whatever the merits of the argument, since the diverse indicators of restructuring are so closely linked in time, the aggregate time series evidence can not be relied to discern which concept of restructuring is most closely linked to productivity growth, or to distinguish the relative importance of restructuring proxies.

To deal with this problem we turn to the disaggregated data on productivity and output by 2-digit industry. The presumed dispersion of restructuring and productivity across the industries offers greater opportunities to pin down relationships.

Our strategy will be to take in to account a wide variety of factors that might influence industry productivity, with restructuring proxies included as terms that might have either an independent effect or will enhance the effect of other factors. Our basic framework is a standard neoclassical production function, where, output, Q, is determined by its inputs

$$Q_t = Af(Z_t)$$

where A is some measure of technology and Z is a vector of inputs that include physical capital, K, and labor, L

$$Z_t = f(K_t, L_t)$$

If production is homogenous of degree one, then productivity growth or growth per worker can be expressed as a function of these inputs. Assuming the production technology is Cobb-Douglas, we express labor productivity, q, by the following identity[5]

$$\Delta q_t = \Delta A_t + \sigma (\Delta K_t - \Delta L_t)$$

where growth rates for any variable X are given by ΔX and σ measures the returns to capital.

In this framework, there are three potential ways restructuring proxies might affect productivity growth:

1. There might be an independent restructuring effect, independent of all other variables--in the jargon of growth studies, restructuring could be directly related to "technical progress" or the "Solow residual" (A). Such an effect could come about if restructuring was linked to "entrepreneurship" in an industry, for example. We depict this effect as a parallel shift in a production function from I to II. (See example on next page.)

2. Restructuring could alter the relationship of factors of production to output. For instance, restructuring could result in a reallocation of an industry's investment, resulting in increased output. In this instance, restructuring leads to an increase in the productivity of capital, rather than directly affecting technical progress. In terms of the symbols above, the restructuring increases σ rather than ΔA_t--increasing the growth rate of labor productivity rather than technical progress. We depict this effect as a shift in the slope of the production function from I to III.

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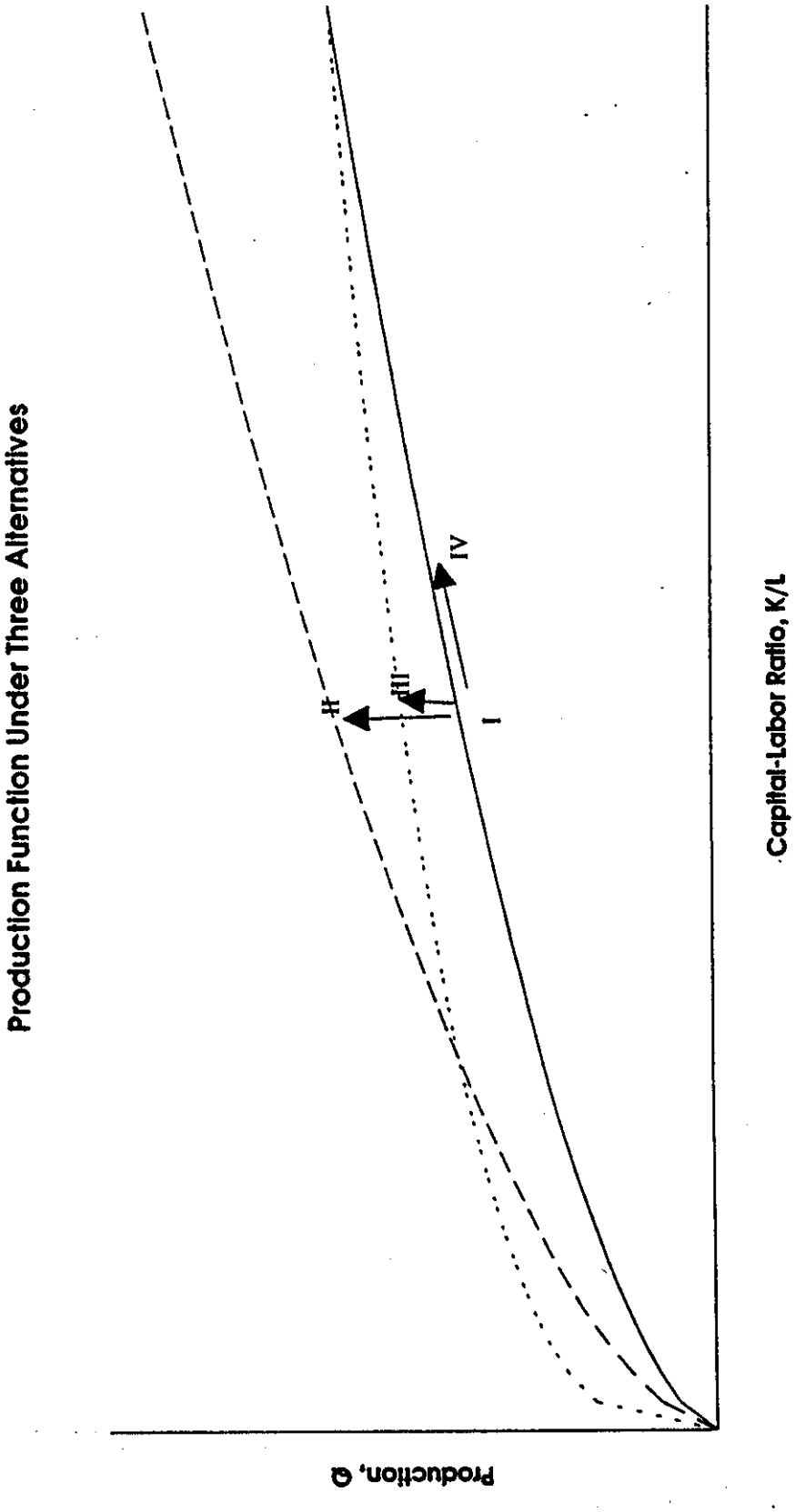
[5]It is not necessary for production to be Cobb-Douglass, however, it greatly simplifies the algebra.


Production Function Under Three Alternatives
Production, Q
Capital-Labor Ratio, K/L
I
II
III
IV

3. Restructuring could alter the demands of an industry for factors of production, thus indirectly affecting the level of output. For instance, an industry might change the overall level of its investment plans following a restructuring, thus changing its capital/labor ratio and altering its labor productivity level, though not necessarily its trend growth. We depict this as a movement along a production function from I to IV.

