6 On Measuring the Impact of Ownership Change on Labor: Evidence from U.S. Food-Manufacturing Plant-Level Data

Robert H. McGuckin, Sang V. Nguyen,
and Arnold P. Reznek

6.1 Introduction

Despite strong opposition from labor unions and widespread, often negative, press reports on ownership changes through mergers and acquisitions, there have been few studies of the impact of ownership change on labor. To our knowledge, there are only two published studies on this issue. The first, by Brown and Medoff (1988), uses a sample of mostly small firms from one state, Michigan. They find that, except for divestitures, ownership changes have little impact on either employment or the average wage.

The second study, by Lichtenberg and Siegel (1992b), examines the impact of ownership change on wages and employment in both auxiliary (central office) and production establishments. They find ownership change to be associated with reductions in both wages and employment in central offices but to have little effect at production plants. Since the chief operating officer's salary is a large component of the average wage in small firms, the Brown and Medoff results appear consistent with those of Lichtenberg and Siegel. These studies suggest that managers and white-collar workers suffer the most following ownership change, but overall, the effects on labor, particularly production workers, appear to be relatively small.

While the Brown-Medoff and Lichtenberg-Siegel studies certainly make significant contributions to the empirical literature on the impact of ownership

Robert H. McGuckin is director of economic research at The Conference Board and a research associate of the Center for Economic Studies, U.S. Bureau of the Census. Sang V. Nguyen and Arnold P. Reznek are economists at the Center for Economic Studies, U.S. Bureau of the Census.

The judgments and conclusions herein are those of the authors and do not necessarily reflect those of the Bureau of the Census. The authors thank Ed Dean, Mark Doms, Kathy Friedman, John Haltiwanger, Frank Lichtenberg, Ken Troske, two anonymous referees, the editors, and conference participants for their helpful comments. Becky Turner provided excellent preparation of the manuscript.

changes on labor, several important issues need to be addressed. These include the representativeness of their samples, the measurement and identification of ownership change, and the appropriate unit of analysis (firms vs. plants). For example, the data set used by Brown and Medoff is for a single state, and most of the firms in their sample are small. Moreover, their sample excludes establishments located outside Michigan even when they are owned by Michigan firms.

The sample used by Lichtenberg and Siegel is much broader, covering the entire U.S. manufacturing sector. However, their sample includes only large, surviving plants in the 1972–81 period. Smaller surviving plants and exiting plants of all sizes are excluded. Restriction of the sample to survivors prevents Lichtenberg and Siegel from analyzing the effects of ownership changes on plant closing.

In this study, we examine these and other data problems and measurement issues in the estimation of the impacts of ownership change on labor. For this purpose, we created an unbalanced panel of more than 28,000 manufacturing establishments from the Census Bureau's Longitudinal Research Database (LRD). It covers the entire population of the U.S. food-producing industry (SIC 20) in 1977. We choose the food-manufacturing industry because it exhibits a substantial number of ownership changes that involve a significant portion of total industry shipments during the period under study. At the same time, it provides a large, tractable set of firms and plants for empirical work. Most important, the data set is comprehensive, covering plants of all sizes.[1]

These data allow us to construct a data set that contains firms undergoing ownership changes involving control[2] and a comparable group of firms not experiencing such changes. They also enable us to keep track of the activities of all food-producing firms and their components (i.e., plants) at discrete five-year intervals through 1987. Specifically, these data allow categorization of firms at the beginning of a period into those that operate continuously, those that close, and those that are sold to other firms. Similarly, the plants of a particular firm at the end of the period can be broken down into those the firm originally owned, those it acquired from other firms, and those that are newly constructed.

Our analysis leads to the following principal findings for the food industry. First, the growth rates of wages, employment, and labor productivity for the typical acquired plant (and originally owned plant of an acquiring firm) are higher than those for the typical plant of a nonacquiring firm in the postacquisition period. Second, to a lesser extent, the typical worker in both types of acquiring firms' plants also enjoyed higher growth rates of wages, employment, and productivity after an acquisition. Third, plants that *changed* owners

1. Also, data for this industry at both the plant and firm level are "cleaned" ready for this particular analysis.

2. See section 6.3.2 for a discussion of the measurement issues involved in relating ownership change and control.

show a greater likelihood of survival than those that did not. These three findings strongly reject the hypothesis that ownership changes through mergers and acquisitions cut wages and employment and reduce labor productivity. None of the findings are obtained using firm-level data, which suggests that plant-level data are more appropriate than firm-level data for studying the effects of ownership changes on the structure and performance of the firm.

We discuss the relationships among ownership change, productivity, wages, and employment in section 6.2. In section 6.3, we describe the data. In particular, we discuss how the LRD data were used to identify ownership change in our sample. In section 6.4, we report some simple statistics describing the characteristics of firms and plants that experienced ownership change. Our regression analysis is discussed in section 6.5. Section 6.6 reports the regression results. Discussions of the results are presented in section 6.7. The last section proposes directions for future research and concludes the paper.

6.2 Ownership Change and Labor

Brown and Medoff (1988) suggest that much of the press and labor union concern with ownership change might stem from extensive media coverage of a small and highly selective group of transactions. There are several issues involved here. Changing ownership itself need not be associated with other changes in the operation of the firm; but ownership changes involving "control"—the type of transaction examined here—typically lead to operational changes.[3] Some ownership changes involving control—hostile takeovers, for example—derive their notoriety from the wholesale upheavals that may accompany them: management dismissal, plant closures, abrogation of pension benefits, and wage reduction. Even though hostile takeovers are not typical of ownership change transactions, other forms of ownership change, such as friendly mergers, also lead to significant operational changes. But even assuming control changes and operations are affected, does economic theory offer clear guidance as to the impact of ownership changes on labor?

In fact, there are not clear theoretical links between ownership change and labor market outcomes. For example, at first glance the consequences for employment of ownership changes to create market power appear clear: market power is exercised by reducing output and raising prices, and reduced output will unfavorably affect employment. But this is not the whole story. A strong union might reasonably be expected to share in the monopoly rents.

As another example, many have argued that the dominant incentive during the conglomerate merger wave of the late 1960s to early 1970s was empire building by managers who were not operating in shareholders' interests (Mueller 1969, 1993; Shleifer and Vishny 1989). The merger wave of the

3. E.g., in the case of a public firm, ownership is constantly changing as shareholders buy and sell shares, but most of such changes bear little relationship to day-to-day operations of the firm.

1980s has been viewed as a response to the managerial excesses of the conglomerate merger wave in the early period. In this view, the acquisitions of the 1980s were motivated by the gains available from replacement of inefficient managers of poorly performing firms (Jensen and Ruback 1983; Lichtenberg 1992; Jensen 1993). Arguably, the net effect of such shifts on aggregate productivity (and thus wages) and jobs is relatively small.

The foregoing discussion offers an a priori reason for skepticism concerning the aggregate net effects of ownership changes on labor markets. However, even if the aggregate net effects of ownership changes are small, the relocation of jobs and workers associated with them can be substantial. Relocation of jobs is an important ingredient in the shifting of resources from lower to higher valued uses and is extremely important to aggregate productivity growth (e.g., see Baily, Bartelsman, and Haltiwanger 1994; Baily, Campbell, and Hulten 1992).

Recent studies also find ownership change associated with productivity growth. Using longitudinally linked firm-establishment data in the LRD, Lichtenberg and Siegel (1992a) and McGuckin and Nguyen (1994) conclude that ownership changes are positively associated with productivity growth in the U.S. manufacturing sector for the 1980s merger wave. Baldwin (1995) obtains a similar result using Canadian establishment data.[4]

The positive association between productivity growth and ownership change is consistent with most merger theories.[5] A key issue is the source of the gains. For example, one leading hypothesis is that ownership changes are undertaken for managerial discipline reasons. Managerial discipline takeovers are generally associated with poorly performing businesses that can be reorganized and restructured to make them more productive. The importance of this motive for ownership change is supported empirically by Lichtenberg (1992). In addition, Lichtenberg and Siegel (1992b) find evidence supporting the hypothesis that ownership changes lead to the elimination of jobs: downsizing and lower wages for central offices in firms undergoing ownership changes. But Lichtenberg and Siegel find little in the way of employment effects at production plants. Thus they do not find that ownership change is associated with loss of manufacturing jobs.

McGuckin and Nguyen (1994) reject the managerial discipline theory as a broad-based explanation of most ownership change. They reach this conclusion because their data show that it is high, not low, productivity establishments that are most likely to experience ownership change. Matsusaka (1993b)

4. These results are in sharp contrast with those found by previous researchers whose samples typically consisted of data only for large firms. E.g., most industrial organization studies have not found gains associated with ownership change (e.g., Ravenscraft and Scherer 1987). As discussed in more detail below, the new microdata appear to have uncovered relationships "hidden" in the more aggregative firm data.

5. Finding productivity gains positively related to ownership change does not fit well with any of the managerial excesses or empire-building arguments.

and Ravenscraft and Scherer (1987) report similar results: corporate acquirers generally purchase good businesses (productive plants) rather than bad businesses. This suggests that the gains in most ownership changes are associated with efficiencies generated by synergies, which result from combining operations.

For a subset of large establishments, McGuckin and Nguyen (1994) find—consistent with Lichtenberg and Siegel (1992a), whose sample consists primarily of larger plants—that establishments changing owners have low initial productivity and improve following the ownership change. Thus, for very large establishments, the results are consistent with managerial discipline motives for ownership change. Matsusaka (1993a) draws a similar conclusion for the 1960s and 1970s using firm-level data and a somewhat different test.

Despite the new evidence that a substantial proportion of the observed ownership changes represent combinations of efficient operations and subsequent improvements in productivity performance, the impact of ownership change on employment cannot be distinguished on theoretical grounds alone. It is possible for the positive association between ownership change and productivity growth to arise in ways that will, on net, have little effect on total employment of the firm. Productivity improvements could come from efficiencies leading to growth, upsizing the firm and increasing employment, rather than from downsizing. But even when synergies are the dominant motive for the ownership change, downsizing is possible. Similarly, one can expect either increases or decreases in wages following ownership changes. Ownership changes leading to productivity increases will tend to increase wages unless all of the rents from the ownership reorganization accrue to management. The relatively small gains to acquiring firms' shareholders found in finance studies are consistent with the view that all the rents do not accrue to acquiring firms. On the other hand, the large premiums paid to acquired firms' shareholders suggest that labor is not a primary recipient of ownership reorganization rents. Even in the absence of rents to labor, however, the average wage could increase if ownership change is associated with shifts to higher levels of worker skills.

To sort out these issues, we turn to a plant-level data set that covers both acquiring and nonacquiring firms and examine the relationships among ownership change, productivity, wages, and employment at both the firm and establishment levels.

6.3 Data and Measurement Issues

In this section, we focus our discussion on the data used and measurement issues associated with this type of research. First, we describe our data set and the details of its construction. Second, we discuss the concept of ownership change, report our techniques for identifying ownership change, and compare our concepts and techniques with those used by Lichtenberg and Siegel and by Brown and Medoff. Third, we discuss the issue of unit of analysis and point

out how this can affect empirical results. Finally, we compare our data to those used in previous studies.

6.3.1 Data and Sample Design

Data Source

Our data are taken from the LRD, which contains data on output, employment, and costs for individual U.S. manufacturing establishments. The output data include total value of shipments and value added. Data on costs include information on capital, labor, energy, materials, and selected purchased services. The employment data contain total and production workers, and their wages, as well as worked hours for production workers.

An important feature of the LRD is its plant classification and identification information, including firm affiliation, location, product and industry, and various status codes that identify, among other things, birth, death, and ownership changes. These identifying codes are used in developing both the longitudinal plant linkages and ownership linkages among plants.[6]

Sample Design and Coverage

We first identified each food-manufacturing plant operating in 1977 using the Census Bureau's SIC codes. Because 1977 is a census year, the entire population of food-manufacturing plants and firms is available. We then identified plants that had ownership change during the periods 1977–82 and 1982–87 (see section 6.3.2 for detailed discussion of identifying ownership change). After identifying all plants that experienced ownership change in these periods, we use each plant's 1977 and 1987 census firm identification number (ID) to identify sellers (acquired firms), buyers (acquiring firms—i.e., firms that acquired at least one food-manufacturing plant during the period), and firms that did not have any plant experiencing ownership change. Finally, we grouped all plants under common ownership in the beginning year (1977) of the study period into three categories: (1) surviving own plants—owned by the firm in 1977 and surviving through 1987; (2) closed plants—existed in 1977 but closed by 1987; and (3) sold plants—owned in 1977 but sold to other firms by 1987. Using a similar classification for 1987 gives three categories for acquiring firms: (1) surviving own plants, (2) acquired plants, and (3) new plants. Nonacquiring firms include only categories 1 and 3. These categories allow us to examine shifts in the composition of the firm over time.

