ON PRODUCTIVITY AND PLANT OWNERSHIP CHANGE: NEW EVIDENCE FROM THE LRD*

By

Robert H. McGuckin**

Sang V. Nguyen**

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Abstract

This paper investigates the questions of what type of establishment experiences ownership change, and how the transferred properties perform after acquisition. Are they the profitable operations suggested by Ravenscraft and Scherer (1986), or the poorly operating ones found by Lichtenberg and Siegel (1992)? Is the primary motive of ownership change the rehabilitation of low productivity plants as suggested by Lichtenberg and Siegel? Our empirical work is based on an unbalanced panel of 28,294 plants taken from the U.S. Bureau of the Census' Longitudinal Research Database (LRD). The data set provides complete coverage of the food manufacturing industry (SIC 20) for the period 1977-1987. Our principle findings are that (1) ownership change is generally associated with the transfer of plants with above average productivity, however, large plants, empirically, those with more than 200 employees, are more likely to be purchased than closed when they are performing poorly; and (2) transferred plants experience improvement in productivity performance following the ownership change.

KEYWORDS: plant ownership change, labor productivity, plant closing

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**Center for Economic Studies, U.S. Bureau of the Census

I. INTRODUCTION

The literature on mergers is long and controversial. Some economists contend that mergers increase firms' efficiency and that only efficient firms survive while inefficient ones are taken over [e.g., Manne, (1965), Mead, (1968), and Jensen, (1988)]. Other economists view mergers, far from being an engine of social gain, as a method for furthering antisocial activity such as monopoly power and management empire building [e.g., Mueller, (1969 and 1993), and Roll, (1986)]. As would be expected, the empirical research offers sharply differing perspectives on merger activity.[1]

This paper investigates the questions of what type of property experiences ownership change and how the transferred properties perform after acquisition. Are they the profitable operations suggested by Ravenscraft and Scherer (1986) or the poorly operating ones found by Lichtenberg and Siegel (1992)? Is the primary motive of ownership change the rehabilitation of low productivity plants as suggested by Lichtenberg and Siegel? Our work is empirical. It relies on an unbalanced panel of 28,294 plants that provides complete coverage of the food manufacturing industry (SIC 20). This contrasts with Lichtenberg and Siegel's use of a panel of <u>large, surviving</u> establishments from many industries. Using these data allows us to examine the possibilities of selection bias in earlier work. We first estimate plant labor productivity and total factor productivity for the years 1977 and 1987. We then use these productivity estimates to analyze the effects of initial productivity, a measure of match quality as in Lichtenberg and Siegel, and plant size, which we interpret as a proxy for business quality, on ownership change. Our empirical model is specified to enable us to allow for non-linearities and interactions between business quality and match quality.

Our empirical results indicate that both initial plant size and productivity are positively related to ownership change, and negatively related to plant closing. This particular result is generally consistent with Ravenscraft and Scherer's finding (1986) that corporate acquirers generally purchase profitable companies. However, when we use truncated samples that include only large plants (with at least 250 employees), we find-- consistent with Lichtenberg and Siegel -- that both initial productivity and plant size have an inverse relationship with plant ownership change. This suggests that Lichtenberg and Siegel's findings are relevant to only a subset of observed mergers, and that their matching model of ownership change needs to be broadened. Finally, our regression analysis provides strong evidence that plant productivity growth is <u>positively</u> related to ownership change. This offers evidence that ownership change improves productivity for surviving plants.

The remainder of this paper is organized as follows. In Section II, we discuss the relationships among ownership changes, productivity, and plant size. In Section III, we discuss the data and measures of productivity. We report and discuss the empirical results in Section IV. The last section concludes the paper.

II. OWNERSHIP CHANGE, PRODUCTIVITY, AND SIZE

Lichtenberg and Siegel (1992) base their empirical work on a matching model closely related to the matching theory of job turnover developed by Jovanovic (1979) and used extensively in labor market studies. According to this theory, heterogenous groups of workers and employers continually engage in a matching process that improves the fit between workers and jobs. In applying the model to ownership change, Lichtenberg and Siegel (1992, pp. 27-28) argue that "firms are constantly evaluating the match or fit between plant and parent" and that "the quality of the match is the major determinant of the corporate level decision to maintain or relinquish ownership of an establishment". This reasoning has two important implications: (1) low productivity, an indicator of a poor match between the establishment and its management will lead to an ownership change, and (2) a change in ownership will result in increased productivity. Using a sample of large surviving U.S. manufacturing plants, Lichtenberg and Siegel find, consistent with the matching theory, that plant productivity is negatively related to ownership change and that ownership change is positively related to productivity growth. They, therefore, conclude that ownership change is primarily motivated by lapses in efficiency. However, there are good reasons, both theoretical and empirical, to believe that their sample selectively favors the managerial efficiency hypothesis.

Lichtenberg and Siegel's version of the matching model appears to be too restrictive. Simply put, it gives little, if any importance to the demand side of the market. Purchase of a plant (or firm) will be undertaken when the buyer or acquiring entity values the property higher than the seller. While the likelihood of a buyer (with potentially better management) valuing a property higher than the owner is apt to be high when the current management is poorly performing, in principle there is no reason for a divergence in the values of buyer and seller to be restricted to poorly performing properties. There are many motives for acquisition that are compatible with obtaining good performing plants: Monopoly power, synergies, and tax incentives are all reasons that do not require purchase of low productivity plants. In fact, recent theoretical work on entrepreneurship and business transfer by Holmes and Schmitz (1990, 1992) suggests that business transfer (i.e., ownership change) is often a signal of high business quality, as distinct from a poor management match.

If plant size is a proxy for the quality of the plant, then the inverse relationship between productivity and ownership change found by Lichtenberg and Siegel is sensible and in line with the managerial efficiency model. The large plants in their sample that experienced ownership change are likely to be high quality businesses, but they performed poorly (low productivity) because of bad matches (good business, bad management). Therefore, transfer rather than closing is required for these large plants to improve their performance.

While size is surely an imperfect measure of business quality, it is correlated with age in the LRD. Longevity and growth are both indicators of business quality. There is also evidence that size is an important factor influencing plant evolution (growth, failure, and change in ownership). For example, Dunne, Roberts, and Samuelson (1989) find that plant size is a major determinant of plant failure, and that large plants have lower failure rates than smaller plants. This finding is consistent with the hypothesis that most large plants are high quality businesses. Controlling for initial productivity, Lichtenberg and Siegel (1992) find a negative relationship between ownership change and plant size within their sample of large surviving plants. This is consistent with the hypothesis that it is lapses in efficiency (bad management) that drives large plant ownership changes.