There is a subtle distinction between possibilities 2. and 3. Possibility 2. implies that restructuring is actually efficiency enhancing, implying that restructuring improves the marginal products of one or more factors. Possibility 3. implies that restructuring changes the input mix, leaving the underlying technological progress unchanged. In short, Possibility 2. means technology progresses (though disembodied technology--the Solow residual, or in our symbols, A--is unchanged) whereas Possibility 3. means at most that resources are allocated more efficiently. Unfortunately, we will not formally differentiate between possibilities 2. and 3.--in a short sample period, a transition to a higher labor productivity level is hard to distinguish from the emergence of a new higher growth path.

Before we begin the formal statistical analysis that tests these possible links between restructuring proxies and productivity, we must first check to see if there is an issue to be explored--is there a large deviation in productivity trends across industries in the 1980s <u>after</u> we have taken into account changes in standard variables affecting productivity growth? If there is, then differences in restructurings across industries may help to explain these differences.

As a first step, Tables 1A-B presents the data on average productivity growth by industry for 1980-84 and 1985-89 (columns 2 and 3) and the change in the average growth between the two periods (column 4) (data for the years since 1989 are still somewhat preliminary). In

Table 1A. Industry Productivity Growth 1980-84 versus 1984-89: The Winners

Industry	*Growth (80-84)*	*Growth (85-89)*	*(85-89) - (80-84)*
Oil & Gas Extract	1.15	7.18	6.02
Misc. Repair Serv.	-3.30	2.40	5.70
Instruments*	1.74	7.43	5.70
Security Brokers	0.17	5.35	5.18
Leather	1.24	6.17	4.92
Machine & Equip.*	1.85	6.58	4.74
Legal Serv.	-5.22	-0.83	4.39
Coal Mining	8.40	12.54	4.14
Electronics*	2.81	6.80	3.99
Electric, Gas, etc.	-0.80	2.76	3.56
Radio & T.V.*	-3.75	-1.11	2.64
Educational Serv.	-2.07	0.49	2.56
Tobacco	-4.71	-2.38	2.33
Apparel	3.07	3.94	0.88
Social Serv.	0.64	1.47	0.83
Primary Metals	0.75	1.54	0.80
Personal Serv.*	-1.40	-0.74	0.66
Holding Co.	-0.28	0.37	0.65
Nonmetal Minerals	3.04	3.56	0.52
Chemicals	4.51	4.95	0.44
Real Estate	-0.77	-0.42	0.36
Health Serv.	-1.97	-1.64	0.33
Telephone & Tele.*	6.18	6.47	0.30
Water Transp.	0.51	0.70	0.19
Local Transit	-1.76	-1.58	0.18
Insurance	-0.24	-0.12	0.11
Transp. Serv.	0.01	0.10	0.09

*Series break 86/87 due to SIC classification change.

principle, one can use these data and relate the changes in trend productivity growth by industry to measures of restructuring. The conventional wisdom is that productivity growth may have increased substantially during the latter period in quite a few industries due to the substantial increase in restructuring. Such an observation, though, could easily fail to account for factors,

Table 1B. Industry Productivity Growth 1980-84 versus 1984-89: The Losers

Industry	*Growth (80-84)*	*Growth (85-89)*	*(85-89) - (80-84)*
Bus. Serv.*	-0.06	-0.32	-0.26
Railroad Transp.	9.82	9.29	-0.53
Paper & Allied	3.41	2.77	-0.64
Printing & Pub.	-0.51	-1.15	-0.64
Other Trans.*	5.96	5.20	-0.76
Insurance Carriers	-1.27	-2.15	-0.88
Lumber & Wood*	2.73	1.72	-1.01
Textile Mill Prod.	4.74	3.46	-1.28
Stone &Glass*	3.60	2.30	-1.30
Trans. by Air	3.62	2.31	-1.32
Amusement & Rec*	2.71	1.11	-1.60
Hotels	0.59	-1.39	-1.98
Retail Trade	2.34	-0.02	-2.36
Banking*	0.01	-2.50	-2.51
Auto Serv.	-0.97	-3.69	-2.72
Construction	0.85	-1.87	-2.73
Fabricated Metals	3.67	0.57	-3.10
Rubber*	5.34	2.01	-3.34
Trucking & Ware.	1.39	-2.08	-3.47
Food	4.51	0.95	-3.56
Furniture	3.08	-0.60	-3.68
Wholesale Tr.	5.86	1.96	-3.90
Pipelines	3.81	-1.20	-5.02
Misc. Manu.	10.38	3.24	-7.14
Petroleum & Coal	13.40	4.39	-9.01
Motion Pictures*	3.91	-5.29	-9.20
Motor Vehicles	7.67	-3.25	-10.92
Metal Mining	29.43	15.42	-14.01
Cred. Ag. no banks*	42.28	16.58	-25.70

*Series break 86/87 due to SIC classification change.

such as business cycle effects, that have significant impacts on productivity but are unrelated to restructuring. Looking at the tables, though, notice that there does not appear to be any systematic patterns in productivity performance--there are practically the identical number of

winners as there are losers. Even more telling, certain industries which obviously experienced major restructuring, e.g., telephone and telegraph, exhibited virtually constant productivity growth rates in the two periods.

Despite the fact that trend productivity does not seem to be higher in most industries the later period, we still have not provided evidence concerning the relationship between restructuring and productivity. For example, it could be that there exists some secular phenomenon that depressed productivity in the later period, independent of the increased incidence of restructuring. For instance, the sharp cyclical increase in productivity in 1983 and 1984 as the economy emerged from the very deep 1981-82 recession could have inflated the first sample relative to the second. To properly evaluate this possibility, we must carefully examine the determinants of productivity to see if there is a problem to explain with the help of restructuring indexes.

Therefore, as a benchmark, Table 2 presents the results of a bare-bones model explaining productivity growth by 2-digit industry. The dependent variable is the growth of real gross output per full-time equivalent employee. The independent variables are the ratio of start-of-year real net fixed reproducible capital per employee, a dummy variable for each year (to account for business cycle effects, such as scale economies), and a dummy variable for each industry (though not reported). The estimated coefficients seem plausible; the elasticity of the capital-labor ratio is 0.28 and the dummies are negative and more significant in the recession years of the early 1980s.