We identify ownership changes occurring during the periods 1977–82 and 1982–87. Each period encompasses two Census of Manufactures years so that we are confident of correctly identifying all ownership changes. In noncensus years information is available only for a sample of plants. The full period 1977–87 includes the beginning and ending years of the latest merger move-

6. A more complete description of the LRD is given in McGuckin and Pascoe (1988).

ment, which extended until 1986 or 1987. Our primary focus is on ownership changes between 1977 and 1982. This allows us to evaluate performance five to nine years after an ownership change transaction. This provides plenty of time for the acquiring firm to integrate acquisitions into the firm, or to dispose of them. Using 1977–87 as the measurement interval for our performance measures also avoids the influence of the 1982 recession.

For the period 1977–82, we identified 733 firms that sold at least one food-manufacturing plant. These 733 firms sold in total 2,111 plants (including 1,573 food plants and 538 nonfood plants) to 732 acquiring firms. As shown in table 6.1, the 732 acquiring firms consisted of 93 single-unit firms, 284 new multiunit firms, and 355 multiunit firms. Of the 284 new multiunit firms, 134 entered manufacturing by acquiring only one manufacturing food plant. Each of the remaining 150 nonmanufacturing firms acquired at least two or more plants. The 355 multiunit manufacturing firms that operated in the food industry in 1977 had the biggest role in the 1977–82 acquisition movement. Together, they acquired 1,455 of the 2,111 transferred plants (68.9 percent) and accounted for $37,435 of the $38,764 million of total value of shipments acquired over the period (98 percent). Of the remaining 656 plants, 93 plants were acquired by 93 single-unit firms, 134 plants were acquired by 132 nonmanufacturing firms, and 431 plants were sold to 150 other nonmanufacturing multiunit firms.

For the nonacquiring group, we identified 17,409 firms that had at least one food manufacturing plant in 1977. Of the 17,409 firms, 15,067 were single-unit firms, 1,185 were nonmanufacturing firms having one food manufacturing plant, and 1,157 were multiunit manufacturing firms. These 1,157 firms owned 7,701 manufacturing plants (both food and nonfood plants) in 1977.

Thus our data cover the entire 1977 population of food-manufacturing firms in the United States. This population consists of 18,141 firms, of which 17,763 firms operated primarily in the food industry. The 18,141 firms owned 30,086 plants in 1977, of which 23,980 plants were owned by food firms and 6,106 plants were owned by nonfood firms.

6.3.2 Ownership Change: Concept and Measurement

Ownership and Control

"Ownership" refers to the person(s) that controls particular resources in the economy. Owners make the decisions about the use of these scarce resources. When resources change hands, the new owners typically change the way the resources are used. Therefore, ownership and ownership change are important aspects of economic growth and have important implications for economic policies. For example, antitrust authorities (the U.S. Department of Justice and the Federal Trade Commission) are concerned with the effects of ownership change on output and pricing decisions. The Securities and Exchange Commission protects minority shareholders' (owners') rights and protects the public

Table 6.1 **Acquiring and Nonacquiring Food-Producing Firms, 1977**

Firm	Number of Firms			Total Shipments (hundred thousand)	Total Employment	Average Employment	1977 Labor Productivity 1987 ($)
	Food[a]	Nonfood	Total				
Acquiring firms 1977–82							
1. Single unit	62	31	93	1,381	14,694	158	73.94
2. Nonmanufacturing, one food plant	109	25	134	1,798	17,554	131	75.06
3. Nonmanufacturing, more than one food plant	103	47	150	9,623	75,600	504	86.73
4. Multiunit manufacturing	236	119	355	172,164	1,203,095	3,389	118.82
Total	510	222	732	184,967	1,278,695	1,747	97.75
Nonacquiring firms[b] *1977–82*							
1. Single unit	15,067	–	15,067	26,124	286,273	19	67.20
2. Nonmanufacturing, one food plant	1,185	–	1,185	8,361	82,950	70	73.67
3. Multiunit[c]	1,001	156	1,157	129,466	1,253,031	1,083	89.42
Total	17,253	156	17,409	163,931	1,622,254	93	69.08

[a]Firms are allocated to food or nonfood industries based on the largest category of shipments.

[b]These firms had no acquisitions in the 1978–82 period but may have had acquisitions in the 1983–87 period.

[c]Includes multiunit firms with nonmanufacturing operations.

against securities fraud. These issues often become important when ownership shifts from one person or group to another. The Department of Labor is concerned with issues involving worker rights and working conditions that can change when ownership changes. Moreover, in the continuing debate on the relative roles of small and large firms in job creation and destruction, it is important to measure ownership and ownership change correctly.

None of the ownership concepts used in the databases underlying the studies considered in this paper (or any study) exactly match those needed for policy purposes. The key issue for policy is "control." Measuring control is particularly difficult for corporations. For corporations, the extent of ownership is determined by the proportion of the ownership shares held by an owner and the legal rules for exercising those shares. Roughly speaking, if a firm acquires more than 50 percent of the shares of another company, it obtains a majority of that firm and the ability to control it. It, of course, may decide not to exercise this right. But even without majority control, an owner may effectively control another company. The issue of who controls corporate assets has a long history. It was raised over 50 years ago by Berle and Means (1932) and is the subject of a large literature. For our purposes, we simply note that in some contexts criteria other than 50 percent ownership are used to approximate a level of ownership at which control is exerted. For example, for many securities transactions, a company is considered to be under the control of another if more than 10 percent of its stock is obtained by one investor.

Even if one settles on the conceptual issues and can precisely define "control," and thereby ownership, it is not simple to define ownership or measure ownership and ownership change in plant- and firm-level data sets like the LRD. These issues and a comparison of our methods for measuring ownership and ownership change with those of Lichtenberg and Siegel (1992a, 1992b) and Brown and Medoff (1988) are presented next.

Measuring Ownership and Ownership Change

Both Lichtenberg and Siegel's study and ours use the LRD as the source of the data set. The ownership concepts in the LRD reflect the LRD's roots in the Census Bureau's Standard Statistical Establishment List (SSEL), which is used as a sampling frame for most Census Bureau surveys of businesses with employment.[7] The SSEL contains current information on ownership, address, classification, employment, payroll, and operational status of each establishment. It also includes limited historical information. The SSEL is based on administrative information maintained in Internal Revenue Service (IRS), Social Security Administration, and (since 1990) Bureau of Labor Statistics re-

7. The SSEL is described in Bureau of the Census (1979), and its role in the Census Bureau's manufacturing establishment surveys is described in Cole, Petrik, and Struble (1995). The SSEL currently covers the following economic sectors: agriculture, mining, manufacturing, transportation and communication, wholesale, retail, finance, insurance, and real estate, services, and public administration.

cords. To facilitate the tracking of ownership at the plant level for the multiunit companies in the SSEL, the Census Bureau collects information from all multiunit companies in the economic censuses (every five years) and from a sample of companies in the Company Organization Survey (COS) in non-census years. Moreover, ownership information on multiunit companies is often obtained from other ongoing Census Bureau surveys.

For the Census Bureau, a company (company A) owns another company (company B) if either of two basic criteria is met: (1) company A owns more than 50 percent of the voting stock of company B or (2) company A has the power to direct the management and policies of company B. Census Bureau data collection forms ask respondents whether they own or are owned by other companies. If the answer is yes, the forms request the name, address, and employer identification number (EIN) of the owned or owning companies. Each business with paid employees is required to obtain a nine-digit EIN from the IRS.

The IRS does not require an enterprise to obtain a unique EIN for each location (establishment) at which it operates—EINs are assigned to facilitate companies' tax reporting, and they can cover anything from a single establishment of a multiunit company up to the entire company. Therefore, the Census Bureau cannot assign a unique ID to each establishment from EINs alone. But it does use the EIN along with information from the COS in constructing its ID numbers. In the LRD, the ID numbers of particular plants can and do change over time. An ID change often indicates an ownership change, but it can indicate other things as well. The following describes the process we used to identify ownership changes and separate them from other types of ID changes.

To identify ownership changes in the LRD requires three steps: (1) Identify plants that change firm ID between two census years. (2) Within this set of plants, use certain codes in the LRD, called coverage codes (CC codes), to identify directly a subset of plants that change ownership for a particular reason. (3) From the remaining plants, identify further ownership changes indirectly.

In step 1 in identifying mergers, we observe the change in the firm ID numbers of each establishment in the period under study. A change in ID can mean any of the following:

1. The establishment was sold to another firm—a true ownership change (merger).
2. A multiunit firm (a firm that owns more than one plant) closed or sold all of its plants but one and became a single-unit firm (a firm with only one plant).
3. A single-unit firm became a multiunit firm by opening new plants or acquiring existing plants. (Note that the ID variable in the LRD for each plant of a multiunit firm incorporates a code for the firm to which the plant belongs.)
4. A multiunit or single-unit firm underwent a legal reorganization (e.g.,

partnership to corporation) that spurred a firm ID change without a change in actual ownership.

5. Errors—erroneous ID changes can occur.

To identify most true ownership changes (mergers or divestitures)—step 2—we need to use information available in the LRD in addition to the ID variable. The main additional information is in the census CC codes assigned to establishments in the census or Annual Survey of Manufactures (ASM). The CC codes are two-digit numbers indicating the status of the establishment in the survey. In particular, there is a CC code indicating that an establishment was acquired by another company. For a complete list of CC codes, see the LRD documentation (Bureau of the Census 1992).

Ideally, all new firm ID and CC codes would be recorded during the years that establishments change status (including ownership), so that it would be easy to identify mergers. In practice, this does not always happen. Except for a set of large ASM establishments, neither changes in ID nor proper CC codes are systematically recorded during the years of status change. In many cases, particularly for small establishments, a change in firm ID appears one or more years before the corresponding CC code change occurs to explain the reason for the ID change. The reverse is also possible: the CC code can indicate an ownership change before the ID changes. To mitigate these problems, we examined CC codes in the years before and after the ID change. However, these procedures have two problems. First, in ASM (noncensus) years, not all plants are in the data set, and in particular, when the ASM panel changes (in years ending in 4 and 9), the set of noncertainty cases (the smaller plants) turns over completely. Second, for a number of single-unit non-ASM establishments (in census years), proper CC codes are not assigned at all.

So, using CC codes allows us to identify only a portion of the establishments that have ID changes due to ownership changes. However, as table 6.2 indicates, this is a large portion. The table summarizes the results for plants that are classified in the food industry. We identified 2,010 establishments that changed ID between 1977 and 1982. The CC codes gave reasons for ID change for 85.7 percent (1,722) of these establishments—of these, 1,507 (75 percent) were acquired and 215 (10.7 percent) changed ID for other known reasons, such as reclassification, combined reports, firm reorganization, and so forth. The remaining 14.3 percent of establishments (288) were not assigned a CC code.

For the 288 plants with unexplained ID changes, we brought together initial and ending firm IDs for all plants that were owned by the firm in question. For example, suppose the LRD shows that plant A belonged to firm X in 1977 and to firm Y in 1982, but the 1982 CC code for plant A does not show this as an ownership change. Suppose, however, we know that firm Y also acquired at least one other plant from firm X between 1977 and 1982. In this case, it seems likely that firm Y bought plant A as well, and we code plant A accordingly. By

Table 6.2 **Identifying Ownership Change in SIC 20 (Food), 1977–82**

Reason for ID Change	Ownership Change Identified Using CC Codes Only			Ownership Change Identified Using CC Codes and Matching Techniques		
	Number of Plants	Percentage of Plants	Average Employment	Number of Plants	Percentage of Plants	Average Employment
Acquired	1,507	75.0	177.9	1,573	78.3	174.2
Converted	160	8.0	112.8	160	8.0	112.8
Duplicate	2	0.1	D	2	1.0	D
Error	4	0.2	D	4	0.2	D
Reclassified	18	0.9	60.8	18	0.9	60.8
Reorganized	22	1.0	124.8	22	1.0	124.8
Sold to nonmanufacturing firm	6	0.3	D	6	0.3	D
Split	3	0.1	D	3	0.1	D
Nonidentifiable	288	14.3	89.1	222	11.0	88.5
Total	2,010	100.0	158.0	2,010	100.0	158.0

Note: D = suppressed to prevent disclosure of confidential information on individual firms.

making such assumptions, we increase the number of plants identified as acquired by 66 to 1,573.[8]

Lichtenberg and Siegel (1992b) use two separate data sets for their studies. One data set is taken from the Census Bureau's auxiliary reports of the 1977 and 1982 economic censuses. This data set is used to study the effects of ownership change on central office employees. The other data set is a balanced panel extracted from the LRD. It contains 20,493 U.S. manufacturing plants that continuously operated during the period 1972–81. This sample is about 6 percent of the population of U.S. manufacturing establishments in 1977 (350,648 establishments), but it accounts for about 55 percent of total U.S. manufacturing employment in that year. Thus the establishments in the Lichtenberg and Siegel data set are very large. Specifically, 82 percent of the plants in this sample employ at least 250 workers, 28.8 percent employ between 250 and 499 workers, and 52.7 percent employ more than 500. The average number of workers per establishment is 501, almost 10 times as large as the population average (53 workers).