The relationship between size and business quality is not likely to be as strong for smaller plants. Small plants are typically younger plants, which tend to have high rates of failure. This suggests that the likelihood of finding poor quality plants with little chance of being acquired is greater among smaller plants. But, small plants also include high quality businesses just beginning their cycles of growth. For such plants, lapses from managerial efficiency may well be a less dominant motive for ownership change than for large plants. This raises the possibility that motives for mergers other than managerial efficiency are more likely found among smaller, better performing plants. This means that the relationship between ownership change and plant size and performance (productivity) will be distinctly non-linear. Productivity will tend to be positively related to ownership change, except for the largest plants. Size will show little relationship to ownership change, except for the largest plants, where it will have a negative relationship to ownership change due to the dominance of the managerial efficiency motives among large plants. That is, the size-business quality relationship is relatively weak among smaller plants.

In short, without conditioning on the quality of the business, ownership change and plant closing can be observed as substitutes or complements in response to poor managerial performance. The only way to sort out these issues is to turn to a sampling plan which covers the universe of plants and deals with failing plants, as well as those that survive.

III. DATA AND PERFORMANCE MEASUREMENT

1. Data Sources

The plant level data used in this study are taken from the LRD maintained at the Center for Economic Studies (CES). The data contained in the LRD describe aspects of manufacturing establishments' production. Output data include total value of shipments and value added. Data on inputs include information on capital, labor, energy, materials, and selected purchased services. The LRD also contains information on classification and identification such as plants' ownership, location, product and industry, as well as various status codes which 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.[2]

2. Sample Coverage

In this study we focus on the food manufacturing industry (SIC 20) and study establishments transferred in the 1977-82 period. Evaluation of their productivity performance before and after merger is based on comparisons of 1977 productivity with that achieved in 1987. We chose the food manufacturing industry because it experienced substantial merger activity during the period under consideration.

There are several reasons for focusing on mergers in the 1977-82 period. First, the period encompasses two censuses of manufactures so that we are confident of correctly identifying all ownership changes -- information is available only for a sample of plants in non-census years. Second, the period encompasses the beginning years of the latest merger movement, one which extended until 1986 or 1987. Third, and perhaps most important, the use of the 1977-82 period allows us to evaluate the performance of plants and firms 5 to 9 years after the transaction. This provides plenty of time for the acquiring firm to integrate purchases into the firm, or to dispose of them.

3. Ownership Change in the Food Manufacturing Industry

Using the LRD, we identified every plant that changed ownership during the 1977-82 period. For each plant so identified, we then singled out all manufacturing plants owned by the acquired firm at the beginning of the period, 1977, whether they were located in the food industry or not. This provided our population of purchased plants and firms. Having identified all transfers of ownership of food manufacturing plants and their purchasers, we were then able to determine whether the acquisition was a partial divestiture or a complete acquisition. We also kept track of whether complete firm sell-offs were to one or multiple firms.

For the period 1977-82, we identified 733 firms selling at least one food manufacturing plant. These firms sold totally 2,113 plants including 1,575 food plants and 538 non-food plants. The purchased food plants amounted to 37,435 million dollars in value of shipments, which accounted for 28.6 percent of the 1977 total value of shipments of the entire food manufacturing industry -- SIC 20 (see Appendix, Table A1). After merger, of the 2,113 purchased plants, we identified 949 plants (44.9 percent) remained with the acquiring firms, 746 plants (36.2 percent) were closed, and 400 (18.9 percent) plants were resold to other firms (see Appendix, Table A2).

For control purposes of the analysis, we next identified all food plants that did not experience any ownership change during the period 1977-82. We then identified the companies that owned these plants in 1977 and included all other (non-food) plants that were owned by the identified companies. For this control group, we identified 26,294 plants that existed in 1977, of which 9,458 plants were kept until 1987, 9,744 plants were closed between 1977 and 1982, 4,710 plants were closed between 1982 and 1987, and the remaining 2,382 plants were sold between 1982 and 1987 (see Table 1). Thus, our analysis is based on 28,294 establishments.[3]

4. Performance Measurement

The best-known measure of firm efficiency performance is its productivity, measured as the ratio of the firm's output to its inputs. Productivity can either be measured for each single input such as labor (the well-known labor productivity) or measured for all inputs, total factor productivity (TFP). Theoretically, TFP is the appropriate measure of productivity because it takes into account all inputs. In practice, labor productivity is often used in empirical work even though it includes only labor in the measurement. The reason for this is that data on inputs, such as capital, required for the measurement of TFP are rarely available, while data on output and labor are available in most economic data sets and are measured more accurately than other inputs such as capital and energy. In this study, because of data limitations, we base our analysis mostly on labor productivity. However, for a subset of plants where the required data are available, we analyzed plants' productivity performance using TFP.

When analyzing productivity at the plant level, measurement problems often arise even with the simple labor productivity. This is particularly true for making comparisons across plants and over time. One problem is that data on output prices at the plant level are required for estimating plants' real output, but these data are not available. To overcome this problem, we use relative labor productivity (RLP), the ratio of plant labor productivity (LP) to average industry labor productivity (ALP). That is,

(1) $$RLP_{ij} = LP_{ij} / ALP_j ,$$

where i and j denote plant i and industry j, respectively.

Plant labor productivity, 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 plants' labor productivity by its industry average labor productivity produces a comparable productivity measure through time and across plants.[4] Thus, plant RLP provides a price dispersion and inflation adjusted measure of plant performance across plants and over time. This is our primary measure for assessing the performance of purchased plants following ownership changes, and for comparison with the performance of plants that did not experience ownership changes.

If all plants in the same industry have similar input-output ratios, then labor productivity should be a good measure of efficiency. However, if the production technology differs substantially among plants, the partial labor productivity could be a misleading measure of performance. To assure the robustness of the analysis, we estimate TFP for a number of large plants for which the required data are available.

Again, to overcome the problems of price dispersion and inflation, we use relative total factor productivity, RTFP, which is defined as

$$RTFP_{ij} = TFP_{ij}/TFP_j \quad (2)$$

or

$$(2.a) \quad \log(RTFP_{ij}) = \log(TFP_{ij}) - \log(TFP_j),$$

where TFP_{ij} is TFP of plant i in industry j, and TFP_j is the average TFP of industry j. Identity (2.a) measures TFP of plant i in industry j in log form, which calculates the deviation of the plants' productivity from the mean productivity in industry j.