Now, we begin by introducing hi-tech investment into the regression because there is a widespread intuitive notion that "computerization" must have contributed greatly to productivity

Table 2: Neoclassical Growth Model 1980-1989

Explanatory Var.	*Coeff.*	*T-stat*
CONSTANT	-3.71	23.79
K/L	0.28	13.69
1980	-0.41	2.80
1981	-0.38	2.87
1982	-0.31	3.08
1983	-0.29	2.66
1984	-0.23	2.38
1985	-0.20	2.27
1986	-0.16	2.03
1987	-0.09	2.42
1988	-0.05	0.90
1989	-0.01	0.32
Adjusted R^2	0.77	

*The explanatory variables in the regressions include a constant, time (1980,...,1989) and industry dummies, and the log of the capital labor ratio (K/L).

growth in the 1980s. It is interesting to analyze what including "high-tech" investment does to the estimated coefficients. For reasons that will not be discussed here, standard neoclassical theory, combined with observations of the rapid declines in computer prices, strongly suggests that computerization did not have substantial impacts on productivity (Steindel, 1992a, 1992b; Oliner and Sichel, 1994). However, it is certainly worth seeing whether computer investments helps explain industry productivity growth--perhaps industries which made heavy use of computers in the 1980s saw unusually rapid growth in productivity. Accordingly, the ratio of real net information processing equipment per full-time equivalent employee was added to the regression model of Table 2. Table 3 shows the results; the coefficient on the computer variable at time t is indeed significantly positive, but the overall fit of the equation is little different from

Table 3: Neoclassical Growth Model with Hi-Tech Investment 1980-1989

Explanatory Var.	*Coeff.*	*T-stat*
CONSTANT	-3.25	20.04
K/L	0.22	10.01
HI-TECH	0.09	2.51
HI-TECH(-1)	-0.01	0.15
HI-TECH(-2)	0.01	0.35
HI-TECH(-3)	0.00	0.26
HI-TECH(-4)	0.03	1.17
1980	-0.41	2.84
1981	-0.40	3.03
1982	-0.40	3.30
1983	-0.32	3.01
1984	-0.26	2.75
1985	-0.23	2.75
1986	-0.20	2.60
1987	-0.12	1.80
1988	-0.08	1.28
1989	-0.03	0.50
Adjusted R^2	0.79	

*The explanatory variables in the regressions include a constant, time (1980,...,1989) and industry dummies, the log of the capital labor ratio (K/L), and 0 to 4 lags of the ratio of real net information processing equipment per full-time equivalent employee (HI-TECH).

that in Table 2, as the adjusted R^2 just edges up from 0.77 to 0.79.[6] More importantly, there is still a great deal of variation in productivity growth by industry left to explain. Indeed, a listing of industries ranked by the swings in their residual productivity from the Table 2 equation between 1980-84 and 1985-89 is not very different from a similar ranking using the Table 3

[6]Alan Krueger (1993) has uncovered evidence that people who work with computers tend to earn higher salaries. To the extent that relative wages are associated with relative productivities, and the real stock of computers is associated with the simple nose-count of machines, these results are reminiscent of his.

Table 4A: Ranking of Industry by Tech. Progress (1985-89) - (1980-84): The Winners

Industry	*Tech Progress*	*Tech Progress w/ Hi-Tech*
Cred Ag. no banks	1.26	1.20
Metal Mining	0.92	0.84
Railroad	0.60	0.54
Textile	0.48	0.40
Apparel	0.40	0.24
Coal Mining	0.35	0.30
Rubber	0.34	0.26
Leather	0.29	0.16
Machinery	0.27	0.29
Hotels	0.26	0.19
Water Trans.	0.25	0.14
Stone & Glass	0.25	0.26
Lumber & Wood	0.25	0.22
Misc. Manu.	0.24	0.09
Primary Metals	0.24	0.31
Nonmetal. Min.	0.20	-0.13
Rec. Serv.	0.18	0.25
Instruments	0.18	0.22
Furniture	0.17	0.04
Retail Trade	0.15	0.21
Fab. Metals	0.15	0.02
Trans. by Air	0.14	0.17
Electronics	0.14	0.22
Trans. Serv.	0.14	-0.16
Other Trans.	0.10	0.08
Paper & Allied	0.09	0.00
Chemicals	0.08	0.27
Social Serv.	0.07	0.08
Trucking	0.06	-0.02
Food	0.06	0.11
Personal Serv.	0.03	0.09
Local Transit	0.03	0.07
Telephone & Tele	0.00	0.33
Oil & Gas	0.00	0.02

*The explanatory variables in the regressions include a constant, time (1980,...,1989) dummies, the log of the capital labor ratio (K/L), and/or 0 to 4 lags of the ratio of real net information processing equipment per full-time equivalent employee (HI-TECH).

model. (See Table 4A-B.) However, the average swing in the residual is somewhat smaller

Table 4B: Ranking of Industry by Tech. Progress (1985-89) - (1980-84): The Losers

Industry	*Tech Progress*	*Tech Progress w/ Hi-Tech*
Auto Repair	-0.03	0.00
Wholesale Trade	-0.03	0.09
Bus. Serv.	-0.06	0.00
Petroleum & Coal	-0.06	0.08
Motor Vech.	-0.10	-0.19
Misc. Repair	-0.13	-0.24
Printing	-0.19	-0.28
Construction	-0.20	-0.30
Radio & T.V.	-0.21	0.02
Educational Serv.	-0.21	-0.28
Motion Pictures	-0.25	-0.04
Electric & Gas	-0.29	-0.25
Banking	-0.30	-0.25
Health Serv.	-0.31	-0.19
Insurance	-0.38	-0.32
Holding Co.	-0.45	-0.28
Insurance Agents	-0.51	-0.32
Security Brokers	-0.58	-0.44
Pipelines	-0.71	-0.98
Legal Serv.	-0.85	-0.82
Real Estate	-1.24	-1.04
Tobacco	-1.28	-1.26

*The explanatory variables in the regressions include a constant, time (1980,...,1989) and industry dummies, the log of the capital labor ratio (K/L), and 0 to 4 lags of the ration of real net information processing equipment per full-time equivalent employee (HI-TECH).

when employing the Table 3 model.

As a second and more important step, we introduce actual measures of restructuring into the framework. We measure "financial" restructuring as net interest as a percent of capital and "real-side" restructuring as the real value of merger and takeover transactions per full-time employee. This "real-side" measure is calculated from both the perspective of the acquiring

industry and the targeted industry.[7]

We use the "financial" measure to capture the idea that firms inefficiently allocate debt and equity prior to restructuring. Conventional wisdom states that, in the course of a restructuring, firms increase debt both to finance the restructuring itself and to resolve agency issues within the firm that held back productive economies--bondholders may demand more stringent performance goals in formal covenants in a high debt firm than do shareholders in a firm with a diffuse ownership, and the switch to high debt levels has often been associated with a concentration of ownership in the hands of management, who presumably then have a stronger personal interest in the best performance of the firm than when they were working on the behalf of outside shareholders. For these reasons, increases in net interest could be associated with more efficient production.[8]

We use both "real-side" measures because there are cogent arguments for using either the acquiring or targeted industry as the appropriate measure of restructuring. Suppose, for example,

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[7]The "real-side" measures are extracted from the Brookings Historical Merger Data file. The Brookings Historical Merger Data file is a listing of corporate merger and takeover transactions from 1955 to 1989. The data was assembled by Blair (1993) who merged data from the Federal Trade Commission and the University of Texas College of Business Administration. We merge the relevant variables from each data set for 43 industries over the period 1977 to 1989, and employ many of our measures of restructuring from this data set.