Lichtenberg and Siegel identify ownership changes using only CC codes (Lichtenberg and Siegel 1992a, 31). They do not take our last step of trying to identify ownership changes not indicated by CC codes.[9] However, their procedure probably presents few problems for accurately tracking ownership change of the plants included in their sample because they use only the balanced panel that contains the largest establishments in the LRD. These plants are generally included in the ASM and have CC codes. On the other hand, because their sample excludes all plants (both small and large) that entered or exited manufacturing after 1972, Lichtenberg and Siegel miss a significant number of plants entering manufacturing and changing owners after 1972 and those that had ownership change during 1972–80 and exited by or before 1981.[10] For the period 1972–81, they identify about 4,300 manufacturing plants changing ownership (21 percent of their sample of 20,500 continuous plants). In preliminary work for the entire manufacturing sector, McGuckin and Nguyen find 7,414 plants with at least one change during the period 1972–77 and 12,289 plants changing owners during 1977–82.

Lichtenberg and Siegel's data set has several disadvantages. First, because

8. Recall that section 6.3.1 indicates that the 1977–82 selling firms sold 1,573 food plants and 538 nonfood plants.

9. For their study of employment in auxiliary establishments, Lichtenberg and Siegel (1992a, 31–32) assume that ownership changes if and only if the ID of the auxiliary establishment changes. They recognize that "this procedure is subject to errors: Some nonmatches of the code may be due to coding errors, and certain ownership changes may not result in changes in the code" (Lichtenberg and Siegel 1992b, 49).

10. The ending date, 1981, of the Lichtenberg-Siegel sample period is unfortunate because it is just before the 1982 Census of Manufactures. This means that extensive revisions in the Census Bureau data files undertaken in preparation for each economic census were not available to help identify ownership change. This increases the possibility of mistakes in identifying ownership change. On the other hand, restriction of the sample to large plants, while raising selection bias issues, mitigates the source of this measurement error in their study.

their balanced panel contains only large, surviving plants, it is not representative of the entire distribution of plants. In fact, it excludes most acquisitions from consideration. Second, their sample requires continuous plants and, hence, excludes plants entering manufacturing after 1972 and subsequently acquired. Finally, their sample excludes closed plants, including plants acquired between 1973 and 1980 and closed by or before 1981.

Brown and Medoff (1988) use data on the employment and wages of firms in Michigan compiled from unemployment insurance (ES-202) records kept by the Michigan Employment Security Commission (MESC). The research database, constructed at the Institute for Social Research at the University of Michigan, covers over 200,000 firms located in the state of Michigan during the period 1978:3–1984:4, is described in Brown et al. (1990). The basic documentation is in Connor et al. (1984).

The MESC database contains data on all Michigan employers that are required to pay unemployment insurance taxes ("liable employers"). The MESC system assigns a six-digit unemployment insurance number to each firm. (The MESC data system also includes the EIN—so there is a link between the EIN and the unemployment insurance number—but the research file used by Brown and Medoff does not include the EIN.) MESC tracks ownership changes that affect the set of liable employers. In general, liable employers are those that had employees in each of a set of different weeks in a calendar year, had persons covered by unemployment insurance on their payrolls, or acquired another liable employer.[11] A business can acquire another business through "sale, foreclosure, lease, bankruptcy, or merger" (MESC 1995, 7). The new owner is known as the successor, and the process of acquiring an existing business is called successorship.[12]

The MESC data set allows Brown and Medoff (1988) to define three types of acquisitions: (1) "simple sales," (2) "asset-only sales," and (3) "mergers." They also define "reorganizations," which look like simple sales except that the type of business changes. Brown and Medoff recognize the difficulty in distinguishing between reorganizations and simple sales.

This data set contains firm-level data, in contrast to the plant-level data in the LRD. The MESC has two advantages over the LRD (used in Lichtenberg and Siegel study and ours): it is not limited to the manufacturing sector, and it has relatively complete coverage of firm activity within Michigan (at least

11. As of 1995, "generally, a liable employer is an employing unit that either (1) employed one or more employees in each of any 20 different weeks in a calendar year . . . ; or (2) paid $1,000 or more in payroll in a calendar year to employees covered by unemployment insurance; or (3) acquired the trade, organization (i.e., all employees), or business, or at least 75 percent of the assets of a liable employer" (MESC 1995, 2). There are different requirements for employers of agricultural or domestic workers.

12. As of 1995, "if a new or existing business acquires 75 percent or more of the assets of another business, and within 12 months either continues the previous or a similar business, or uses the trade name or good will of the previous business, then there is a mandatory transfer of the unemployment tax experience, or history, of the previous business" (MESC 1995, 7).

firms covered by unemployment insurance). However, the MESC data set exhibits certain weaknesses in identifying ownership changes. A major weakness—not shared by the LRD—stems from its coverage of only one state. Mergers between a Michigan firm and an out-of-state firm will look like a simple sale because there is no record of the out-of-state firm in the MESC data set. Also, when a Michigan firm acquires an out-of-state firm, there is no record of the acquisition at all (Brown and Medoff 1988, 12). "For instance, General Motors' acquisition of EDS and Hughes Aircraft would probably not be recorded in their data" (Carliner 1988, 27). Farber observed that "the central limitation of the data is that it deals explicitly with employment in Michigan. In particular, many firms have business . . . operations that span state boundaries, so that looking strictly at Michigan employment is likely to give a misleading picture of both the employment size distribution of firms involved in mergers and acquisitions and the employment effects of mergers and acquisition" (1988, 28–29).

Compared to Brown and Medoff's and Lichtenberg and Siegel's data sets, our sample has several advantages. First, our data cover the entire *population* of the food-manufacturing industry and includes all small, medium-size, and large establishments located anywhere in the United States. Second, our unbalanced panel includes both entering and exiting plants. This allows us to more accurately measure ownership change activities and hence the effects of ownership change on labor. Finally, our decomposition of individual firms into separate components (own plant, closed plant, and acquired plant, etc.) allows us to take a close look at individual components of the firm before and after ownership change.

While our data set has advantages, it also has several shortcomings. First, it includes only one two-digit SIC industry. Therefore, it is not representative of the entire U.S. manufacturing sector. Second, it does not contain data for central offices. This prevents us from examining the effect of ownership change on control management operations. Finally, as with the other two data sets, ours does not contain information on types of merger, for example, whether a takeover is hostile or friendly.

6.3.3 Unit of Analysis: Firm versus Plant

An important issue in studying the impact of ownership change on firms' activities is: What is the appropriate unit of analysis? Is the "firm" or "plant" the right unit of analysis? Because acquisition is part of a strategy to realign resources and operations of the firm—a strategy that may encompass acquisition, divestiture, and internal growth—the *composition effects* associated with the nature and timing of the transaction may be important in assessing the impact of particular transactions. Indeed, the components of a firm can and do change over time. In particular, the mix of plants of an acquiring firm before and after merger can differ substantially. Before merger, the firm owns a set of plants: some will be closed, some will be sold, and others will be retained by

the firm. After merger, the structure of the firm may look much different from before: it now includes acquired plants and plants that are newly built in addition to its surviving own plants. Thus simply looking at the performance (e.g., employment, wage, and productivity growth) of the *whole* firm before and after merger may not be appropriate. A related issue involves the empirical flexibility and richness of models based on plant-level data.

For example, in their conclusions, Brown and Medoff point out that "the estimated effects of mergers are also subject to a composition effect. If the (relatively highly paid) head of the acquired firm leaves following the merger, average wages will fall. Given the small size of our typical firm, a nontrivial share of our estimated wage decline from merger may be due to such composition effects" (1988, 23). Lichtenberg and Siegel's results based on plant-level data provide strong evidence on this composition effect: ownership changes have a significant, negative effect on both employment and wage growth in central offices and little effect in production plants. The advantages of plant data are discussed further in McGuckin (1995).

6.3.4 Variable Measurement

The main variables used in this study are employment, wages, and productivity.

Employment and Wage Variables

Employment is measured by the total number of employees, which comprise production workers and nonproduction workers. Wages are defined as workers' annual salaries. We note that this measure of wages does not include nonwage costs associated with labor because separate data on these costs are not available for the two types of workers. In addition, Dunne and Roberts find that "non-wage costs are a poorly reported variable in the census data . . . many of the plants have this variable imputed" (1993, 7). Following Dunne and Roberts, we do not include nonwage costs in the wage measure used here. This is a potentially important measurement problem since the form of compensation can vary across firms and industries. Real wages are defined as nominal wages deflated by the consumer price index taken from the *Survey of Current Business* (September 1993).

Productivity Measurement

We use value of shipments as our measure of output in the productivity measure. Data on value added are not always available, particularly for small plants. In practice, productivity results using either measure are highly correlated. For example, the results in McGuckin and Nguyen (1994), which also use food industry data over this period, are unaffected by the choice of value added or shipments. (See also Baily et al. 1992; Baily et al. 1994.)

Productivity can be measured either for each single input such as labor (labor productivity, LP) or for all inputs (total factor productivity, TFP). Theoretically, TFP is the appropriate measure of productivity because it takes into ac-

count all inputs. In practice, LP is often used because data on inputs, such as capital, that are required for the measurement of TFP are not available. Because of data limitations, we base our analysis on LP.[13]

Plant LP is measured as value of shipments in current dollars divided by the total number of employees. While output prices and value of shipments vary across plants and over time because of price dispersion and inflation, deflating each plant's LP by its industry average LP produces a comparable productivity measure through time.[14] We call this adjusted LP measure relative labor productivity (RLP).[15]

Plant RLP provides a good measure of plant performance if all plants in the same industry have similar input-output ratios. If the production technology differs substantially among plants, RLP could be a misleading measure of performance. However, in our earlier work (McGuckin and Nguyen 1994), we estimate TFP for a number of large plants for which the required data are available. We then compare the TFP results to the RLP results and find that both measures lead to the same conclusions regarding plant performance.

While single-unit firms are classified in a single industry, multiunit firms often have plants operating in various industries. For multiunit firms, we calculate the productivity for each plant separately then obtain the firm productivity as a weighted sum of plant productivities. Thus we measure the RLP of the firm by

$$\text{(1)} \qquad \text{RLP}_k^F = \sum_j w_{kj}\text{RLP}_{kj},$$

where RLP_k^F is RLP of firm k, the weight w_{kj} is the ratio of plant j's employment to the total number of employees of firm k, and the summation is over the n plants of firm k.

6.4 Descriptive Statistics

6.4.1 Firm-Level Data

Table 6.3 presents 1977 and 1987 wages, productivity, and total employment for all firms operating in the food industry during the period under study. Since we only observe the manufacturing operations of each firm, we classify acquiring firms into four groups: (1) single-unit firms, (2) multiunit nonmanufacturing firms entering manufacturing by buying one food plant, (3) multiunit nonmanufacturing firms entering manufacturing by buying more than one food

13. McGuckin and Nguyen (1994) estimate both RLP and TFP using data for 3,800 continuous plants in the food industry. They then use these two productivity estimates in their regression analysis of ownership change and find that the two measures yield very similar results. They note, however, that the results based on data for continuous plants are subject to serious sample selection bias.