For comparison purposes, we use the regression approach employed by Lichtenberg and Siegel (1992) to estimate TFP using the following production function,

$$(3) \quad lnq = a_k lnK_i + a_l lnL_i + a_m lnM_i + u_i ,$$

where ln is the natural logarithm. Q, K, L, and M denote output, capital, labor, and materials. The estimated residual u_i is an estimator of log (RTFP) in identity (2a), which measures the deviation of the plants' TFP from the mean TFP in the relevant industry.[5]

We estimate Equation 3 separately by industry to compute RTFP for each individual plant within an industry.

IV. EMPIRICAL RESULTS

1. Relative Labor Productivity Results

Table 1 reports initial RLP (in 1977) of purchased plants as well as non-purchased plants. The results show that purchased plants (those that experienced ownership changes) had high initial productivity relative to their industry averages. The average RLP of plants that were purchased between 1977 and 1982 is 1.15, while that of plants purchased during the 1982-87 period is 1.17. This means that on average, the labor productivity of plants experiencing ownership change was roughly 16 percent above the industry average at the time they were transferred.

Table 1 also shows that purchasers kept the most productive plants and immediately closed (1977-82) the least productive plants (RLP77 = 1.02)[6]. Purchasers resold or closed about one-half of the total plants they acquired after operating them for 5 to 10 years. These plants showed RLP77 of 1.10, above the industry average, but only one-half as large as those plants they retained. As for the plants that did not experience an ownership change in either period, we find that the average 1977 RLP of closed plants are well below industry average -- 12 percent below industry average for plants closed during 1977-82, and 9 percent below for plants closed during 1982-87.

The foregoing results strongly suggest that acquirers purchased relatively productive plants. Even the plants that were closed immediately after purchase had above industry average initial labor productivity. These results are consistent with the finding of Ravenscraft and Scherer (1986), and contradict Lichtenberg and Siegel's general conclusion that low productivity leads to ownership change.[7]

To test the matching hypothesis -- that plants with low productivity due to poor match are more likely to change owners than those with good matches -- we estimate the following probit regression,

$$(4) \qquad OC7782_i = a_0 + a_1 RLP77_i + a_2 TE77_i + a_3 (RLP77)_i^2 + a_4 (RLP77)_i^3 + a_5 (TE77_i)^2 + a_6 (TE77)_i^3 + a_7 (RLP77xTE77)_i + u_i,$$

where OC7782 is a dummy variable with values equal to one if the plant experiences ownership change during 1977-82; it equals zero, otherwise. RLP77 and TE77 denote the plant's initial (1977) RLP and total number of employees.

Equation 4 is specified to allow for a nonlinear effect of initial RLP and size (measured in total employment) on ownership changes. For comparison purposes, we also estimate a simple linear form which is similar to the one used by Lichtenberg and Siegel (1992). In addition, we estimate both the linear and non-linear models using the entire data set and several truncated samples. This allows us to examine the effects of functional forms and sample selection on the model parameter estimates.[8]

Columns 1 and 2, Table 2, report the estimates for the linear and non-linear probit regressions based on all observations, while columns 3 and 4 present the results based on a truncated sample, including only the 12,972 plants that existed in 1977 and survived through 1987 (balanced panel). The linear regression results, columns 1 and 3, show that initial plant size and productivity have significantly positive effects on ownership changes. This result is robust in that it is invariant, whether all observations or only surviving plants are included in the estimation. Similar results are also obtained from the non-linear model reported in columns 2 and 4, even though the interpretation of the estimates of the non-linear models is less straightforward than those obtained from the linear model.

The above results contradict Lichtenberg and Siegel's finding that low productivity generally leads to ownership change. We emphasize, however, that Lichtenberg and Siegel's results were based on a truncated sample, including most large surviving U.S. manufacturing plants. Specifically, 82 percent of their sample are large plants with at least 250 employees. For a direct comparison with Lichtenberg and Siegel's results, we re-estimate the probit models using both balanced and unbalanced panels of plants with at least 250 workers. Columns 5 and 6, Table 2, show the probit estimates using data for large plants with at least 250 employees, including plants that were closed between 1982-87. Columns 7 and 8 report the estimates based on the same sample, but closed plants were excluded. The results are striking. Most of the estimated coefficients have opposite signs compared to those reported in columns 1, 2, 3, and 4, and they are now similar to those obtained by Lichtenberg and Siegel. Thus, there is strong evidence suggesting that the inclusion of only large plants in the analysis has a significant impact on the model parameter estimates, and hence, the general conclusion regarding the effect of productivity on ownership change.

To better assess the impact of productivity on the probability of plants' ownership change, we use the parameter estimates of the probit models reported above to calculate the probability of ownership change in response to varying levels of productivity. Table 3 reports the probabilities of ownership change with estimates based on the parameter estimates of the non-linear probit model (Equation 4). These probabilities are estimated by varying RLP and keeping total employment fixed at the mean. The probabilities estimated by using all 28,294 observations reported in column 3 indicate a positive relationship between plants' initial productivity and ownership change. This relationship is even stronger -- the probability magnitudes are twice as large -- when the probabilities are estimated based on the balanced panel reported in column 5. This is expected because the balanced panel includes only surviving plants while the unbalanced panel includes low productivity plants that were closed between 1977 and 1982.

Columns 7 and 9, Table 3, show the probabilities of ownership change estimated using balanced and unbalanced panel data for large plants with at least 250 employees. As with the regression results, the probability results based on large plant data are striking. Using this truncated sample of large plants, we find that the probability of ownership change increases as productivity rises up to about 30 percent above the relevant industry average, and declines afterward. Finally, column 11 shows that the estimated probabilities based on data for plants with fewer than 250 employees are almost identical to those for the full sample.

Table 4 reports the probabilities of ownership change estimated by varying both RLP and size (employment) and using the entire data set (28,284 observations). From the table, it is clear that probability of ownership change has a positive relationship with both plant productivity and size. Moreover, this relationship becomes much stronger with large size (250 employees or more) and high productivity (above 1.079).

When truncating the data by including only plants with at least 250 workers, we find a reverse effect of both productivity and size on the estimated probabilities of ownership change. As shown in Table 5, the probability of ownership change declines as plant size increases. This result is invariant regardless of model specifications (i.e., linear vs. non-linear probit models).

As for the effect of productivity, the estimates obtained from the linear model show a negative relationship between initial productivity and the probability of ownership change. The results from the non-linear model indicate that the probability increases with productivity up to a certain point and declines afterward. Specifically, when plants' productivity reached about 26 percent above the relevant industry average, the probability of ownership change began to decline.