[8]It is also possible for debt to decrease following a restructuring because the firm had previously been issuing too much debt for efficient production--fears of bankruptcy, for instance, may have hampered innovation. It is possible, then, that the measure of financial restructuring that is associated with improved productivity is a large change of any sign, not just an increase. To evaluate this possibility, we included non-linear measures of "financial" structuring in our empirical specifications. None of the qualitative results were sensitive to these changes.

an automobile company targets a steel company for acquisition. The automobile company may be targeting the steel company because the steel company's inefficiency has continued to raise the automobile company's production costs, thereby providing an incentive for the steel company to be acquired. However, it could also be the case that because of its own poor productivity, the automobile company is losing its competitive edge and so it acquires a more efficient steel company to lower production costs. In the end, we find the results from the statistical analysis are qualitatively the same regardless of the measure chosen.

We first consider the distribution of productivity and "real-side" restructuring. From 1977 to 1989, average real productivity increased by 1.3 percent per year whereas the average real value of restructurings increased by 19 percent annually over the same period.

Chart 1 then separates the industries in our sample into four distinct categories based on the relationship between restructuring and productivity. Industries that experienced high levels of restructuring as well as positive productivity growth made up 58 per cent of the entire sample.[9] Industries which experienced high levels of restructuring but lower productivity accounted for the second largest portion of the sample, covering 32 percent. The pie chart suggests that roughly 3/5 of the industries had a positive relationship between restructuring whereas 2/5 did not. The distribution indicated in Chart 1 suggests there may be no systematic relationship between restructuring and productivity. This should not be surprising given that it duplicates the impressionistic findings reported earlier.

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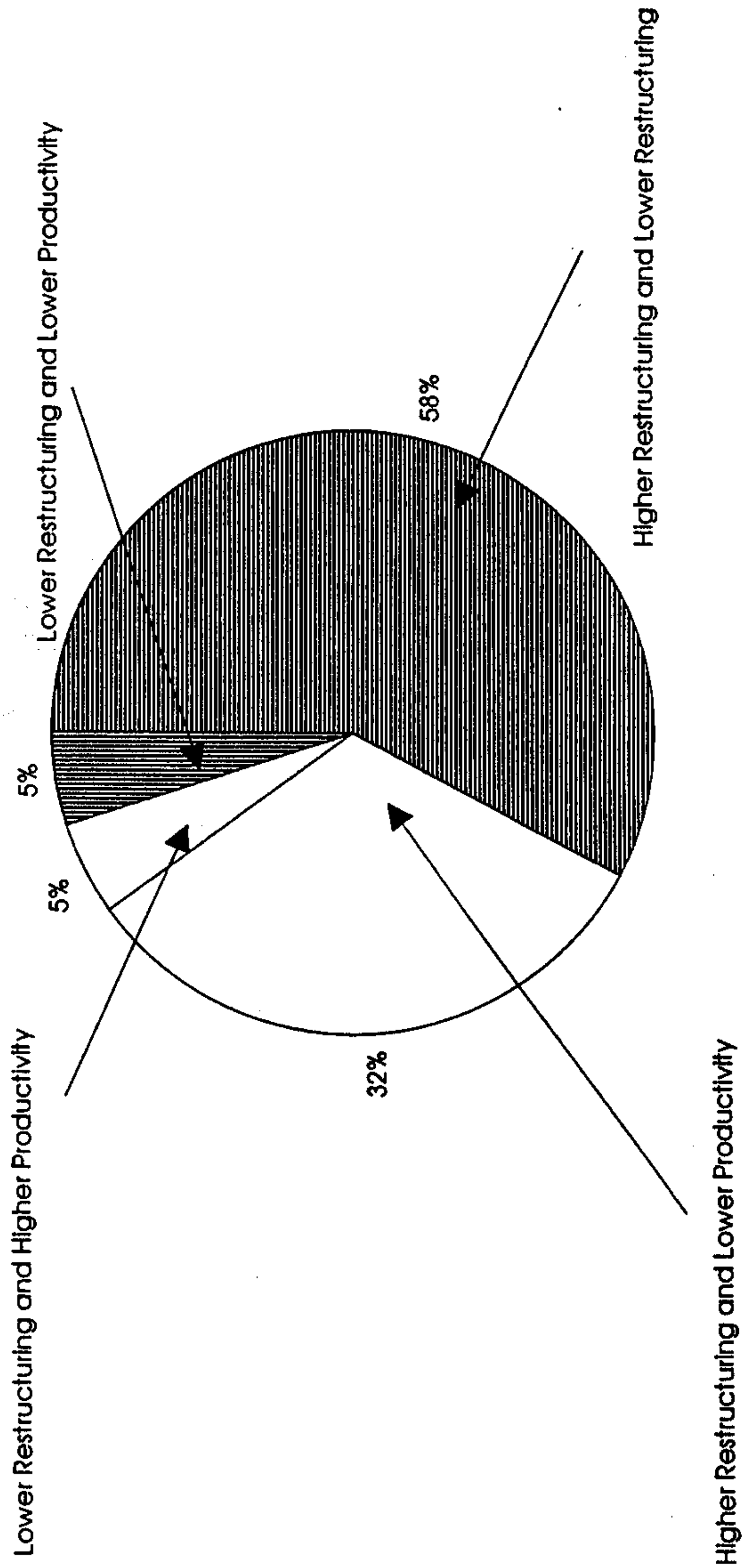
[9]The measure of restructuring chosen for the graphical analysis is taken from the "acquiring" and not "target" industry. However, the general qualitative results hold regardless of definition.

Chart 1: Industry Restructurings and Productivity



Charts 2-4 provide further impressionistic evidence that there is at best a weak relationship between restructuring and productivity. These charts plot restructuring activity versus productivity, where each square denotes a particular industry. The line plotted through these points is the overall fit between the variables. Chart 2 shows that the correlation between real - side restructuring, as measured by the targeted industry, is practically non-existent. Charts 3 and 4 provide slightly more evidence of correlation, however, neither example is particularly conclusive.

We now return to the neoclassical production function for more formalized analysis. Recall that

$$\Delta q_t = \Delta A_t + \sigma (\Delta K_t - \Delta L_t)$$

We posited earlier that either 1. restructuring has a direct impact on production where

$$A_t = \beta_0 + \sum_{j=0}^{M} \beta_{1+j} R_{t-j}$$

or 2., 3. restructuring (R) influences the factors of production

$$Z_t = h(R)$$

where Z_t is the vector of inputs.