14. Industry is defined at the four-digit level throughout the paper.

15. For further justification on its use, see McGuckin and Nguyen (1994) and Christensen, Cumming, and Jorgenson (1981).

Table 6.3 **Acquiring and Nonacquiring Food Manufacturing Firms 1977–87**

Firm	Average Employment Size		No. of Firms		Wage Rate		Total Employment		1977 RLP[a]	
	1977	1987	1977	1987	1977	1987	1977	1987	1977	1987
Acquiring firms 1977–82										
1. Single unit										
Surviving by 1987	113	79	25	25	20,228	18,911	2,821	1,980	.82	.65
Sold by 1987	195	–	–	–	22,183	–	2,920	–	1.11	–
Exit by 1987	172	–	–	–	20,747	–	8,955	–	.98	–
Subtotal	158	79	25	25	20,839	18,911	14,696	1,980	.96	.65
2. Nonmanufacturing, one food plant										
Surviving by 1987	91	208	48	48	22,581	20,817	4,379	9,997	1.09	.98
Sold by 1987	225	–	33	–	19,708	–	7,425	–	.82	–
Exit by 1987	109	–	53	–	19,751	–	5,754	–	.93	–
Subtotal	131	208	134	48	20,754	20,817	17,558	9,997	.96	.96
3. Nonmanufacturing, more than one food plant										
Surviving by 1987	638	1,086	84	84	22,605	22,566	53,557	91,201	1.03	1.07
Sold by 1987	393	–	40	–	20,323	–	15,739	–	1.05	–
Exit by 1987	234	–	27	–	21,202	–	6,308	–	1.07	–
Subtotal	501	1,086	15	84	21,750	22,566	75,604	91,201	1.04	1.07

4. Multiunit manufacturing										
Surviving by 1987	3,649	5,011	268	268	22,352	23,360	977,878	1,343,051	1.14	1.08
Sold by 1987	2,407	–	65	–	22,202	–	221,430	–	1.03	–
Exit by 1987	157	–	22	–	24,200	–	3,463	–	1.07	–
Subtotal	3,338	5,011	355	268	22,439	23,360	1,202,734	1,343,051	1.11	1.08
Nonacquiring firms 1977–82[b]										
1. Single unit										
Surviving by 1987	25	32	5,162	5,162	19,849	16,222	129,050	163,864	.76	.69
Sold by 1987	60	–	436	–	20,266	–	26,160	–	.90	–
Exit by 1987	13	–	9,469	–	19,438	–	123,097	–	.78	–
Subtotal	18	32	15,067	5,162	19,603	16,222	278,307	163,864	.78	.69
2. Nonmanufacturing, one food plant										
Surviving by 1987	90	121	475	475	19,908	19,507	42,750	57,686	.88	.82
Sold by 1987	126	144	80	80	21,431	21,851	10,080	11,527	.96	–
Exit by 1987	48	–	630	–	19,467	–	30,240	–	.84	–
Subtotal	70	125	1,185	555	19,776	19,845	83,070	69,213	.87	.82
3. Multiunit manufacturing[c]										
Surviving by 1987	1,570	1,451	667	667	21,298	22,203	1,047,255	967,793	1.00	1.02
Sold by 1987	981	–	169	–	21,843	–	165,789	–	.96	–
Exit by 1987	124	–	321	–	19,735	–	39,804	–	.90	–
Subtotal	1,083	1,451	1,157	667	20,940	22,203	1,252,848	967,793	.97	1.02

[a]Multiunit firm productivity is based on the weighted average (labor weights) of plant productivity.

[b]Includes 120 firms that acquired properties in the 1983–87 period.

[c]Includes multiunit firms with nonmanufacturing operations.

plant, and (4) multiunit manufacturing acquiring firms. Using the same framework gives three groups for nonacquiring firms: (1) single-unit firms, (2) nonmanufacturing multiunit firms having only one plant operating in the food-manufacturing industry, and (3) multiunit manufacturing firms having at least one plant operating in the food-manufacturing industry.

While we report data by each grouping of firms, we focus our discussion on multiunit manufacturing firms because they account for most economic activity in the food industry, regardless of how economic activity is defined. For example, in both 1977 and 1987, multiunit manufacturing acquirers accounted for more than 91 percent of the total number of workers employed by all firms that acquired at least one food plant. Multiunit manufacturing firms also accounted for large fractions of total nonacquiring firm output, 77.6 and 80.0 percent in 1977 and 1987, respectively.

Table 6.3 shows a striking difference in employment growth between acquiring and nonacquiring surviving firms. The average size of multiunit manufacturing acquiring firms increased by 37.3 percent (from 3,649 employees in 1977 to 5,011 employees in 1987), whereas the average size of nonacquiring multiunit manufacturing firms declined by 7.6 percent during the same period (from 1,570 in 1977 to 1,451 employees in 1987). By 1987 the 268 surviving multiunit acquiring firms employed in total 1,343,051 workers, approximately 12 percent more than the total employment of the 1977 cohort of 355 acquiring firms (1,202,734 workers) and 37.3 percent more than the 977,878 workers they employed in 1977. In contrast, by 1987 the 667 surviving multiunit nonacquiring firms employed 967,793 workers, a 7.6 percent decline from their 1977 employment level and well below the 1,252,848 workers employed by the 1977 cohort of 1,157 firms that did not change owners during 1977–82.

Turning to wages, we find that, on average, multiunit firms paid the highest wages. Multiunit acquiring firms paid average wages of $22,439 (in 1987 dollars) per year in 1977 and $23,360 per year in 1987, a 3.6 percent increase in real wages. Multiunit nonacquiring firms paid average wages of $20,940 per year in 1977 and $22,203 in 1987, a 5.7 percent increase.

Regarding productivity, we find that firms having the highest initial productivity survived, while those with the lowest closed. Acquired firms had above average levels of productivity, but their productivity levels were well below those of surviving firms and above those of closed firms. Acquiring firms had higher productivity levels than nonacquiring firms in both 1977 and 1987. The 1977 and 1987 productivities of acquiring firms were 1.14 and 1.08, while those of nonacquiring firms were 1.00 and 1.02, respectively. Thus, although acquiring firms showed higher productivity levels at both the beginning and end of the 1977–87 period, they experienced a 56 percent decline in relative productivity over the period, while nonacquiring firms showed modest productivity improvement (2.0 percent).

Unfortunately, it is not clear from these results exactly how acquisition affects a firm's productivity, employment, and wages. For example, table 6.3

shows that acquiring firms increased their employment substantially during the 1977–87 period, but it is not clear whether this increase came from upsizing existing plants or acquired plants or simply from opening new plants. In a similar vein, the decline in productivity of acquiring firms could come from the diminishing productivity of old existing plants or acquisition of plants with productivity levels below those already a part of the firm, or it could come from a decline in productivity of acquired plants. It is imperative to turn to plant-level data and examine the performance of the different components of the firm to isolate the impacts of acquisition on observed firm-level results.

6.4.2 Plant-Level Data

Table 6.4 reports productivity, total employment, and wages for individual components of both acquiring and nonacquiring firms in 1977 and 1987. Columns (1) and (2) show that, except for plants purchased during 1983–87 by firms acquiring in both the 1977–82 and 1983–87 periods, all groups of purchased plants show improvement in relative productivity by 1987. Specifically, plants purchased during 1977–82 and kept by acquiring firms through 1987 increased their productivity by 4 percent (from 1.02 in 1977 to 1.06 in 1987). Plants purchased by (1977–82) nonacquirers during 1983–87 also increased their productivity by 2 percent (from 0.95 in 1977 to 0.97 in 1987).

In contrast, the relative productivity of plants initially owned and kept until 1987 by both acquirers and nonacquirers declined noticeably: a 6 percent decline for plants owned by acquirers (from 1.18 in 1977 to 1.11 in 1987) and a 5 percent decline for plants owned by nonacquirers (from 1.04 in 1977 to 0.99 in 1987). New plants opened by both acquirers and nonacquirers had 1987 productivity levels well above those of existing and purchased plants.

These results suggest two major sources for the observed decrease in the relative productivity of acquiring firms. The first is the decline in the *relative* efficiency of older plants initially owned by the acquiring firms. The second is the lower productivity of the plants purchased by acquirers: while acquired plants experienced a noticeable improvement in productivity, their 1987 productivity levels were still below those of old (1977 kept plants) and new plants. Inclusion of these "below average" plants lowers the average productivity of the firm.

New plants built by both acquirers and nonacquirers had the highest levels of productivity. For nonacquirers, these high-productivity new plants offset the decline in the relative efficiency of their older plants. However, in the case of acquiring firms, the high productivity of new plants could not compensate for the relative efficiency decline because acquired plants had lower levels of productivity than previously owned plants. Thus, even though acquired plants had above industry average productivity prior to acquisition and became more productive after acquisition, the firm-level relative productivity of acquiring firms fell.

Turning to employment, columns (3) and (4) show that both acquiring and

Table 6.4 **Productivity, Employment, and Wages of Acquiring and Nonacquiring Multiunit Manufacturing Firms and Component Parts, 1977 and 1987 (simple means)**

Firm or Component	Relative Productivity		Total Employment		Real Wage Rates	
	1977 (1)	1987 (2)	1977 (3)	1987 (4)	1977 (5)	1987 (6)
Acquiring firms 1977–82[a]						
Surviving to 1987	1.14	1.08	977,878	1,343,051	22,352	23,630
Sold by 1987	1.03	–	221,430	–	22,202	–
Exit by 1987	1.07	–	3,460	–	24,200	–
All firms	1.12	1.08	1,202,768	1,343,051	22,439	23,630
Components of surviving acquiring firms						
Plants owned in 1977						
Kept in 1987	1.18	1.11	647,486	662,300	22,554	23,793
Sold by 1987	1.11	–	139,643	–	22,645	–
Exit by 1987	1.04	–	190,749	–	21,628	–
All plants	1.12	1.11	977,878	662,300	21,806	23,793
Plants acquired 1977–82						
Kept in 1987	1.02	1.06	189,496	261,811	21,198	21,653
Sold by 1987	.95	–	75,234	–	21,265	–
Exit by 1987	.97	–	15,919	–	24,205	–
All plants	.98	1.06	280,649	261,811	21,629	21,653
New plants 1977–82	–	1.20	–	52,335	–	21,808
New plants 1983–87	–	1.16	–	67,687	–	23,034
Plants acquired 1983–87	1.01	.98	322,328	347,404	21,719	21,876
Nonacquiring firms 1977–82[a,b]						
Surviving to 1987	1.00	1.02	1,047,255	967,793	21,291	22,203
Sold by 1987	.96	–	165,789	–	21,843	–
Exit by 1987	.90	–	39,804	–	19,735	–
All firms	.97	1.02	1,252,848	967,793	21,422	22,203
Components of surviving nonacquiring firms						
Plants owned in 1977						
Kept in 1987	1.04	.99	639,377	595,662	21,515	22,184
Sold by 1987	1.05	–	127,241	–	22,616	–
Exit by 1987	.95	–	235,637	–	20,198	–
All plants	1.01	.99	1,047,255	595,662	21,136	22,184
New plants 1978–82	–	1.21	–	65,626	–	20,935
New plants 1983–87	–	1.15	–	100,145	–	22,305
Plants acquired 1983–87	.95	.97	183,752	206,360	22,157	22,376

[a]Firm productivity is based on the weighted average (labor weights) of plant productivity.

[b]Includes 120 firms that acquired plants in the 1983–87 period.

nonacquiring firms were very active in restructuring themselves. Each sold and built new plants and closed old plants. However, only acquirers also bought plants. Acquiring firms increased their employment, while nonacquiring firms showed decreases. The reason for this difference is that acquiring firms increased their employment by acquiring and building plants more than they decreased their employment by closing and selling plants. In contrast, nonacquiring firms closed and sold more plants than they built.

One of the reasons that the surviving acquiring firms show good job performance is that they include the employment of sold firms that they acquire. As shown in table 6.4, this source of growth for acquiring firms is substantial. But even taking this source of employment into account does not alter the conclusion that ownership change is associated with employment increases. Unlike acquirers that hired more workers for their existing plants, nonacquiring firms cut employment in their existing plants. Taken together, the net employment gain for plants purchased by acquirers during 1977–87 was 16,238 workers (from 602,977 workers in 1977 to 619,215 workers in 1987).

Finally, columns (5) and (6) report on annual wages. In general, plants owned by acquiring firms paid higher wages than those owned by nonacquiring firms. This is expected because, on average, acquirers' plants were bigger and more productive than nonacquirers' plants. Nonetheless, the differences between acquiring and nonacquiring firms are not large in either 1977 or 1987. While both surviving acquiring and nonacquiring firms show increases in real wages in all their components, the observed increases range from 2 to 7 percent over the 10-year interval.