Thus, there is evidence that the inverse relationship between initial productivity and the probability of ownership change is only observed when the linear probit model is applied with data for large plants. Moreover, this inverse relationship is weak. For example, when using a balanced panel of plants with at least 250 workers and keeping employment fixed at the mean, we found that as plants' productivity increases, the probability of ownership change declines, but the decline is negligible (from .461 to .412).

2. Total Factor Productivity Results

The foregoing analysis is based on labor productivity which is theoretically inferior to total factor productivity as a measure of technical efficiency. However, as mentioned earlier, if the production technology does not differ substantially among the plants within an industry, both labor and total factor productivity would measure efficiency equally well. In this section, we estimate total factor productivity for a subset of plants that have complete data on output, capital, labor, and materials. We then use the estimated TFPs to estimate the probit model and calculate the probabilities of plant ownership changes.

For each industry, we estimate Equation 3 to obtain the estimated residuals. These residuals, as discussed earlier, are deviations of plants' TFP from the mean of TFP in the relevant industry, which are equivalent to the logarithm of plants' relative TFP. For purposes of comparison, we estimate the following probit regression for ownership change with the variables defined and constructed as in Lichtenberg and Siegel (1992),

$$(5) \quad OC7782_i = a_0 + a_1 LOGRTFP77_i + a_2 LOGTE77_i + a_3(LOGRTFP77_i)^2$$

$$+ a_4(LOGRTFP77_i)^3 + a_5(LOGTE77_i)^2 + a_6(LOGTE77_i)^3$$

$$+ a_7(LOGRTFP77_i \times LOGTE77_i) + u_i,$$

where OC7782 is a dummy variable equal to unity if the plant changed ownership between 1977-82; it equals zero, otherwise. LOGRTFP77 is the plants' 1977 (log) total factor productivity;

and LOGTE77 is the plants' level of total employment normalized by industry.

We estimate Equation 5 in both linear and non-linear forms and report the results in Table 6. Columns 1 and 2 of the table show the results for 3,800 plants that had required data for estimating RTFPs, whereas columns 3 and 4 report the estimates using data for large plants with at least 250 employees. The results uniformly show that with truncated samples of large plants there is an inverse relationship between plants' initial productivity and ownership change. This result is consistent with the labor productivity result reported in Table 2, and is in agreement with Lichtenberg and Seigel (1992) that ownership change is negatively related to plant productivity. We note, however, that the estimated coefficients of the productivity variable based on the sample, including small plants (columns 1 and 2), are not statistically significant. When we truncate the sample by including only large plants with at least 250 employees, the productivity coefficient in the linear model becomes significant at the 10 percent level, and the coefficient in the non-linear model is more significant compared to that in column 2. Thus, again, there is evidence that the restricted matching model may be applicable only to large plants.

Tables 7 and 8 report the estimated probabilities of ownership change in response to changes in both total factor productivity and plant size for both subsets of data. Examining the two tables we find the familiar patterns that we observe from the labor productivity results. In particular, when truncating the data by including only large plants and using the linear probit model, we find a negative relationship between plants' initial productivity and ownership change. However, as with the labor productivity result, this negative relationship is weak. For example, when keeping employment constant at the mean, the probability of ownership change declines at a negligible rate from .4688 to .4046 as the relative total factor productivity increases from the 5^{th} percentile level to the 95^{th} percentile level (see last column, Table 8). The probabilities estimated based on the non-linear probit model show a different pattern. Again, as with the labor productivity results, the non-linear estimates show that the probability of ownership change increases with productivity up to a point, and declines afterward.

In summary, our regression and probability analyses based on data on ownership change in the food manufacturing industry during the period 1977-82 indicate that (1) productivity generally has a positive effect on ownership change, (2) ownership change is strongly affected by plant size, and (3) an inverse relationship between productivity and ownership change can only be observed when a sample of large plants is used in the analysis, but this relationship is not robust.

3. Plant Closing

The productivity analysis presented above does not support the general conclusion that low productivity leads to owner change. In fact, our simple calculations reported in Table 1 suggest that plants with productivity below industry average were closed, rather than sold. It is, therefore, instructive to analyze the effects of productivity and other important determinants, such as size, on plant closing.[9] To do so, we first estimate a probit regression model similar to Equation 4, but the dependent variable is "plant closing between 1977-82", instead of "ownership change". That is,

$$(6) \qquad PC7782_i = a_0 + a_1 RLP77_i + a_2 TE77_i + a_3 (RLP77)_i^2 + a_4 (RLP77)_i^3 + a_5 (TE77_i)^2 + a_6 (TE77)_i^3 + a_7 (RLP77xTE77)_i + u_i \,,$$

where PC7782 is a dummy variable having value of unity if the plant is closed between 1977-82; otherwise, it equals zero. Other variables are defined as in Equation 4.

Table 9 reports probabilities of plant closing, estimated by using the parameter estimates of Equation 6. The table shows that the probability of plant closing is a decreasing function of both plant (initial) productivity and size. Keeping size fixed at the mean, we find that as plants' relative productivity increases from .2145 to .8482 the probability of plant closing declines from .5525 to .5006. When a plants' productivity exceeds the relevant industry average, the estimated probability of closing is less than .50. On the other hand, when productivity is kept constant at its mean, the probability of plant closing declines from .6151 to .1954 as the plants' total employment increases from 1 to 412 employees.

When both productivity and employment are allowed to vary simultaneously, as shown in the upper left corner of Table 9, the estimated probabilities of closing are relatively high, ranging from .60 to over .67 percent for small plants (20 employees or less) with productivity below industry average. For large plants (223 employees or more), the probability of closing is low even for those with low productivity. For example, for plants with 412 employees the probability of closing is only .236 even though their relative labor productivity is at the 5^{th} percentile (.2145). This result is consistent with Jovanovic's theoretical model of industry evolution (1982) and Dunne, Roberts, and Samuelson's empirical finding (1989) that large plants have lower failure rates than small plants.

The findings of low probability of closing of large plants, and the inverse relationship between productivity and ownership change of large plants reported earlier are also consistent with the theory of business transfer developed by Holmes and Schmitz (1990, 1992) discussed in Section II. Large, poorly performing plants are more likely to be acquired (rather than closed) because they are generally good businesses, but are poorly managed. Thus, better matches (good business, good management) through ownership change are required for performance improvement. For small plants to be purchased, they must be both a good business and perform well. This is consistent with our finding that the probability of ownership change is positively related to plant productivity for small plants -- those having less than 250 employees. Moreover, non-purchased closed plants had initial productivity well below their industry averages.