We test 2.,3. by examining the relative importance of restructuring in the usage of capital and labor. By employing simple χ^2 tests, we examine whether or not there are contemporaneous or lagged effects of restructuring on each factor.

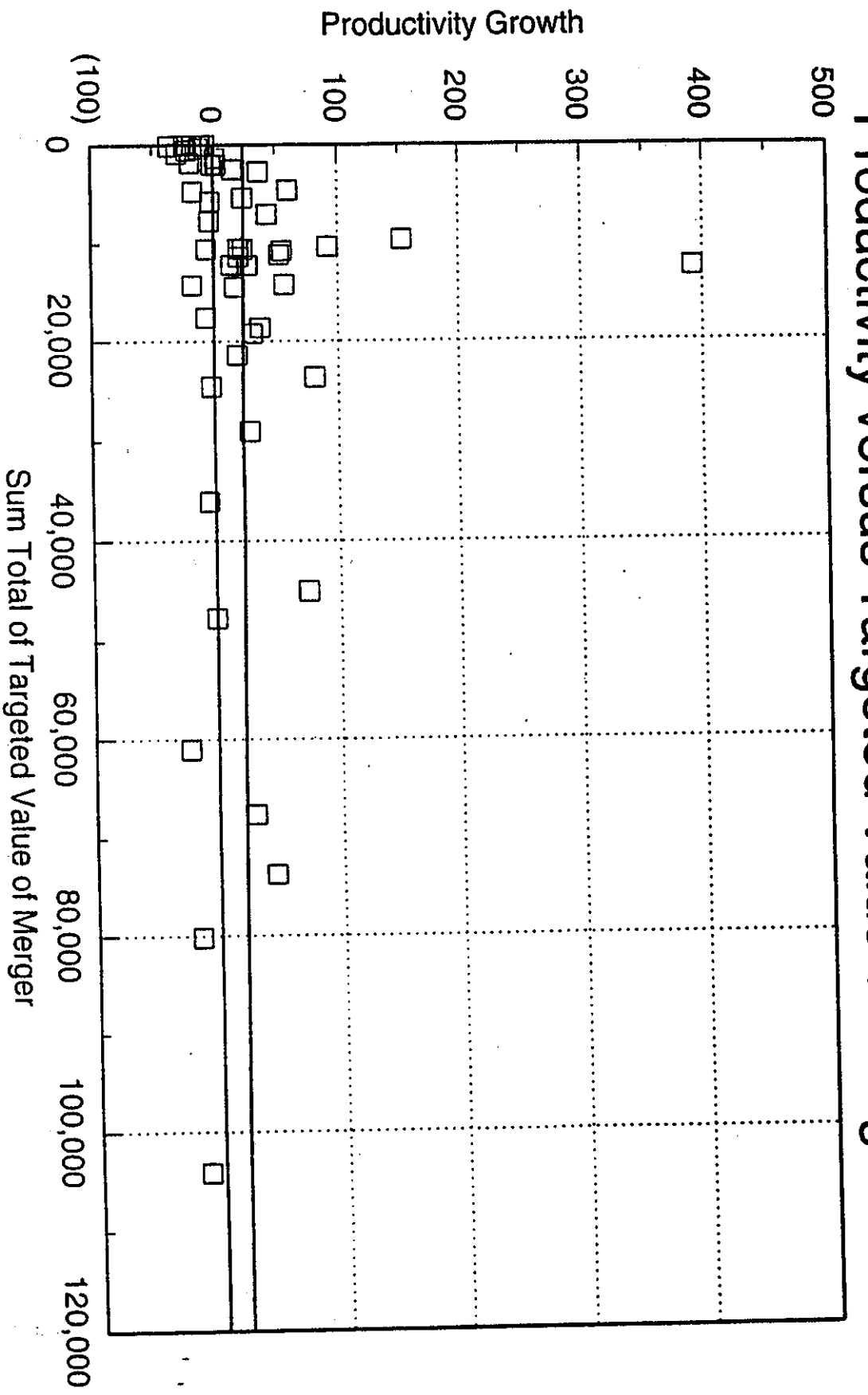


Chart 2
Productivity versus Targeted Value of Merger
Productivity Growth
500
400
300
200
100
0
(100)
0
20,000
40,000
60,000
80,000
100,000
120,000
Sum Total of Targeted Value of Merger