These statistics suggest that ownership change had positive effects on both employment and productivity growth during the period under study. For wages, the difference in performance appears much smaller. However, conclusions based on simple averages like these can only be tentative because they do not control for the effects of factors other than ownership change. Among other things, such factors include the firm's size, technology, and the industry in which the firm operates. For this reason, we turn to a regression analysis. This allows us to assess the impact of ownership change on employment, wages, and productivity while controlling for possible effects of other factors. It also helps to clarify the important differences in experimental design associated with use of firm or plant as the unit of analysis.

6.5 Regression Analysis

In this section, we use the detailed microdata described above to estimate the effects of ownership change on employment, wage, and labor productivity growth. To control for the effects of factors other than ownership change, we estimate reduced-form regressions in which the growth rates of employment, wages, and productivity are the dependent variables. Ownership change and several predetermined variables are used as explanatory variables. We also per-

form probit regressions designed to assess the likelihood that ownership change is associated with plant closures. We note that most variables in our models are likely to be determined jointly, and without a structural model, including good instrumental variables, we are limited in what we can say about causality. Nonetheless, we think this exercise is an instructive first step in understanding the role of ownership change in labor markets.

We specify our wage and employment equations as

$$\ln X_{87} - \ln X_{77} = a_0 + a_1 OC_{77\text{-}82} + a_2 \ln W_{77} + a_3 \ln E_{77} + a_4 \Delta TECH + a_{12} OC_{77\text{-}82} * \ln E_{77}, \tag{2}$$

where ln is natural logarithm; X denotes total employment (number of workers, E) or wages (Wage); OC is a dummy variable (OC = 1 if the firm or plant experienced ownership change; otherwise OC = 0); and ΔTECH denotes change in technology of the firm or plant. The ratio of machinery and equipment to capital stock provides a proxy for the level of technology of the firm—we assume that given the same level of capital stock, the firm that uses more equipment and machinery is more technologically advanced. This variable may also be viewed as an adjustment to account for the fact that, other things equal, labor productivities will be higher in capital-intensive plants.

The above wage and employment equations are similar to those used by Brown and Medoff (1988) and Lichtenberg and Siegel (1992b). They reflect specifications used in the literature analyzing the impact of training on workers' earnings and employment. The basic idea underlying the equations is to ask whether changes in ownership had significant effects on employment and wages controlling for initial conditions (i.e., initial employment and wages). Our specifications differ in that we also include the variable ΔTECH and an interaction term, $OC_{77\text{-}82} * \ln E_{77}$, to allow for interactions between OC and (employment) size. We do this because our data reveal that large firms (or plants) behave differently from small ones.

Similarly, our productivity change equation is specified as

$$\ln RLP_{87} - \ln RLP_{77} = b_0 + b_1 OC_{77\text{-}82} + b_2 \ln RLP_{77} + b_3 \ln E_{77} + b_4 \Delta TECH + a_{13} OC_{77\text{-}82} * \ln E_{77} + a_{23} \ln RLP_{77} * \ln E_{77}, \tag{3}$$

where RLP denotes relative labor productivity. Other variables are defined as above.

The regression analysis outlined so far is based on *surviving* plants: each equation relates ownership change to changes in productivity, wages, and employment that are estimated using data on surviving plants. Thus it is important to address the issue of plant closing or exiting after ownership change. To do so, we run probit regressions in which plant closing (PC) is the dependent variable. Ownership change (OC) is specified as an explanatory variable. We

include initial relative productivity (RLP_{77}) and employment (E_{77}) as control variables. For comparisons, we also include the variable $OWNPLT_{AF77}$, which identifies whether the plant was originally owned by an acquiring firm in 1977 (the omitted category is plants that were owed by nonacquiring firms in 1977). Finally, we allow for nonlinear effects of initial productivity and employment size on plant closure. Our probit regression is

$$
\begin{aligned}
PC_{87} = {} & a_0 + a_1 OC_{77\text{-}87} + a_2 OWNPLT_{AF77} + a_3 RLP_{77} + a_4 \ln E_{77} \\
& + a_{13} OC_{77\text{-}87} * RLP_{77} + a_{14} OC_{77\text{-}87} * \ln E_{77} \\
& + a_{23} OWNPLT_{AF77} * \ln E_{77} + a_{33} (RLP_{77})^2 \\
& + a_{44} (\ln E_{77})^2 + a_{34} RLP_{77} * \ln E_{77},
\end{aligned} \tag{4}
$$

where PC_{87} equals one if the plant was closed by 1987 (zero otherwise), $OC_{77\text{-}87}$ equals one if the plant changed ownership during 1977–87 (zero otherwise), and $OWNPLT_{AF77}$ equals one if the plant was owned by an acquiring firm in 1977 (zero otherwise). The remaining variables are defined as before.

Before proceeding, we note that RLP_{77}, E_{77}, and W_{77} may reflect "transitory" rather than "initial" conditions of plants acquired during 1977–82. A better approach is to use data on these variables for several years before the plant is acquired to describe its initial condition. However, doing so requires continuous data, which in turn significantly reduces our sample size. Estimates based on such a truncated sample could lead to serious sample selection bias. Nevertheless, in preliminary work using data for the entire U.S. manufacturing sector, use of average values of 1972 and 1977 data as a proxies for initial conditions of acquired plants (e.g., initial $RLP = (RLP_{72} + RLP_{77})/2$) shows results very similar to those using 1977 values alone.

6.6 Regression Results

6.6.1 Firm-Level Results

Table 6.5 reports the firm-level results for the wage, employment, and productivity equations.[16] In each equation, the variable ACQUIRER equals one if the firm is an acquiring firm. FOOD is a zero-one dummy variable having a value of one if the firm is a primary food-producing firm. The variable ξ is the residual estimated from the productivity equation (3). This variable is included in the wage equation to capture the possible effect of productivity on wages. We use ξ instead of the explicit productivity variable to avoid a potential simultaneity problem. Inclusion of ξ, FOOD, and ΔTECH does not significantly affect the estimated coefficients of the key variable ACQUIRER.

16. In our preliminary work, we estimated various competing models for each equation. Here we report only the results of two models for each equation because other models yield very similar results.

Table 6.5 **Firm-Level Regressions**

	Wage Equation		Employment Equation		Productivity Equation	
Independent Variable	Model I (1)	Model II (2)	Model I (3)	Model II (4)	Model I (5)	Model II (6)
Intercept	1.094*	1.143*	.536	.390	.452*	.519*
	(12.6)	(13.8)	(1.6)	(1.1)	(3.8)	(4.0)
ACQUIRER	−.082	−.087	.459	.166	−.196	−.205
	(1.2)	(1.4)	(1.7)	(1.7)	(1.3)	(1.4)
ln E_{77}	.046+	.012	−.262*	−.258*	−.022	−.024*
	(2.1)	(1.7)	(8.9)	(8.6)	(0.9)	(1.0)
ln W_{77}	−.384*	−.374*	.234+	.241+		
	(14.5)	(15.5)	(2.3)	(2.1)		
ln RLP_{77}					−.363*	−.358*
					(4.8)	(4.8)
ln E_{77}*ACQUIRER	.010	.010	.067	.068	.031	.030
	(0.9)	(0.9)	(1.6)	(1.6)	(1.3)	(1.3)
ln E_{77}*ln RLP_{77}					.006	.006
					(0.4)	(1.4)
ΔTECH		.138*		.047		−.317*
		(2.5)		(0.2)		(2.4)
FOOD		−.076*		.115		−.069
		(3.8)		(1.3)		(1.4)
ξ		.188*				
		(12.5)				
R^2	.212	.353	.166	.166	.147	.154
n	804	804	804	804	804	804

Notes: Dependent variables of the wage, employment, and productivity equations are ln W_{87} − ln W_{77}, ln E_{87} − ln E_{77}, and ln RLP_{87} − ln RLP_{77}, respectively. Numbers in parentheses are t-ratios.

*Significant at the 1 percent level.

+Significant at the 5 percent level.

For the wage equation (cols. [1] and [2]), the ACQUIRER coefficient is about −0.08 and that for the interaction term, ln E_{77} * ACQUIRER, is 0.01. These estimates imply that the wage growth of a typical acquiring firm—a firm with average (log) employment of 5.65—is about 2.5 percent higher than that of a typical nonacquiring firm, but the result is not statistically significant. This estimate is consistent with the Brown and Medoff (1988) firm-level finding that the impact of acquisition on wages is small.

Columns (3) and (4) present estimated coefficients for the employment equations. The coefficient for ACQUIRER is 0.166 and that for ln E_{77} * ACQUIRER is 0.068 (col. [4]), indicating that, on average, the employment growth of acquiring firms is about 55.2 percent (= 0.166 + 0.068(5.65)) higher than that of nonacquiring firms. While this estimate is not statistically significant, it appears to be economically significant. Acquiring firms do not appear to reduce their workforces.

Finally, columns (5) and (6) show estimated coefficients for the productivity growth equations. The estimated coefficient for the ACQUIRER variable is about −0.200 and that for ln E_{77} * ACQUIRER is 0.006. These estimates imply labor productivity growth for an average acquiring firm about 16.5 percent lower than that for an average nonacquiring firm. While economically significant, the estimated coefficients are statistically insignificant. The negative coefficients for ACQUIRER are consistent with the figures reported in table 6.3 showing that the average relative labor productivity of multiunit acquiring firms declined from 1.14 in 1977 to 1.08 in 1987, while that of multiunit nonacquiring firms increased from 0.97 to 1.02. More generally, these results are consistent with many studies of mergers and acquisitions that suggest there has been little gain to acquiring firms after merger (see, e.g., Ravenscraft and Scherer 1987). Before drawing any conclusions we turn to analysis with the plant-level data. The figures in table 6.4 show vastly different performance among the various components of both acquiring and nonacquiring firms. The plant-level data allow us to directly model these differences and to isolate the effects of ownership change on the performance of acquiring firms.

6.6.2 Plant-Level Results

Wage Change Equation

Table 6.6 reports the coefficients for the wage equations estimated using plant-level data.[17] The variable OC has a value of one if a plant had ownership change in either the 1977–82 or the 1983–87 period. In addition, we introduce two variables: $OC_{77\text{-}82}$ equals one if a plant had ownership change between 1977 and 1982 and zero otherwise, and $OC_{82\text{-}87}$ equals one if it was purchased between 1982 and 1987 and zero otherwise. This specification allows us to isolate the impacts in each subperiod of the 1972–87 period. In the plant-level specifications, we also introduce a new variable, $OWNPLT_{AF}$, which equals one if a plant is initially owned by an acquiring firm in 1977 and operates through 1987 and zero otherwise. The omitted category is nonacquiring firms' own plants. Other variables are defined as before. Models II, IV, and VI use four-digit industry dummies as control variables, while models I, III, and V do not.[18]

Columns (1) and (2) of table 6.6 show estimated coefficients for the linear wage equation model. The coefficient for the OC variable is negative and insignificant (model I). It is only marginally significant when four-digit industry dummies are incorporated into the model (model II). With the nonlinear models (models III and IV), the coefficient for OC is positive and highly significant and that for ln E_{77} * OC is significantly negative. The significance of the inter-

17. Inclusion of non-food-manufacturing plants owned by food-manufacturing firms does not alter the results.

18. Because the dependent variables are in growth rates, the sample used in this regression analysis does not include closed plants and new plants.

Table 6.6 **Wage Change Equation: Food Plant Data**

Independent Variable	Model I (1)	Model II (2)	Model III (3)	Model IV (4)	Model V (5)	Model VI (6)
Intercept	.494*	.757*	.490*	.754*	.485*	.732*
	(14.8)	(20.4)	(14.8)	(20.4)	(19.6)	(19.6)
OC	−.012	−.020+	.508*	.387*		
	(1.2)	(1.9)	(13.0)	(10.2)		
$OC_{77\text{-}82}$					.470*	.377*
					(8.3)	(7.0)
$OC_{83\text{-}87}$					.599*	.465*
					(11.3)	(9.1)
$OWNPLT_{AF}$					.403*	.278*
					(9.8)	(6.8)
ln E_{77}	.125*	.132*	.134*	.138*	.140*	.144*
	(55.4)	(54.5)	(54.0)	(55.2)	(49.0)	(50.9)
ln W_{77}	.374*	−.471*	−.373*	−.468*	−.379*	−.465*
	(34.2)	(40.4)	(34.6)	(40.4)	(35.1)	(40.1)
ΔTECH	.085*	.074*	.046*	.035*	.048*	.035*
	(16.8)	(15.3)	(9.1)	(7.1)	(9.2)	(7.2)
ln E_{77}*OC			−.113*	−.089*		
			(13.8)	(11.3)		
ln E_{77}*$OC_{77\text{-}82}$					−.115*	−.095*
					(9.6)	(8.3)
ln E_{77}*$OC_{83\text{-}87}$					−.127*	−.104*
					(11.7)	(9.9)
ln E_{77}*$OWNPLT_{AF}$					−.083*	−.063*
					(9.5)	(7.2)
ξ	.262*	.272*	.262*	.273*	.259*	.271*
	(47.3)	(50.3)	(47.9)	(50.9)	(4.73)	(50.5)
Four-digit industry	No	Yes	No	Yes	No	Yes
R^2	.450	.576	.462	.523	.469	.526
n	8,955	8,955	8,955	8,955	8,955	8,955

Notes: Dependent variable is ln W_{87} − ln W_{77}. Numbers in parentheses are t-ratios.