Examining the estimated probabilities of plant closing together with the results on ownership change reported in the previous section suggests the following results: (1) Acquirers generally purchase productive plants; (2) Small plants with initial productivity below industry average are most likely to be closed rather than sold; (3) large low productivity plants, especially those with more than 250 employees, are more likely to be purchased than to be closed when they are performing poorly.

4. Post-Merger Productivity Performance

We now turn to the issue of whether plant ownership change results in productivity improvement. To examine the effects on plant ownership on productivity, we regress growth rates of relative labor productivity as well as its changes between 1977 and 1987 on plants' initial (1977) relative labor productivity, and a set of dummy variables representing the status of the plant in 1987. We also include dummy variables to control for regional and industry effects. The omitted category is surviving plants with no mergers. The estimated results are reported in Table 10.

Examining Table 10, we find that one important result stands out: Plants experiencing ownership changes had higher productivity growth rates than those plants which had no ownership changes. This result is robust in that it is invariant regardless of whether or not the initial productivity variable, industry dummy variables, and regional dummy variables are included in the model. The results are also insensitive to whether or not new plants and closed plants are included in the estimation.

Compared to plants that did not change ownership during the period under study, plants purchased during 1977-82 and kept by acquirers until 1987, experienced between 6.7 and 9.1 percent higher labor productivity growth. Plants acquired during 1982-87 also had between 3.1 and 4.3 percent higher productivity. Finally, plants acquired during 1977-82 and resold had between 4.5 and 6.2 percent higher productivity than plants that remained with the same owners during 1977-87. Although not shown in Table 10, we found no significant difference between plants that were transferred as part of a complete or full merger and those plants that were divested.[10] However, comparison of the coefficients for plants experiencing one ownership change in the period with those plants that are resold, does not suggest that Lichtenberg and Siegel's finding of increased productivity is based on a sample weighted toward divestitures, as suggested by Mueller (1993). Our results support Lichtenberg and Siegel's empirical finding that ownership change improves productivity.

IV. CONCLUDING REMARKS

This analysis provides evidence that the motive for ownership change is not simply "lapses from efficiency." Ownership change is generally associated with the transfer of plants with above average productivity, not with the transfer of poorly performing assets. Moreover, these transferred plants experience improvements in productivity performance following the ownership change. Even for those plants that do not perform as well following the transfer as before it, their performance simply falls toward the industry average, while remaining well above it. It appears that ownership transfers are associated with the purchase and integration of good properties into new firms. This suggests that synergies and related efficiencies are important motives for the ownership change. To be sure many, in fact a majority of the plants transferred, are either closed or resold. But, those that are kept or resold are of above average efficiency. Further, those plants that are closed are poorly performing and this is true both for plants closed after ownership change as well as plants closed by firms not experiencing any change in ownership.

Only for the largest plants is the probability of ownership change inversely related to initial plant productivity. We tentatively attribute this deviation from the general pattern with particularly valuable assets that -- like fine historic buildings -- are worth fixing up. They are good quality businesses with poor management. Thus, it appears that ownership changes are associated with good properties with both good and bad management. Poor quality businesses are closed whether they have good or bad managers.

In closing, we note that we plan to continue this line of research on two fronts. First, we are recasting the analysis to the level of the firm and making comparisons between the performance of those firms that grow with acquisitions and those that grow internally. This will enable us to examine in some detail the way in which acquired properties are integrated into the activities of the purchasing firm, and how important such acquisitions are to the overall performance of the firm.

Second, the analysis in this paper needs to be extended to incorporate the various possibilities for the disposition of a plant into a single choice process that will allow for efficient econometric estimation. At the same time, better measures need to be developed to isolate good businesses and management from bad ones. In addition this analysis needs to be extended in time to account for more than one merger wave and to other industries.

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TABLE 1
RELATIVE LABOR PRODUCTIVITY IN 1977
BY OWNERSHIP CHANGE STATUS 1977-1987*

Type of Plant	Number	Average Labor Productivity
Purchased Plants (1977-1982)		
Kept until 1987	929	1.22
Sold by 1987	384	1.09
Closed in 1977-1982	59	1.02
Closed in 1982-1987	628	1.11
Subtotal	2,000	1.15
Purchased Plants (1982-1987)	2,382	1.17
Non-Purchased Plants		
Kept until 1987	9,458	1.00
Closed 1977-1982	9,744	.88
Closed 1982-1987	4,710	.91
Total	28,294	.97

* Includes all food manufacturing plants in 1977 plus non-food manufacturing plants owned by acquired firms operating in the food industry.

TABLE 2
PROBIT REGRESSION OF OWNERSHIP CHANGE
(X^2 IN PARENTHESIS)

Variable	All Observations		Balanced Panel		Unbalanced Panel (TE77 > 249) (truncated sample)		Balanced Panel (TE77 > 249) (truncated sample)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-1.2173[ǀ] (8251.6)	-1.6380[ǀ] (4691.2)	-.7592[ǀ] (1660.0)	-1.2085[ǀ] (1234.0)	-1.913[*] (11.19)	-.3291[*] (5.26)	.0513 (.64)	.0225 (.02)
RLP77	.1292[ǀ] (210.9)	.4537[ǀ] (262.0)	.1205[ǀ] (90.3)	.5650[ǀ] (156.7)	-.0059 (.02)	-.4246[*] (3.72)	-.0478[+] (2.61)	.3182 (1.16)
TE77	.0006[ǀ] (539.0)	.0030[ǀ] (1491.0)	.0003[ǀ] (129.0)	.0020[ǀ] (379.3)	-.0001[*] (12.3)	-.0004[*] (4.16)	-.0002[*] (15.1)	-.0002[*] (10.1)
$RLP77^2$	---	-.0564ǀ[ǀ] (96.0)	---	-.1080[ǀ] (78.0)	---	-2.146[*] (4.14)	---	-.1908 (1.56)
$RLP77^3$	---	.0017[ǀ] (51.3)	---	.0050[ǀ] (51.0)	---	.0243[*] (3.33)	---	.0176 (.67)
$TE77^2$	---	-1.09E-6[ǀ] (2389.5)	---	-6.8E-7[ǀ] (624.3)	---	1.11E-7 (1.70)	---	2.16E-7[*] (4.7)
$TE77^3$	---	8.096E-11[ǀ] (1261.0)	---	5.10E-11[ǀ] (191.5)	---	-1.18E-11 (1.5)	---	-2.19E-11[*] (3.16)
RLP77 x TE77	---	-.0003[ǀ] (22.45)	---	-.0003[ǀ] (23.6)	---	-.00003 (.19)	---	.0001 (1.40)
n	28,294	28,294	12,972	12,972	2,643	2,643	2,028	2,028

[ǀ] denotes "significant" at the 1 percent level (or less).
[*] denotes "significant" at the 5 percent level (or less).
[+] denotes "significant" at the 10 percent level.