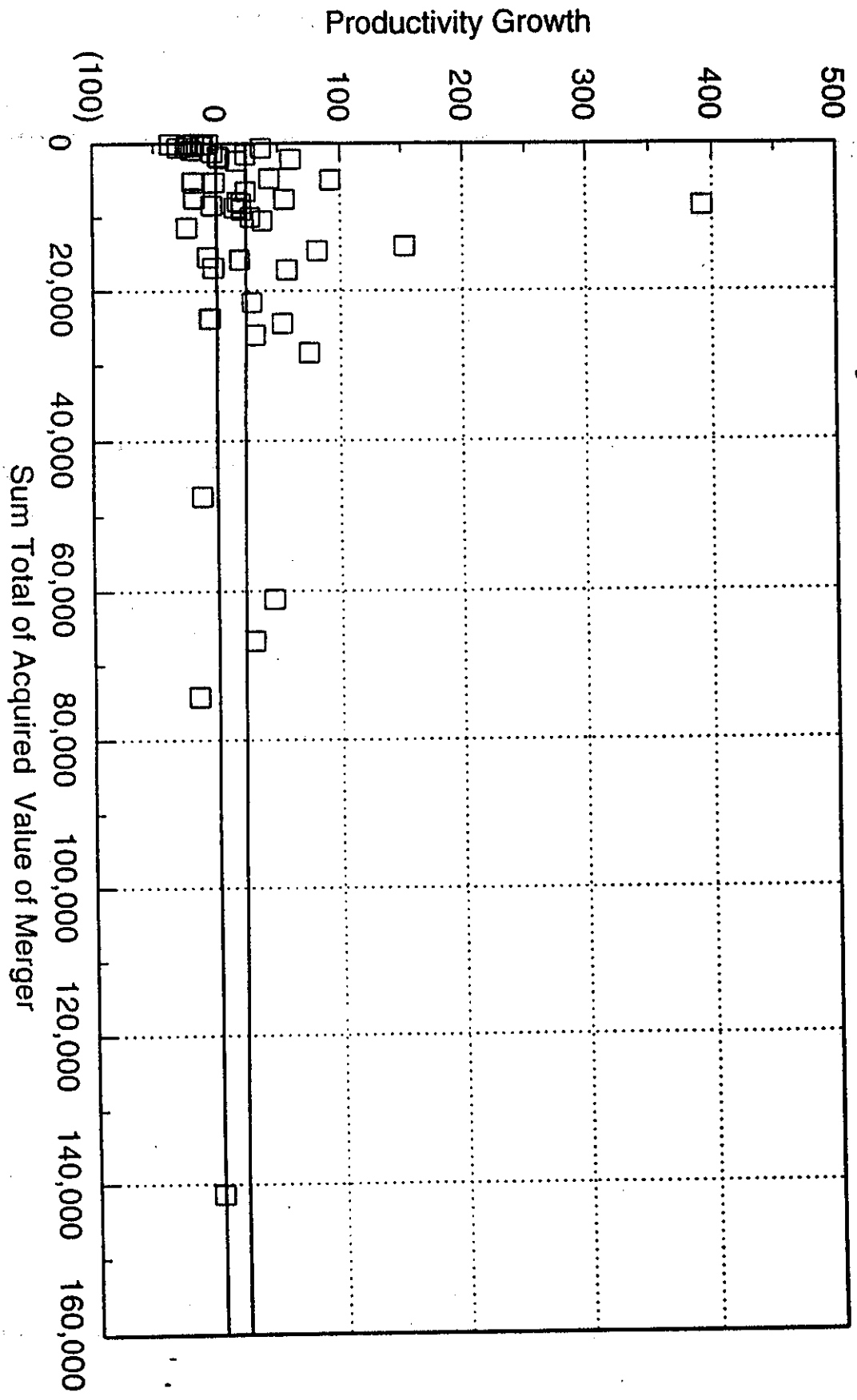


Chart 3
Productivity versus Acquired Value of Merger
Productivity Growth
(100)
0
100
200
300
400
500
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
Sum Total of Acquired Value of Merger

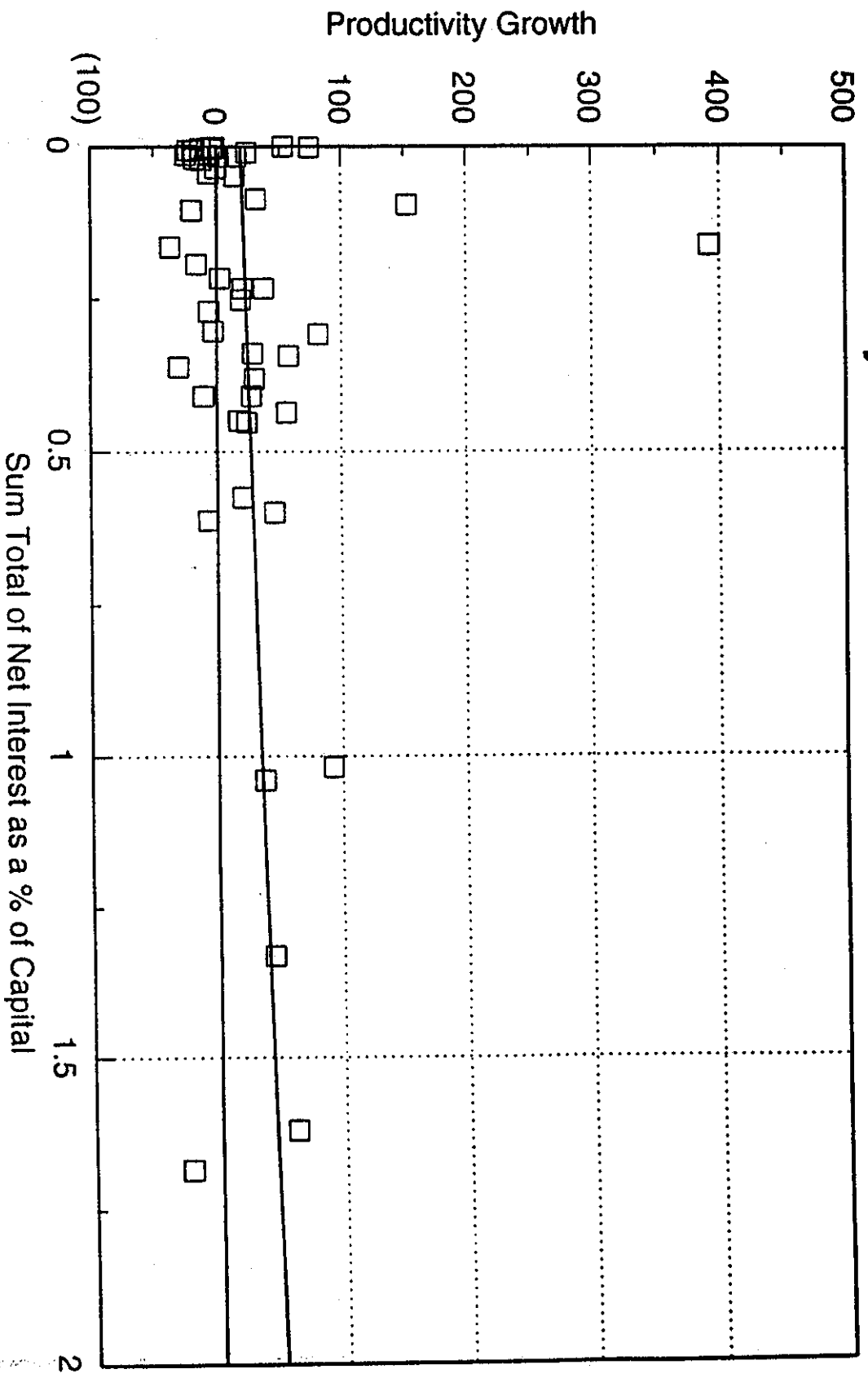


Chart 4
Productivity versus Net Interest as as % of Capital
Productivity Growth
(100)
0
100
200
300
400
500
0
0.5
1
1.5
2
Sum Total of Net Interest as a % of Capital

We test 1. by looking for significant increases in productivity directly attributable to restructuring.[10] As when testing 2.3., we employ χ^2 or F-tests to examine whether or not there is a contemporaneous or lagged effect of restructuring on productivity.

It is, of course, possible that the relationship between restructuring and productivity is more attributable to "reverse-causation." The "reverse-causation" hypothesis implies that the typical firm in more productive industries provide higher actual and potential profits and are therefore more likely to be the recipient of takeover activity. Alternatively, though, firms in less productive industries might in general offer greater scope for earnings growth. To test the possibility of "reverse-causality", we also look at a system of jointly determined equations to see whether restructuring influences productivity or vice-versa.