*Significant at the 1 percent level.

+Significant at the 5 percent level.

action term indicates that a nonlinear model is more appropriate than a linear model.

Models III and IV indicate that the wages of smaller plants increase more quickly if they have an ownership change. But larger plants increase wages faster if they do not undergo ownership change. More specifically, the estimate of 0.387 for OC and −0.089 for ln E_{77} * OC (with the mean of ln E_{77} equal to 3.00) implies that a typical acquired plant increased its workers' wages 12 percent (= 0.387 − 0.089(3)) faster than a plant owned by a nonacquiring firm.[19]

19. The exact size at which performance of nonacquirers exceeds acquirers is sensitive to the sample of plants and model specification. Nonetheless, the size cutoff is always well above the third quantile of the employment size distribution and usually falls in the top 10 to 20 percentiles.

While for many questions the behavior of a typical plant is a key issue, for many others the effect on a typical worker is of interest. We assess the latter using the (employment size) weighted average of the estimated effect of ownership change on the dependent variable (wage growth). We find this weighted average effect is positive, indicating that the wage growth of a typical worker in acquiring firms is 1.4 percent higher than that of a typical worker in nonacquiring firms. This figure is much smaller than that found for the typical acquired plant because a typical worker is more likely to work in a large plant than in a small plant. Thus the slower growth in wages at large plants affects more workers. Nevertheless, using either the unweighted or weighted figure, ownership change has a positive effect on wages.

A key question is whether this gain in wages for workers in acquired plants is achieved at the expense of workers in other plants of the firm. Columns (5) and (6) show estimates for models V and VI, which classify acquiring firms' plants into three groups: plants acquired between 1977 and 1982 ($OC_{77\text{-}82}$), plants acquired between 1982 and 1987 ($OC_{82\text{-}87}$), and acquiring firms' surviving plants ($OWNPLT_{AF}$). The coefficients for $OC_{77\text{-}82}$ and $OC_{82\text{-}87}$ are significantly positive, and the corresponding interaction terms are significantly negative. This is in accord with the estimate of ownership change discussed above: except for a subset of large plants, plants having ownership change tend to increase wages more quickly than plants that do not change ownership. Using the coefficients of model VI (col. [6]) and keeping employment fixed at the mean plant size, we find that typical plants acquired during 1977–82 and 1982–87 outperformed the corresponding nonacquiring firms' plants in terms of wage growth by 9.2 and 15.3 percent, respectively. The corresponding (employment) weighted figures are −2.2 percent and 2.9 percent, indicating that typical workers in plants acquired during 1977–82 were worse off, while typical workers in plants acquired during 1982–87 were better off, compared with workers in plants owned by nonacquiring firms.

Turning to the workers in acquiring firms' plants owned prior to acquisition, we estimate the coefficients for $OWNPLT_{AF}$ and $\ln E_{77} * OWNPLT_{AF}$ as 0.278 and −0.063, respectively. These coefficients indicate that wage growth in acquiring firms' own plants is about 9 percent higher than in plants of nonacquiring firms. The corresponding employment-weighted figure is 5.5 percent. Thus a typical worker in an acquiring firm's own plant also experiences wage gains relative to a typical worker in a nonacquiring firm.

Employment Change Equation

Columns (1) and (2) of table 6.7 report estimated coefficients for the linear employment models, while the remaining columns show estimated coefficients for nonlinear models. The estimated coefficients for OC in both linear and nonlinear models are significantly positive, indicating that acquired plants' employment grew faster than that of nonacquired plants. Using the estimates from model IV and fixing employment at mean plant size, we find that, on average, acquired plants increased employment faster than nonacquiring firms' plants

Table 6.7 **Employment Change Equation: Food Plant Data**

Independent Variable	Model I (1)	Model II (2)	Model III (3)	Model IV (4)	Model V (5)	Model VI (6)
Intercept	−.147*	−.480*	−.140⁺	.493*	−.057	−.412*
	(2.3)	(6.7)	(2.2)	(6.8)	(0.91)	(5.6)
OC	.114*	.119*	.033	.239*		
	(6.0)	(6.3)	(0.4)	(3.3)		
$OC_{77\text{-}82}$					−.150	.033
					(1.4)	(0.3)
$OC_{83\text{-}87}$					.067	.357*
					(0.7)	(3.6)
$OWNPLT_{AF}$					−.434*	−.004
					(5.6)	(0.1)
ln E_{77}	−.155*	−.183*	−.156*	−.181*	−.181*	−.200*
	(31.5)	(36.1)	(30.1)	(33.9)	(29.5)	(32.5)
ln W_{77}	.209*	.387*	.209*	.389*	.203*	.374*
	(18.3)	(17.3)	(10.3)	(17.3)	(10.0)	(16.7)
ΔTECH	.351*	.354*	.351*	.353*	.351*	.355*
	(35.7)	(36.9)	(35.9)	(36.8)	(36.0)	(37.09)
ln E_{77}*OC			.018	−.026		
			(1.1)	(1.7)		
ln E_{77}*$OC_{77\text{-}82}$					.069*	.239
					(3.0)	(1.3)
ln E_{77}*$OC_{83\text{-}87}$					.021	−.038⁺
					(1.0)	(1.9)
ln E_{77}*$OWNPLT_{AF}$					.116*	.033⁺
					(7.0)	(2.0)
					(7.0)	(2.0)
Four-digit industry	No	Yes	No	Yes	No	Yes
R^2	.226	.286	.228	.288	.277	.293
n	8,955	8,955	8,955	8,955	8,955	8,955

Notes: Dependent variable is ln E_{87} − ln E_{77}. Numbers in parentheses are t-ratios.

*Significant at the 1 percent level.

⁺Significant at the 5 percent level.

by 16.1 percent (i.e., 0.239 − 0.026(3) = 0.161). The employment-weighted figure is 13.0 percent.

When we split the OC variable into two variables, $OC_{77\text{-}82}$ and $OC_{82\text{-}87}$, the estimated coefficient for $OC_{77\text{-}82}$ is 0.033 and that for ln E_{77} * $OC_{77\text{-}82}$ is 0.029, indicating that growth in a typical plant acquired between 1977 and 1982 is about 12 percent higher than that in a nonacquiring firm's plant. Weighting the estimates by employment, we find this effect to be even higher, about 15.5 percent. Note that, although these figures appear to be economically significant, they are not statistically significant. For the 1982–87 period, the estimated coefficients for $OC_{82\text{-}87}$ and ln E_{77} * $OC_{82\text{-}87}$ are 0.357 and −0.038. Both are statistically significant. These estimates imply that a typical plant acquired during 1982–87 had an employment growth rate about 24 percent higher than

that of a typical plant of a nonacquiring firm. The employment-weighted effect is about 20 percent.

Finally, the coefficient for $OWNPLT_{AF}$ is -0.004 and is not statistically significant, while that for $\ln E_{77} * OWNPLT_{AF}$ is 0.033 and is significant at the 5 percent level. These coefficients imply that a typical previously owned plant of an acquiring firm had an employment growth rate 9.5 percent higher than that of a typical plant of a nonacquiring firm. The weighted figure is even higher at 13.5 percent. These estimates suggest that the increase in employment at acquired plants did not come at the expense of workers in existing plants.

Productivity Change Equations

Table 6.8 reports results for the productivity equation. The coefficient for OC is negative in the linear models (cols. [1] and [2]). It, however, becomes significantly positive in the nonlinear models (cols. [3]–[6]). The coefficient for $\ln E_{77} * OC$ is also significant in the nonlinear models. Columns (5) and (6) show that the coefficients for $OC_{77\text{-}82}$ are significantly positive, indicating that productivity grew faster for plants acquired during 1977–82 than for nonacquiring firms' plants. This result holds whether or not four-digit dummies are incorporated in the regressions. The coefficients for $OC_{83\text{-}87}$ are negative and insignificant, indicating that plants changing ownership just before 1987 did not perform better than nonacquiring firms' plants. These results are consistent with the data, reported earlier in table 6.4, that showed that the productivity of plants purchased during 1977–82 grew 4.0 percent (from 1.02 in 1977 to 1.06 in 1987), while the productivity of plants acquired during 1982–87 declined by 3.0 percent (from 1.01 in 1977 to 0.98 in 1987). One explanation for this is that it takes some time for acquiring firms to integrate purchased plants into their operations. For this reason, and because preliminary work with other industries suggests the positive effect is robust, we give more credence to the results for ownership changes for the 1977–82 period.

Using the estimates of model VI and fixing employment at mean plant size, we find that productivity for a typical plant acquired during 1977–82 grew faster than that for a plant owned by a nonacquiring firm (by 16.2 percent [i.e., $0.459 - 0.099(3) = 0.162$]). This advantage for acquired plants diminishes as plant size increases. To be exact, when $\ln E = 4.64$ (i.e., $0.459/0.099 = 4.64$, the eightieth percentile value of the sample) the productivity of both types of plants grew at the same rate. Beyond this size—about twice the average size in our sample—the productivity of acquiring firms' plants grew more slowly than for nonacquired plants. The weighted estimates suggest that the plants acquired during 1977–82 had a 4.4 percent higher productivity growth rate than nonacquired plants.

The coefficients for $OWNPLT_{AF}$ and $\ln E_{77} * OWNPLT_{AF}$ are 0.580 and -0.115. Both are statistically significant at the 1 percent level. These estimates suggest that labor productivity for a typical existing plant is 23.5 percent

Table 6.8 **Productivity Change Equation: Food Plant Data**

Independent Variable	Model I (1)	Model II (2)	Model III (3)	Model IV (4)	Model V (5)	Model VI (6)
Intercept	−.239*	−.089*	−.251*	−.084+	−.268*	−.088*
	(13.0)		(10.2)	(2.3)	10.7)	(2.5)
OC	−.127*	−.123*	.194*	.104		
	(6.0)	(6.0)	(2.5)	(1.4)		
$OC_{77\text{-}82}$					.535*	.459*
					(4.8)	(4.3)
$OC_{83\text{-}87}$					−.084	−.167
					(0.8)	(1.5)
$OWNPLT_{AF}$					.617*	.580*
					(7.5)	(7.0)
ln RLP_{77}	−.220*	−.205*	−.228*	−.227*	−.247*	−.243*
	(38.7)	(35.6)	(12.6)	(12.9)	(13.4)	(13.6)
ln E_{77}	.086*	.101*	.091*	.100*	.096*	.099*
	(18.5)	(21.2)	(13.8)	(15.2)	(13.5)	(14.1)
ΔTECH	.142*	.169*	.141*	.168*	.141*	.167*
	(14.4)	(17.6)	(14.3)	(17.5)	(14.3)	(17.5)
ln E_{77}*OC			−.069*	−.049*		
			(4.2)	(3.1)		
ln E_{77}*$OC_{77\text{-}82}$					−.118*	−.099*
					(5.0)	(4.3)
ln E_{77}*$OC_{83\text{-}87}$					−.041	−.020
					(1.8)	(.9)
ln E_{77}*$OWNPLT_{AF}$					−.130*	−.115*
					(7.5)	(6.6)
ln E_{77}*ln RLP_{77}			.001	.005	.008	.011*
			(.3)	(1.2)	(1.6)	(2.5)
Four-digit industry	No	Yes	No	Yes	No	Yes
R^2	.191	.267	.193	.268	.203	.277
n	8,955	8,955	8,955	8,955	8,955	8,955

Notes: Dependent variables is ln E_{87} − ln RLP_{77}. Numbers in parentheses are t-ratios.