TABLE 3
ESTIMATED PROBABILITIES OF OWNERSHIP CHANGE
BY 1977 PRODUCTIVITY LEVEL*

	All Observations (n=28,294)		**Balanced Panel (n = 12,972)**		**Balanced Panel TE77 >250 Employees (n= 2,028)**		**Unbalanced Panel TE77 >250 Employees (n=2,643)**		**Unbalanced Panel TE77 <250 Employees (n= 25,651)**	
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Quantile	Productivity	Probability of Ownership Change	Productivity	Probability of Ownership Change	Productivity	Probability of Ownership Change	Productivity	Probability of Ownership Change	Productivity	Probability of Ownership Change
.05	.215	.102	.241	.212	.444	.411	.426	.347	.204	.102
.10	.322	.110	.351	.226	.551	.419	.530	.357	.307	.110
.25	.554	.127	.579	.256	.741	.435	.726	.373	.539	.127
.50	.848	.151	.881	.293	.980	.443	.964	.384	.835	.151
.75	1.079	.168	1.191	.326	1.294	.447	1.263	.340	1.062	.169
.90	1.591	.207	1.808	.387	1.751	.437	1.698	.325	1.574	.210
.95	2.139	.246	2.404	.448	2.089	.428	2.062	.309	2.148	.259

* The probabilities are estimated based on the parameter estimates of the non-linear probit model.

TABLE 4*
EFFECT OF SIZE AND PRODUCTIVITY ON PROBABILITY OF OWNERSHIP CHANGE
(n=28,294)
TOTAL EMPLOYMENT
(VALUE OF QUANTILE IN PARENTHESIS)

		5 percent (1)	10 percent (2)	25 percent (5)	50 percent (20)	75 percent (78)	90 percent (223)	95 percent (412)	Mean (96.594)
Relative Labor Productivity (Value of Quantile in Parenthesis)	5 percent (.2149)	.0617	.0621	.0632	.0688	.0933	.1733	.3043	.1021
	10 percent (.3223)	.0675	.0679	.0690	.0750	.1008	.1835	.3160	.1100
	25 percent (.5542)	.0806	.0811	.0824	.0890	.1174	.2053	.3403	.1274
	50 percent (.8482)	.0985	.0990	.1005	.1079	.1392	.2326	.3689	.1501
	75 percent (1.0794)	.1133	.1138	.1154	.1234	.1567	.2534	.3895	.1682
	90 percent (1.5913)	.1470	.1476	.1493	.1583	.1951	.2960	.4287	.2074
	95 percent (2.1386)	.1823	.1829	.1848	.1945	.2332	.3346	.4602	.2460
	Mean (.967)	.1061	.1066	.1081	.1158	.1482	.2505	.3797	

* Probabilities are estimated based on the parameter estimates of the non-linear probit model.

TABLE 5
EFFECTS OF SIZE AND PRODUCTIVITY ON PROBABILITY OF OWNERSHIP CHANGE
(UNBALANCED PANEL, TE77 > 249, N = 2,643)

		Total Employment (value of quantile in parenthesis)							
		5 percent (261)	10 percent (273)	25 percent (319)	50 percent (432)	75 percent (679)	90 percent (1,151)	95 percent (1,706)	mean (684.72)
Relative Labor Productivity (value of quantile in parenthesis)	5% (.4267)	.390[a] (.410)[b]	.389 (.408)	.383 (.406)	.370 (.400)	.344 (.386)	.308 (.361)	.280 (.333)	.347 (.388)
	10% (.5298)	.400 (.410)	.398 (.408)	.393 (.406)	.377 (.399)	.354 (.386)	.318 (.361)	.291 (.332)	.357 (.388)
	25% (.7261)	.415 (.408)	.413 (.407)	.407 (.405)	.394 (.399)	.369 (.386)	.333 (.361)	.306 (.332)	.373 (.387)
	50% (.9642)	.426 (.408)	.424 (.407)	.419 (.405)	.406 (.398)	.381 (.385)	.346 (.360)	.320 (.332)	.384 (.387)
	75% (1.2631)	.431 (.407)	.429 (.406)	.424 (.404)	.412 (.398)	.388 (.384)	.354 (.359)	.330 (.331)	.390 (.386)
	90% (1.6980)	.424 (.406)	.423 (.405)	.418 (.403)	.406 (.397)	.383 (.383)	.352 (.358)	.330 (.330)	.385 (.385)
	95% (2.0628)	.407 (.405)	.406 (.404)	.401 (.402)	.390 (.396)	.369 (.383)	.339 (.358)	.321 (.329)	.382 (.384)
	mean (1.0738)	.428 (.407)	.427 (.407)	.422 (.404)	.409 (.398)	.385 (.385)	.350 (.360)	.325 (.331)	

[a] Probabilities are estimated based on the estimates of the non-linear probit model.
[b] Probabilities are estimated based on the estimates of the linear probit model.

TABLE 6
PROBIT REGRESSION OF OWNERSHIP CHANGE, TRUNCATED SAMPLE
(WITH RELATIVE TFP AS AN EXPLANATORY VARIABLE RATHER THAN RLP)
(X^2 IN PARENTHESIS)

Variable	Balanced Panel		Balanced Panel (TE77 > 249)	
	(1)	(2)	(3)	(4)
Intercept	-.1330* (34.36)	-.0302 (1.02)	-.1063* (12.20)	-.0549 (1.91)
RTFP77	-.0981 (2.08)	-.0208 (.05)	-.1630+ (2.71)	-.1744 (1.79)
LOGTE77	-.0106 (.24)	-.1158* (14.77)	-.2549* (31.73)	-.2641* (16.62)
$RTFP77^2$	---	-.1973 (1.38)	---	-.2417 (1.46)
$RTFP77^3$	---	.0952 (.62)	---	.0176 (.49)
$LOGTE^2$	---	-.1349* (37.28)	---	-.1122+ (2.77)
$LOGTE^3$	---	-.0109+ (2.83)	---	.0493 (1.94)
RTFP77 x LOGTE77	---	-.1202+ (2.59)	---	-.0803 (.29)
n	3,800	3,800	1,900	1,900

+ denotes "significant" at the 10 percent level.
* denotes "significant" at the 1 percent level.