4. Empirical Results

Before discussing how we estimate these relationships it is first necessary to describe how we ensure that our estimates are robust. Since the data is a cross-sectional time-series data set, in order to correct for industry "fixed effects", we remove the industry mean from each variable. We also include various lags of the variables and "year" dummies to correct for serial correlation and business-cycle effects. Also, when appropriate, we permit calculation of a consistent covariance matrix allowing for heteroscedasticity. We begin by analyzing the relationship between restructuring (e.g. TARGET, ACQUIRE, NETINT/K) and capital, K, and labor, L:

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[10] Alternatively, we could estimate the affect on the "Solow" residual rather than productivity itself. The results are qualitatively the same regardless of method of estimation.

$$Z_{it}=\alpha_0+\sum_{j=1}^{M}\alpha_j Z_{it-j}+\sum_{k=0}^{N}\alpha_{k+M}R_{it-k}+e_{it}$$

where Z denotes the log input for industry i at time t, and R denotes the log real value of the merger transaction per full-time employee (either target or acquiring industry) or the log of net interest as a percentage of capital. If R affects Z, then we would expect to reject the following hypothesis:[11]

$$\alpha_M=\alpha_{M+1}=\ldots=\alpha_{M+N}=0$$

Table 5 reports the results from this exercise. The first column is the dependent variable, Z, chosen in the estimation. The second column reports the appropriate measure of restructuring. The next two columns report the appropriate test statistic accompanied by its p-value, and the last column reports the calculated long-run elasticity of factor demand.

Table 5 shows that the acquired measure of restructuring and net interest as a percentage of capital seem to be important in explaining movements in capital, with p-values of 0.02 for ACQUIRE and 0.09 for NETINT/K. However, all of the restructuring variables seem to be important in determining labor demand.

The economic interpretation of these results is quite revealing. In each case, the restructuring elasticity of labor is negative, whereas only the "real-side" restructuring of elasticity of capital is positive. Taken literally, this means that "real-side" restructuring leads to a substitution of capital for labor. This also suggests that "financial" restructuring creates such a

[11]Note that we are testing the value that *all* coefficients are zero; not merely the *sum* of coefficients are zero.

Table 5: The Effects of Restructuring on the Factors of Production*

Dependent Var.	*Other Var.*	*Test-Stat*	*Sig.*	*Elasticity*
CAPITAL	TARGET	1.43	0.91	0.001
	ACQUIRE	12.51	0.02	0.038
	NETINT/K	9.36	0.09	-0.113
LABOR	TARGET	11.63	0.02	-0.435
	ACQUIRE	26.02	0.00	-0.349
	NETINT/K	33.97	0.00	-0.663

*The explanatory variables in the regressions include a constant, time trend, year dummies, and 1 to 5 lags of CAPITAL, the log capital stock, and either 0 to 4 lags of ACQUIRE, the log real value of the acquired industry per full-time employee, or 0 to 4 lags of TARGET, the log real value of the targeted industry per full-time employee, or 0 to 4 lags of NETINT/K, the log real value of net interest as a percentage of the CAPITAL equation. For the LABOR equation, the same variables were chosen except the lag length was reduced by one and the log of the number of full-time employees was substituted as the dependent variable.

debt burden that firms must cut back on both factors of production. However, to put some perspective on the magnitude of these effects, these results mean that if restructuring increases by 1 percent, then labor usage falls by .35 to .66 percent, while capital rises by, at most, a modest .04 percent.

Reducing the demand for labor, *ceteris paribus*, increases the capital labor ratio which indirectly improves the level of labor productivity. However, unless these changes are productivity enhancing and not just taken to improve the firm's short-term earnings, productivity growth may not improve over the long haul. Therefore, it is necessary to analyze the direct impact of restructuring on productivity, controlling for these indirect affects on factor demand.

Table 6: The Effect of Restructuring on Productivity*

Restruct. Var.	*Test-Stat*	*Sig*	*Elasticity*
TARGET	1.55	0.46	-0.033
ACQUIRE	1.69	0.43	-0.041
NETINT/K	4.72	0.09	-0.024

*The explanatory variables in the regressions include a constant, time trend, year dummies, and 1 lag of CAPITAL, the log capital stock, 1 lag of LABOR, the log number of full-time employees, 1 lagged dependent variable and either 0 to 1 lags of ACQUIRE, the log real value of the acquired industry per full-time employee, or 0 to 1 lags of TARGET, the log real value of the targeted industry per full-time employee, or 0 to 1 lags of NETINT/K, the log real value of net interest as a percentage of capital. Also included were control variables such as the log real value of assets of targeted or acquired industries per full-time employee.

In this case, we estimate

$$q_{it}=\alpha_0+\alpha_1 TIME_{it}+\sum_{j=1}^{M}\alpha_{j+1}Z_{it-j}+\sum_{k=0}^{N}\alpha_{k+M+1}R_{it-k}+\varepsilon_{it}$$

where TIME denotes a linear time trend and q is the log of real output per full-time employee. Restructuring may take some time to affect productivity; hence, the lags. We test the hypothesis that the coefficients associated with R are jointly significant.

Table 6 reports the results from this exercise. The first column is the measure of restructuring, the next two columns report the appropriate test statistic accompanied by its p-value, while the fourth column reports the long run restructuring elasticity of production. Table 6 shows that neither "real-side" nor "financial-side" measures of restructuring seems to be extremely important in explaining movements in productivity. In fact, the elasticity of each measure of restructuring are negative, which implies that restructuring may actually *reduce* productivity. Furthermore, if we allow for even longer dynamic processes by increasing lag lengths, the effect becomes even more strongly negative.

A possible criticism of these results is that we have not considered the possibility that the causation between restructuring and productivity runs in the opposite direction. In other words, by estimating a production function and not allowing the feedback from production back to restructuring, our results may be biased. We formally tested this by employing Hausman (1978) specification tests. We tested the null that restructuring was independent of contemporaneous and lagged productivity. We found that productivity significantly influenced restructuring as measured by NETINT/K but had little influence on ACQUIRE or TARGET. Therefore, in order to correct for this possible problem, we examine the joint relationship between corporate restructuring and productivity.

By constructing the model in such a manner, we do not force any structure on the manner in which restructuring and productivity are related. In this case, the estimated model is

$$q_{it}=\alpha_0+\alpha_1 TIME_{it}+\sum_{j=0}^{1}\alpha_{2+j}K_{it-j}+\sum_{j=0}^{1}\alpha_{4+j}L_{it-j}+\alpha_6 q_{it-1}+\sum_{j=0}^{1}\alpha_{7+j}R_{it-j}+\varepsilon_{it}^1$$

$$R_{it}=\beta_0+\beta_1 TIME_{it}+\sum_{j=0}^{1}\beta_{2+j}q_{it-j}+\sum_{j=0}^{1}\beta_{4+j}Asset_{it-j}+\sum_{j=1}^{2}\beta_{5+j}R_{it-j}+\varepsilon_{it}^2$$

where we examine the sign and significance of the coefficients associated with the endogenous variables. This system of equations is estimated using the Seemingly Unrelated Regressions (SUR) estimation procedure.