*Significant at the 1 percent level.

+Significant at the 5 percent level.

higher for an acquiring firm than for a nonacquiring firm. Using weighted estimates, we also find that productivity growth is higher in acquiring firms' own plants than in nonacquiring firms' plants by about 10 percent.

Plant Closing Equation

The probit regression results reported in table 6.9 show that the coefficients for $OC_{77\text{-}87}$ are negative and significant in all models. This indicates that plants experiencing ownership change are less likely to be closed than plants not changing owners. The coefficient for $OWNPLT_{AF}$ is negative and significant with the linear models (models I and II); however, this coefficient becomes significantly positive in the nonlinear models (models III and IV). The coeffi-

Table 6.9 **Probit Regressions of Plant Closure**

Independent Variable	Model I (1)	Model II (2)	Model III (3)	Model IV (4)
Intercept	.315*	.887*	.809*	.931*
	(.009)	(.017)	(.025)	(.032)
$OC_{77\text{-}87}$	−1.266*	−.926*	−1.520*	−1.372*
	(.025)	(.026)	(.089)	(.090)
$OWNPLT_{AF}$	−.428*	−.076*	.671*	.861*
	(.024)	(.026)	(.095)	(1.00)
ln E_{77}		−.203*	−.186*	−.263*
		(.005)	(.008)	(.016)
ln RLP_{77}		−.053*	−.045⁺	−.029*
		(.009)	(.022)	(.028)
ln E_{77}^2				.012*
				(.002)
ln RLP_{77}^2				.006*
				(.001)
$OC_{77\text{-}78}$*ln E_{77}			.139*	.113
			(.018)	(.018)
$OC_{77\text{-}87}$*ln RLP_{77}			−.012	−.050⁺
			(.027)	(.027)
$OWNPLT_{AF}$*ln E_{77}			−.128*	−.166*
			(.019)	(.020)
$OWNLPT_{AF}$*ln RLP_{77}			−.147*	−.169*
			(.023)	(.024)
ln E_{77}*ln RLP_{77}			−.022*	−.013
			(.007)	(.008)
n	28,236	28,236	28,236	28,236

Notes: Dependent variable is plant closure (equals one if the plant was closed by 1987, zero otherwise). Numbers in parentheses are standard errors.

*Significant at the 1 percent level.

⁺Significant at the 5 percent level.

cients for the interaction terms $OWNPLT_{AF}$ * RLP_{77} and $OWNPLT_{AF}$ * ln E_{77} are negative and significant. These estimates imply that small plants originally owned by acquirers are more likely to be closed than those owned by nonacquirers. However, for larger plants nonacquirers are more likely to close plants than acquirers. To better assess the probability of plant closure, we used the parameter estimates for a probit model reported in table 6.8 to estimate the probabilities of plant closure for plants that experienced ownership change and plants originally owned by acquirers and nonacquirers.

The results reported in table 6.10 show that plants owned by nonacquirers were most likely to be closed and plants that had ownership change are most likely to survive. The unconditional probability of closure (model I) for plants owned by nonacquirers is .62, while that for plants having ownership change is .17. The probability of closing for acquirers' own plants is .46. When con-

Table 6.10 **Probabilities of Plant Closings**

Plant Type	Model I	Model II	Model III	Model IV
Plant had ownership change	.1708	.1525	.1329	.1519
Acquirer's own plants	.4550	.4323	.3838	.4120
Nonacquirer's own plants	.6236	.6322	.6011	.6326

trolling for initial productivity and employment size and allowing nonlinearity, we find similar results. The evidence suggests that plants changing owners had a much greater chance to survive than plants not changing owners. Acquirers' own plants are less likely to be closed than those originally owned by nonacquirers.

6.7 Discussion

Our regression results can be summarized as follows. The firm-level results suggest that, on average, acquiring firms increased both employment and wages faster than nonacquiring firms. Using the firm-level specifications, the rate of increase for employment is 55 percent faster, while that for wages is in the 2.5–3.0 percent faster range. However, acquiring firms' labor productivity grew about 16.5 percent slower. While these estimates—especially those for employment and productivity—are large in magnitude, they are not statistically significant.

At first glance, these estimates, especially the 55 percent figure, seem to be economically significant; but they are misleading because comparing a *whole* firm before and after ownership change does not isolate the effects of ownership change on the firm. Ownership change is one of many changes in composition that typically occur in acquiring firms. The possibilities for misinterpretation of a firm-level change can be illustrated by considering, for example, a firm with 50 employees in 1977 that purchases another firm that also has 50 employees in 1977. If the acquiring firm has 90 workers in 1987, one might conclude that its employment increased by 80 percent, from 50 to 90 employees. However, the true effect of this acquisition is a 10 percent decline in total employment: the combined firm fell from 100 to 90 employees. (A more sophisticated way to estimate the impact of mergers might include projections of each plant's employment growth based on the average growth for plants classified in the same industry and then do the calculation.) The key issue is knowing what to hold constant in assessing the impact of mergers.

Using the plant-level specifications, we found a typical plant acquired during 1977–82 showed increases in wages, employment, and labor productivity of about 12, 16, and 16 percent, respectively, higher than for the typical plant of a nonacquiring firm. The growth rates of productivity and employment of the typical worker in plants acquired during 1977–82 were also higher, about 4.5 and 13 percent, respectively. However, the growth rate of wages for a typi-

cal worker in nonacquiring firms' plants was about 2 percent lower than that of a typical worker in acquired plants during this period. The results for the 1982–87 subperiod were similar except for productivity, for which we found insignificant effects. As we noted, we think this is because integration of acquired properties takes time and productivity gains probably lag labor force adjustments. The growth rates of employment, wages, and productivity at the typical acquiring firm's existing plant grew about 9, 9.5, and 23.5 percent, respectively, faster than those of a typical nonacquiring firm's plant. The typical worker in these plants also gained in wages, employment, and productivity growth, about 5.5, 13.5, and 10 percent, respectively, higher than the corresponding growth rates for a typical worker in nonacquiring firms' plants.

The above results show that ownership change had stronger positive effects on the typical plant than on the typical worker, particularly with respect to wages and productivity. For example, the growth rate of wages at a typical acquired plant was about 12 percent higher than that at a typical plant of an acquiring firm, whereas the typical worker in an acquired plant enjoyed wage growth only about 1.4 percent higher than that of a typical worker in a nonacquiring firm. Similarly, productivity growth in a typical plant acquired during 1977–82 increased about 16 percent more than that in a typical nonacquiring plant. In contrast, the typical worker employed in a plant acquired during 1977–82 worked in a plant with a productivity growth increase only about 4.0 percent higher than that of a plant that employed a typical nonacquiring firm worker. The reason for these differences is that wages and productivity grew more slowly in large acquired plants than in smaller plants. Because the large plants employed a substantial number of workers, weighting the effect of ownership change by employment reduces the measurement effect on a typical worker.

Comparing the plant-level results to those obtained using firm-level data, we find that both suggest ownership change has positive effects on employment and wages. But with respect to productivity, the firm-level results suggest a negative effect of ownership change, while the plant-level results show a positive effect of ownership change on labor productivity, especially for plants that were acquired during 1977–82. But all the estimates associated with ownership change in the firm-level regressions are statistically insignificant. In contrast, the plant-level results are generally significant and positive. As already discussed, while firm-level regressions fail to capture changes in the composition of the firm, plant-level specifications account for individual components of the firm. Thus they allow us to isolate the effects of ownership change.

The finding that wages of workers in the typical acquired plant grew faster than those in the typical nonacquiring firm's plant is striking and does not support the notion that acquisitions and mergers cut wages. This result holds for all plants undergoing ownership change in both the 1977–82 and 1982–87 periods, even after controlling for the effects of plant initial employment, size,

wages, productivity, changes in technology, and (four-digit) industry. This result is inconsistent with both Brown and Medoff's (1988) and Lichtenberg and Siegel's (1992a) findings that wage changes associated with ownership change are relatively small. However, the Brown-Medoff evidence is based on firm-level data. In this regard, our results are not inconsistent with theirs. The difference between Lichtenberg and Siegel's results and ours needs to be explained because both studies use plant-level data.

As discussed before, Lichtenberg and Siegel use a sample of very large plants, but we think the difference is mainly due to the fact that they classify plants in their sample into only two categories: acquired plants and nonacquired plants. In contrast, we classify plants into four categories: plants acquired during 1977–82, plants acquired during 1982–87, acquiring firms' existing (own) plants, and nonacquiring firms' existing (own) plants. Lichtenberg and Siegel's categorization puts acquiring firms' existing own plants together with nonacquiring firms' own plants in one group and compares them with all acquired plants. Because employment, wages, and productivity of acquiring firms' existing own plants grew faster than those of nonacquiring firms' plants, grouping these plants together would bias the results.

Our finding that ownership change has a significant, positive effect on plants' employment growth is not consistent with the findings of either Lichtenberg and Siegel or Brown and Medoff. Again, we think that this difference is due to our explicit introduction of individual components of firms into the regression. Moreover, in contrast to Lichtenberg and Siegel, who use data for large plants, we include small-plant data in our sample. In view of our results that large acquired plants increase their employment relatively slowly, their finding of a negative (but small) effect of ownership change on employment is not surprising. Overall, we find no evidence supporting the hypothesis that ownership change destroys jobs by either reducing employment in surviving plants or increasing the probability of plants' closing. This, together with the result that acquired plants are less likely to be closed than nonacquiring firms' plants, provides strong evidence against the notion that mergers and acquisitions reduce employment.

Finally, when using the firm as the unit of analysis, we find no statistically significant effects of ownership change on productivity, wages, and employment.[20] This result is extremely important. It points to the fact that assessing the impact of ownership change (including mergers and acquisitions) on the structure and performance of firms requires a careful look at individual components—establishments—of the firms. Mueller (1993) correctly pointed out that "any *real* consequences of a merger must come about through changes in the development of one or both joining units that can be attributed to the merger in the following years" (emphasis in original). Our firm-level results

20. McGuckin and Nguyen (1995) use firm-level data to estimate productivity growth equations in which acquiring firms are classified into two groups: full mergers and divestitures. They obtain similar results for both groups.

demonstrate that simply looking at the performance of firms before and after ownership change fails to capture the effects of ownership change and the different factors at work.

Before concluding, we note that our data do not cover auxiliary establishments. Lichtenberg and Siegel (1992b) find that failure to account for auxiliary establishments leads to an underestimate of productivity gains associated with ownership change. However, this indicates that including auxiliary establishment data would strengthen, rather than weaken, our finding that ownership change improved productivity.

Regarding wages and employment, if ownership change results in reduced wages and employment in auxiliary establishments as indicated by the Lichtenberg-Siegel study, our estimates of employment and wage growth are likely to be biased upward. We note, however, that this bias is most likely to be serious in the case of large multiunit firms. For smaller firms, the bias may be less important; and it does not exist in the case of single-unit firms.

6.8 Concluding Remarks

A wide range of recent empirical work with establishment-level data finds within-industry differences between establishments to be the major source of variation in productivity, wages, and jobs. For example, Davis, Haltiwanger, and Schuh (1996) report a greater range of variation in job changes between plants in the steel industry than the range of difference between the average establishments in the steel and textile industries. Similarly, Davis and Haltiwanger (1992) and Bernard and Jensen (1994) show that most of the variation in wages occurs within industries. Moreover, Baily et al. (1992) demonstrate that the within-industry variation in productivity growth is primarily associated with movements between establishments. In the Baily et al. study it is gains in market share by high-productivity plants and the exit of low-productivity plants that drive industry-level changes in productivity. Entry plays a significant but much smaller role in productivity growth, according to these studies. Taken together, these studies convincingly demonstrate that between-plant variation is important for productivity, wages, and job reallocations.

The evidence developed in this study shows that, at least for food industry establishments, ownership change is associated with increased productivity and employment growth. For wages the impacts are very small. Acquiring firms are high-productivity firms that acquire plants with above average productivity and improve them. This suggests that ownership change is an important part of the process of reallocating resources from lower to higher valued plants found in these earlier plant-level studies. The result that ownership change is associated with productivity growth appears robust across the U.S. manufacturing sector for the period studied, the late 1970s and 1980s.[21] Thus,

21. Our preliminary results based on data for the entire manufacturing sector appear to be consistent with those based on data for the food industry.

ownership change fits well within a framework emphasizing productivity growth through reallocations of labor from lower to higher productivity firms. While the benefits associated with changing ownership—movement of resources from lower to higher valued uses—may be large, the costs also can be significant. The often expressed hostility toward mergers—by labor unions and the press—reflects the view that the costs are high. Typically cited effects of ownership change are closed plants and shifts of production to areas with low labor costs. The combination of high costs and benefits makes the study of ownership change a prime area for applied research.