TABLE 7
EFFECT OF SIZE AND TOTAL FACTOR PRODUCTIVITY ON THE
PROBABILITY OF OWNERSHIP CHANGE
(n = 3,800)

		Log of Relative Employment (Value of Quantile in Parenthesis)							
		5% (-2.2652)	**10% (-1.8105)**	**25% (-1.1093)**	**50% (-.4442)**	**75% (.1877)**	**90% (.7356)**	**95% (1.1032)**	**mean (-.0493)**
Deviation of plant's TFP from industry mean (value of quantile in parenthesis)	5% (-.4396)	.3178[a] (.4737)[b]	.3765 (.4718)	.4473 (.4689)	.4805 (.4661)	.4730 (.4634)	.4306 (.4611)	.3823 (.4596)	.4794 (.4663)
	10% (.3265)	.3324 (.4693)	.3897 (.4674)	.4573 (.4645)	.4769 (.4617)	.4760 (.4590)	.4306 (.4567)	.3804 (.4552)	.4861 (.4619)
	25% (-.1758)	.3508 (.4635)	.4059 (.4615)	.4688 (.4586)	.4937 (.4558)	.4782 (.4531)	.4289 (.4508)	.3762 (.4493)	.4932 (.4560)
	50% (-.0202)	.3675 (.4574)	.4199 (.4555)	.4780 (.4525)	.4979 (.4497)	.4777 (.4471)	.4244 (.4448)	.3693 (.4433)	.4978 (.4500)
	75% (-.1733)	.3835 (.4499)	.4324 (.4480)	.4841 (.4450)	.4979 (.4422)	.4718 (.4396)	.4137 (.4373)	.3558 (.4358)	.4983 (.4425)
	90% (.4000)	.3934 (.4411)	.4376 (.4392)	.4818 (.4363)	.4884 (.4335)	.4555 (.4308)	.3920 (.4286)	.3315 (.4270)	.4893 (.4337)
	95% (.5743)	.3928 (.4343)	.4333 (.4325)	.4716 (.4295)	.4726 (.4268)	.4346 (.4243)	.3675 (.4219)	.3057 (.4203)	.4102 (.4270)
	mean (.0181)	.3711 (.4559)	.4229 (.4540)	.4797 (.4511)	.4984 (.4483)	.4770 (.4456)	.4228 (.4433)	.3671 (.4418)	----- -----

[a] Probabilities of ownership change estimated using the parameter estimates of the non-linear probit model.
[b] Probabilities of ownership change estimated using the linear probit model.

TABLE 8
EFFECT OF SIZE AND TOTAL FACTOR PRODUCTIVITY ON THE PROBABILITY OF OWNERSHIP CHANGE
(TE77 > 249, n = 1,900)

		Log of Relative Employment (Value of Quantile in Parenthesis)							
		5% (-.7237)	**10% (-.5581)**	**25% (-.2614)**	**50% (.1623)**	**75% (.5992)**	**90% (1.1084)**	**95% (1.4468)**	**mean (.2149)**
Deviation of plant's TFP from industry mean (value of quantile in parenthesis)	5% (-.5078)	.5155[a] (.7102)[b]	.5143 (.6693)	.5018 (.6023)	.4664 (.5357)	.4173 (.4716)	.3608 (.4164)	.3249 (.3808)	.4610 (.4688)
	10% (-.4109)	.5227 (.7047)	.5210 (.6636)	.5076 (.5962)	.4709 (.5295)	.4204 (.4653)	.3623 (.4103)	.3254 (.3743)	.4653 (.4625)
	25% (-.2394)	.5283 (.6950)	.5257 (.6533)	.5107 (.5853)	.4716 (.5183)	.4187 (.4542)	.3582 (.3995)	.3197 (.3637)	.4839 (.4514)
	50% (-.0777)	.5263 (.6857)	.5229 (.6435)	.5064 (.5750)	.4652 (.5078)	.4102 (.4338)	.3477 (.3893)	.3080 (.3539)	.4590 (.4410)
	75% (.1113)	.5172 (.6747)	.5127 (.6320)	.4943 (.5629)	.4506 (.4995)	.3934 (.4316)	.3292 (.3775)	.2885 (.3425)	.4441 (.4289)
	90% (.3381)	.4987 (.6613)	.4930 (.6179)	.4725 (.5483)	.4260 (.4808)	.3666 (.4171)	.3011 (.3636)	.2599 (.3290)	.4192 (.4144)
	95% (.4936)	.4831 (.6520)	.4766 (.6082)	.4547 (.5382)	.4064 (.4707)	.3454 (.4073)	.2800 (.3541)	.2390 (.3199)	.3320 (.4046)
	mean (-.0512)	.5256 (.5345)	.5219 (.5177)	.5051 (.4875)	.4635 (.4446)	.4082 (.4010)	.3455 (.3518)	.3056 (.3203)	----- -----

[a] Probabilities of ownership change estimated using the parameter estimates of the non-linear probit model.
[b] Probabilities of ownership change estimated using the parameter estimates of the linear probit model.

TABLE 9
EFFECT OF SIZE AND PRODUCTIVITY ON PROBABILITY OF PLANT CLOSING
(n=28,294)
TOTAL EMPLOYMENT
(VALUE OF QUANTILE IN PARENTHESIS)

Relative Labor Productivity (Value of Quantile in Parenthesis)		5 percent (1)	10 percent (2)	25 percent (5)	50 percent (20)	75 percent (78)	90 percent (223)	95 percent (412)	Mean (96.594)
	5 percent (.2145)	.6737	.6725	.6687	.6498	.5760	.4033	.2360	.5525
	10 percent (.3223)	.6650	.6638	.6600	.6409	.5667	.3946	.2295	.5433
	25 percent (.5542)	.6466	.6453	.6415	.6221	.5474	.3766	.2163	.5240
	50 percent (.8482)	.6240	.6227	.6188	.5991	.5240	.3554	.2011	.5006
	75 percent (1.0794)	.6068	.6055	.6015	.5818	.5065	.3399	.1902	.4833
	90 percent (1.5913)	.5710	.5697	.5657	.5458	.4708	.3093	.1694	.4480
	95 percent (2.1386)	.5365	.5352	.5312	.5113	.4372	.2817	.1514	.4150
	Mean (.967)	.6151	.6138	.6098	.5901	.5149	.3474	.1954	---

TABLE 10
REGRESSIONS OF CHANGE AND GROWTH RATE OF PRODUCTIVITY (1977-1987)
(t-ratio in parenthesis)