Table 7 reports the key results from these systems. The first column is the dependent variable of the relevant equation, the second column is the measure of restructuring or productivity included in the equation. The last three columns report the appropriate test statistic accompanied by its p-value and the sign of the sum of the coefficients of interest. Table 7 shows

Table 7: Restructuring and Productivity in the Jointly Determined System*

Dependent Var.	*Other End. Var.*	*Test-Stat*	*Sig*	*Sign of Coeff.*
PRODUCTIVITY	TARGET	0.800	0.37	(Positive)
TARGET	PRODUCTIVITY	1.100	0.29	(Negative)
PRODUCTIVITY	ACQUIRE	0.011	0.91	(Positive)
ACQUIRE	PRODUCTIVITY	0.909	0.34	(Positive)
PRODUCTIVITY	NETINT/K	3.520	0.06	(Negative)
NETINT/K	PRODUCTIVITY	3.070	0.08	(Positive)

*The explanatory variables in the regressions include a constant, time trend, year dummies, 1 to 2 lags of CAPITAL, the log capital stock, 1 to 2 lags of the log of full-time employees and either 0 to 1 lags of ACQUIRE, the log real value of the acquired industry per full-time employee, or 0 to 1 lags of TARGET, the log real value of the targeted industry per full-time employee, or 0 to 1 lags of NETINT/K, the log real value of net interest as a percentage of the capital stock. The ACQUIRE and TARGET equations are identified by the log real value of the targeted industry per full-time employee, or 0 to 1 lags of ASSET. All other equations are identified by including one more lagged dependent variable in that equation over the other equation.

that no measure of restructuring is statistically different from zero at the .05 significance level in any of the productivity regressions. NETINT/K is significant at the .10 level in the productivity equation, however, the sign of the sum of coefficients implies that financial restructuring is productivity-*reducing* not productivity-enhancing. However, the sign of the sum of the coefficients are positive for the other measures, though not statistically different from zero.

It is also worthwhile to examine the restructuring equations. The sign of the coefficients associated with productivity in these equations imply that unproductive industries encourage takeover activity; whereas productive industries are those industries more likely to acquire other industries. However, we cannot reject the hypothesis that productivity has no significant impact on any "real-side" measure of restructuring, given the lack of significance associated with our test-statistics. And, while there is some evidence that productivity leads to "financial"

restructuring, the null would be rejected at the .05 and .01 significance levels.

5. Alternative Hypothesis

Thus far, we have shown that restructuring influences factors of production but seems to have little impact on productivity itself. It is conceivable that, restructuring plays a larger role in making labor markets more efficient rather than influencing the goods market. As Jensen (1989) argues, corporate restructuring achieves efficiencies by substituting "incentives and compensation for direct monitoring by large bureaucratic staffs." If Jensen is correct, then as industries restructure themselves, compensation and layoffs should rise, creating an implicit reward for good work and an implicit punishment for shoddy work.

Since we already showed that restructuring seemed to reduce employment, it is only necessary to examine what restructuring does to wage growth. If restructuring were statistically significant in changing wages, then there may be something to the hypothesis that restructuring improves the efficiency of the labor market. In the short run, restructurings presumably attempt to align wages more with the value of marginal products--some workers gain, some lose. More fundamentally, though, a more efficient firm or industry might be presumed to see accelerated growth in both productivity and wages (either because true underlying technological growth improves or the entity is steadily gaining on state-of-the-art practice). However, if there is no significant impact on wages, it suggests restructuring might not have influenced efficiency.

To test the implication that restructuring influences wages, we estimate

$$W_{it}=\beta_0+\sum_{j=0}^{4}\beta_{1+j}R_{it-j}+\sum_{j=1}^{4}\beta_{4+j}W_{it-j}+\varepsilon_{it}$$

where W is the growth rate of real compensation. If corporate restructuring makes labor markets more efficient, we would expect the coefficients associated with *R* to be positive and significantly

Table 8: The Effect of Restructuring on Real Compensation

Restruct. Var.	*Test-Stat*	*Sig*	*Long Run Effect*
TARGET	3.17	0.67	0.007
ACQUIRE	2.58	0.76	0.002
NETINT/K	4.51	0.47	-0.000

*The explanatory variables in the regressions include a constant, time trend, year dummies, and 1 to 4 lags of WAGE, the growth in real compensation per employee, and either 0 to 4 lags of ACQUIRE, the log real value of the acquired industry per full-time employee, or 0 to 4 lags of TARGET, the log real value of the targeted industry per full-time employee, or 0 to 4 lags of NETINT/K, the log real value of net interest as a percentage of the capital stock.

different from zero. The results from this experiment are reported in Table 8.

Column one reports the appropriate measure of restructuring, the next two columns report the appropriate test statistic accompanied by its p-value and the last column reports the long run impact of restructuring on real wage growth. The long run effect from "financial" restructuring on compensation growth is negative. The coefficients associated with "real-side" restructuring are positive but statistically insignificant.

6. Conclusions

Past research has found that restructuring has positive effects on firm profits and shareholder wealth and some studies suggest a connection between certain types of restructurings and plant or firm productivity. We find, however, that the restructuring-productivity linkage is virtually nonexistent at the industry level, at least for the indexes of productivity we used. Our results need not be inconsistent with the plant-level studies; the productivity improvements found in the earlier work could have been the fruit of firms shedding their costliest and least productive operations and concentrating technology improvements at the best performing operations. If the

least-productive operations remain at work under different ownership, the net result of the original firm's restructuring on the industry's productivity in the short run could well be zero (in the long run, though, the emergence of more productive leaders in an industry may, of course, have the effect of spurring growth throughout). We do find, however, that restructuring has significant impacts on the factors of production employed by firms. We find that restructuring led firms to substitute capital for labor improving the labor productivity of all "dynamically" efficient firms.

As we noted at the outset, the implications of our results are unclear. Obviously, there are many ways to define and measure "restructuring" and it need not be the case that we made the best choices. Furthermore, even if one would accept our results for the 1980s at face value, it may well be that more recent restructurings--often involving "downsizing" and reductions of leverage--have common factors which will show up more clearly in positive associations with industry productivity. Nevertheless, the evidence in this paper shows that the restructuring movement can not be easily associated with the revival of productivity growth in the 1980s.

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