While we think this work is in the right direction, the results obtained should be considered suggestive rather than conclusive. Several reasons for this have been discussed. First, we use data for only one industry, although it is one of the most active in terms of ownership change in the period we study. Second, we do not include data for central offices in the analysis. Third, our models do not take into account potential endogeneity of ownership change, and hence, the results may be subject to simultaneity biases. Finally, our data cover only the 1977–87 period, and therefore other merger waves are excluded from the analysis. Despite these shortcomings, we think the results strongly suggest that ownership change is an important avenue for enhancing productivity in job reallocation. Most important, we think that further examination of this issue must proceed with plant-level models.

In closing, we note that we plan to continue this line of research on several fronts. Our immediate plan is twofold: to extend the data set in time to account for more than one merger wave and to include other industries. We also plan to extend the data set to include data for auxiliary establishments such as central offices. Finally, rather than looking at total employment, further research should treat production workers and nonproduction workers separately. This would shed more light on the impact of ownership change on wages and shifts in the skill distribution of workers within the firm.

References

Baily, M. N., E. J. Bartelsman, and J. C. Haltiwanger. 1994. Downsizing and productivity growth: Myth or reality? Discussion Paper no. CES 94-4. Washington, D.C.: U.S. Bureau of the Census, Center for Economic Studies.

Baily, M. N., D. Campbell, and C. Hulten. 1992. Productivity dynamics in manufacturing plants. *Brookings Papers on Economic Activity: Microeconomics*, 187–249.

Baldwin, J. 1995. Turnover and productivity growth. In *The dynamics of industrial competition*, ed. J. Baldwin, 208–38. Cambridge: Cambridge University Press.

Berle, A. A., and G. C. Means. 1932. *The modern corporation of private property*, New York: Commerce Clearing House (rev. ed.; New York: Harcourt, Brace and Jovanovich, 1968).

Bernard, A. B., and J. B. Jensen. 1994. Exporters, skill-upgrading, and the wage gap.

Discussion Paper no. CES 94–13. Washington, D.C.: U.S. Bureau of the Census, Center for Economic Studies.

Brown, C., J. Connor, S. Heeringa, and J. Jackson. 1990. Studying (small) businesses with the Michigan Employment Security Commission longitudinal data base. *Small Business Economics* 2:261–77.

Brown, C., and J. L. Medoff. 1988. The impact of firm acquisition on labor. In *Corporate takeovers: Causes and consequences*, ed. Alan J. Auerbach, 9–25. Chicago: University of Chicago Press.

Carliner, G. 1988. The impact of acquisition on labor: Comment. In *Corporate takeovers: Causes and consequences*, ed. Alan J. Auerbach, 25–28. Chicago: University of Chicago Press.

Christensen, L. R., D. Cumming, and D. W. Jorgenson. 1981. Relative productivity levels, 1947–1973: An international comparison. *European Economics Review*, 16: 61–94.

Cole, S. J., J. Petrik, and R. E. Struble. 1995. The relation between the Standard Statistical Establishment List and Manufacturing Establishment Surveys. MCD Working Paper no. Census/MCD/WP-95/02. Washington, D.C.: U.S. Bureau of the Census, Manufacturing and Construction Division.

Connor, J. H., M. Converse, S. G. Heeringa, and J. E. Jackson. 1984. The Michigan Employment Security Commission longitudinal database of Michigan businesses. Ann Arbor: University of Michigan, Institute for Social Research, Survey Research Center.

Davis, S. J., and J. Haltiwanger. 1992. Gross job creation, gross job destruction, and employment reallocation. *Quarterly Journal of Economics* 107:819–63.

Davis, S. J., J. Haltiwanger, and S. Schuh. 1996. *Gross job flows in U.S. manufacturing.* Cambridge, Mass.: MIT Press.

Dunne, T., and M. J. Roberts. 1993. The long-run demand for labor: Estimates from census establishment data. Discussion Paper no. CES 93-13. Washington, D.C.: U.S. Bureau of the Census, Center for Economic Studies.

Farber, H. S. 1988. The impact of firm acquisition on labor: Comment. In *Corporate takeovers: Causes and consequences*, ed. Alan J. Auerbach, 28–31. Chicago: University of Chicago Press.

Jensen, M. C. 1993. Corporate control and the politics of finance. *Bank America Journal of Applied Corporate Finance* 4 (2): 13–33.

Jensen, M. C., and R. S. Ruback. 1983. The market for corporate control: The scientific evidence. *Journal of Financial Economics* 11:5–50.

Lichtenberg, F., ed. 1992. *Corporate takeovers and productivity.* Cambridge, Mass.: MIT Press.

Lichtenberg, F., and D. Siegel. 1992a. Productivity and changes in ownership of manufacturing plants. In *Corporate takeovers and productivity*, ed. F. Lichtenberg, 25–43. Cambridge, Mass.: MIT Press.

———. 1992b. Takeovers and corporate overhead. In *Corporate takeovers and productivity*, ed. F. Lichtenberg, 45–67. Cambridge, Mass.: MIT Press.

Matsusaka, J. G. 1993a. Takeover motives during the conglomerate merger wave. *Rand Journal of Economics* 24:357–79.

———. 1993b. Target profits and managerial discipline during the conglomerate merger wave. *Journal of Industrial Economics* 41:179–89.

McGuckin, R. H. 1995. Establishment microdata for economic research and policy analysis: Looking beyond the aggregates. *Journal of Business and Economic Statistics* 13 (1): 121–26.

McGuckin, R. H., and S. V. Nguyen. 1994. On productivity and plant ownership change: New evidence from the LRD. *Rand Journal of Economics* 26 (2): 257–76.

———. 1995. Exploring the role of acquisition in the performance of firms: Is the

"firm" the right unit of analysis? Discussion Paper no. CES 95-13. Washington, D.C.: U.S. Bureau of the Census, Center for Economic Studies.
McGuckin, R. H., and G. Pascoe. 1988. The Longitudinal Research Database: Status and research possibilities. *Survey of Current Business* 68:30–37.
Michigan Employment Security Commission (MESC). 1995. Overview of unemployment insurance taxes. From the Internet: http://www/mesc.state.mi.us/mesc/empirhb/taxover1.htm.
Mueller, D. C. 1969. A theory of conglomerate mergers. *Quarterly Journal of Economics* 83:643–59.
———. 1993. Mergers: Theory and evidence. In *Mergers, markets, and public policy*, ed. Gallium Mussati. Dordrecht: Kluwer.
Ravenscraft, D. J., and F. M. Scherer. 1987. *Mergers, selloffs, and economic efficiency*. Washington, D.C.: Brookings Institution.
Shleifer, A., and R. W. Vishny. 1989. Management entrenchment: The case of manager-specific investments. *Journal of Financial Economics* 25:123–39.
U.S. Bureau of the Census. 1979. The Standard Statistical Establishment List program. Washington, D.C.: U.S. Department of Commerce.
———. 1992. Longitudinal Research Database technical documentation. Washington, D.C.: U.S. Department of Commerce.

Comment

Frank R. Lichtenberg

This paper represents a very useful extension and contribution to the literature on the "real" (ex post) effects of ownership change (as opposed to its effects on investor expectations, as measured in "event studies" of stock prices). The period studied in the paper (1977–87) is more recent than that studied in Lichtenberg and Siegel's (1987) analysis of 1972–81 ownership changes (although Lichtenberg and Siegel 1990a studied the effects of leveraged buyouts—a specific type of ownership change—that occurred through 1986). Hence, the authors' sample period includes most of the takeover wave of the 1980s. Their sample also includes a substantial number of small plants, whereas previous studies were based primarily on large plants.

On the other hand, they study a single industry—food manufacturing—whereas previous studies of ownership change have analyzed data for the entire manufacturing sector, if not also nonmanufacturing industries. (I have no particular reason to believe that the food industry is atypical with regard to the effects of ownership change, however.) Their sample also excludes central administrative offices and auxiliary establishments; Lichtenberg and Siegel (1990b) showed that the largest (most negative) employment and wage responses to ownership change often occur in these establishments and that these need to be accounted for to obtain accurate estimates of productivity effects.

Frank R. Lichtenberg is the Courtney C. Brown Professor of Business at the Columbia University Graduate School of Business and a research associate of the National Bureau of Economic Research.

Ownership change is a reasonably frequent event: about 10 to 15 percent of workers are employed in plants that will be acquired in the next five years, and 50 percent of workers are employed by firms that will engage in acquisitions in that period. The authors make a convincing case that using firm-level data to determine the effects of ownership change is far from optimal and may yield quite distorted estimates of these effects. This is not very surprising, since many changes in ownership involve only parts (often small parts) of firms; for example, a firm may decide to "spin off" one of its minor divisions.

I will therefore focus on their plant-level analysis of the effects of ownership change. The authors reexamine the question of whether it is relatively efficient (high productivity level) or inefficient plants that are most likely to subsequently undergo ownership change. The authors find that *among large plants* the correlation between initial productivity and ownership change is negative: inefficient plants are more likely to subsequently change owners. This is consistent with Lichtenberg and Siegel's (1987) findings, which were also based primarily on large plants.

However, when they include small as well as large plants in their sample, they reach the opposite conclusion: "It is high, not low, productivity establishments that are most likely to experience ownership change." Thus the negative correlation between initial productivity and ownership change (which is implied by the "managerial discipline theory" of ownership change) "only" applies to large plants. *But most people are employed, most wages are paid, and most output is produced in large plants.* In 1982, for example, there were 335,000 small establishments (less than 250 employees) and 13,000 large establishments (250 or more employees) in U.S. manufacturing, but large establishments employed more people and their aggregate value added and investment were respectively about 60 and 94 percent larger than those of small establishments.

The finding that there are significant differences between the ownership change behavior of small and large plants is certainly interesting and merits further study and explanation. But in their analysis of the full sample of plants, the authors implicitly give equal weight to large and small plants; since small plants are far more numerous, their overall estimates are dominated by these plants. This does not seem to be the appropriate way to determine the aggregate or (weighted) average effect of ownership change.

In the conclusion of the paper, the authors claim that "ownership change is associated with increased productivity and employment growth." But their estimates of the productivity change equation based on plant-level data (reported in table 6.8) do not seem to support this. These estimates are fairly unstable, and it is difficult to know what we can conclude from them. In the simplest models (I and II) of productivity change, the coefficient on ownership change is *negative* and significant. When the authors allow the effect of ownership change on productivity growth to depend on plant size by including an interaction term of ownership change with initial employment (models III and

IV), their results imply that ownership change has a positive effect on productivity growth only for very small plants (those with fewer than 20 employees). Again, the appropriateness of giving equal weight to small and large plants seems questionable, especially when the effect (sign as well as magnitude) of ownership change seems to be so size related.

The estimates also imply that the effect of ownership change on the rate of plant productivity growth between 1977 and 1987 depends crucially on when in that period the ownership change occurred. Only ownership changes during the first five years appeared to have a significant effect (table 6.8, models V and VI). (Also, ownership changes occurring during the 1983–87 period had a significant positive effect on employment growth, but those during 1977–82 did not.) The authors conjecture that this may be due to the fact that "it takes some time for acquiring firms to integrate with purchased plants." Indeed, Lichtenberg and Siegel (1987), who analyzed *annual* data on productivity and ownership change, found support for the gradual adjustment hypothesis. But the stark contrast between the estimated effects of "early" and "late" (and small plant and large plant) ownership changes is somewhat troubling to me. I think that additional empirical research (e.g., on other industries) is needed to assess whether these apparent differences reflect signal rather than noise. If these patterns are confirmed, they will constitute a new (and difficult!) set of stylized facts for future theorists of ownership change to explain.

References

Lichtenberg, Frank, and Donald Siegel. 1987. Productivity and changes in ownership of manufacturing plants. *Brookings Papers on Economic Activity*, no. 3: 643–73.

———. 1990a. The effect of leveraged buyouts on productivity and related aspects of firm behavior. *Journal of Financial Economics* 26:165–94.

———. 1990b. The effect of ownership changes on the employment and wages of central-office and other personnel. *Journal of Law and Economics* 33 (October): 383–408.