Dependent Variable		Intercept	Initial Productivity	Mergers Kept	Mergers Sold	Mergers Closed	Non-Mergers 1977-1982 Sold 1982-1987	Non-Mergers Closed	Regional and Industry Dummies	n	R^2
$RPL_{87} - RPL_{77}$	1)	.435 (36.61)	-.490 (60.83)	.114 (3.85)	.137 (3.08)		.097 (4.95)		no	12,971	.222
	2)	.670 (1.70)	-.518 (64.02)	.103 (3.45)	.106 (2.40)		.074 (3.57)		yes	12,971	.296
Growth Rate	1)	-.104 (23.30)		.069 (4.46)	.052 (2.29)	-1.893 (110.5)	.035 (3.55)	-1.896 (330.6)	no	28,294	.828
$\frac{(RPL_{87} - RPL_{77})}{.5(RPL_{87} + RPL_{77})}$	2)	-.004 (.83)	-.100 (35.55)	.091 (6.24)	.062 (2.79)	-1.883 (112.3)	.053 (5.44)	-1.907 (339.2)	no	28,294	.836
	3)	.084 (.74)	-.103 (35.56)	.084 (5.67)	.048 (2.16)	-1.891 (111.7)	.041 (4.00)	-1.897 (332.9)	yes	28,294	.842
	4)	-.020 (.86)		.067 (4.39)	.045 (1.99)	-1.897 (109.6)	.031 (3.02)	-1.886 (324.3)	yes	12,972	.835
	5)	.122 (15.35)	-.200 (37.07)	.102 (5.19)	.060 (2.03)				no	12,972	.097
	6)	.427 (1.54)	-.208 (38.26)	.093 (4.63)	.032 (1.07)				yes	12,972	.178

TABLE A1
ACQUIRED FOOD AND NON-FOOD MANUFACTURING ESTABLISHMENTS (1977-1982)
BY TYPE OF TRANSACTION
(Column percentages in parenthesis)

Type of Acquisition	Number of Establishments			Number of 4-Digit LOBs			Total Shipments (1977) (millions)			Number of Selling Firms	Number of Acquiring Firms
	Food	Non-Food	Total	Food	Non-Food	Total	Food	Non-Food	Total		
Complete acquisitions (single buyer)	629 (.400)	43 (.080)	672 (.318)	434 (.462)	33 (.098)	467 (.366)	12,527 (.335)	824 (.086)	13,351 (.284)	392 (.535)	263
Complete acquisitions (multiple buyers)	375 (.238)	138 (.257)	513 (.243)	171 (.182)	70 (.208)	241 (.189)	10,921 (.292)	2,522 (.263)	13,443 (.286)	43 (.059)	127
Divestiture[a]	317 (.201)	231 (.430)	548 (.259)	170 (.181)	136 (.404)	306 (.240)	8,177 (.218)	4,016 (.419)	12,193 (.259)	86 (.117)	238
Divestiture (Seller also a buyer)	254 (.161)	126 (.234)	380 (.180)	165 (.176)	98 (.291)	263 (.206)	5,810 (.155)	2,217 (.231)	8,027 (.171)	63 (.086)	205
Total	1,575 (6.9%[c])	538	2,113	940	337	1,277	37,435 (28.6)[c]	9,579	47,014	733 (<1%)[c]	753[b]

[a] One hundred and seven additional manufacturing plants were sold to twenty-five different buyers by twenty-seven non-manufacturing food companies which had only one manufacturing plant. These sellers disappeared from our data because they became totally non-manufacturing.

[b] Number of unique acquiring firms.

[c] Percent of total for Food Industry (20), 1977.

Source: special tabulations, Longitudinal Research Database (LRD)

TABLE A2
ACQUIRED FOOD AND NON-FOOD MANUFACTURING ESTABLISHMENTS
(1977-1982)
BY 1987 STATUS
(Number of Plants)

Type of Acquisition		Kept	Closed	Sold	Total
Complete Acquisition (Single Buyer)	Food	271	245	113	629
	Non-Food	19	20	4	43
	Subtotal	290	265	117	672
Complete Acquisition (Multiple Buyers)	Food	168	122	85	375
	Non-Food	69	32	37	138
	Subtotal	237	154	122	513
Divestitures	Food	156	117	44	317
	Non-Food	111	90	30	231
	Subtotal	267	207	74	548
Divestitures (Seller also a buyer)	Food	113	87	54	254
	Non-Food	42	51	33	126
	Subtotal	155	138	87	380
Total	Food	708	571	296	1,575
	Non-Food	241	193	104	538
	Total	949	764	400	2,113

Endnotes

1. Extensive evidence from stock market event studies has been interpreted as indicating that mergers generate substantial value (See Jensen, 1988a). In contrast, traditional studies of post-merger performance have not found gains approximating those reported in the financial literature. See Ravenscraft and Scherer (1986) and Mueller (1985). More recent empirical work on mergers using the U.S. Census Bureau's Longitudinal Research Database (LRD) provides a more sympathetic view of ownership changes. See Lichtenberg and Siegel (1992).

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

3. This sample includes both food and non-food establishments because many food manufacturing firms owned establishments that produced non-food products.

4. Abbott (1989) used plant level data extracted from the 1982 Census of Manufactures to analyze output prices across producers. He found that prices vary substantially across plants, even at the 7-digit product level.

5. For a detailed discussion of this approach for measuring RTFP, see Lichtenberg (1992, pp. 21-22).

6. We note, however, that the productivity of closed plants could be overstated because it is possible that there is a number of plants that we identified as "closed" are reclassified as non-manufacturing plants, and therefore disappeared from the 1987 CM. In addition, it is likely that sales from inventory and labor reductions around the time of closing may "inflate" labor productivity resources.

7. We note, however, that Lichtenberg and Siegel did not find a negative relationship between productivity and ownership change for all types of mergers. In fact, they found that plants involved in leveraged buyouts (LBOs) were efficient prior to transaction, showing above-average productivity 3 years before the buyout. In this regard, our results do not entirely contradict their findings.

8. In our preliminary work, we also included dummy variables representing nine census regions and dummy variables for 4-digit industries in both linear and non-linear models. However, the inclusion of these dummy variables did not significantly affect other model parameter estimates. Therefore, we report only the results of the regressions without regional and industry dummy

variables.

9. In future work, we plan to model ownership change, plant closing, and continued operation under the same owner in the same model. Here we adopt the simple expedient of looking at the decisions separately.

10. In future work, we plan to extend our merger series to periods before 1977 so that more complete merger histories can be incorporated in the analysis.