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Michael Ollinger, Sang V. Nguyen, Donald P. Blayney, Bill Chambers, and Ken Nelson

Abstract

Empirical analysis of mergers and acquisitions in eight important food industries suggests that workers in acquired plants realized modest increases in employment and wages relative to other workers. Results also show that mergers and acquisitions reduced the likelihood of plant closures while high relative labor costs encouraged plant shutdowns. These results differ from commonly held views that mergers and acquisitions lead to fewer jobs, wage cuts, and plant shutdowns.

Keywords: Food product industries, mergers and acquisitions, plant closures

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Contents

Summary

For many years, mergers and acquisitions in the food industry have been viewed with skepticism. The primary concern was that mergers, by reducing the number of firms and increasing industry concentration, were promoting anticompetitive pricing behavior. Senate hearings on the effect of mergers and acquisitions in meatpacking and slaughter are a good example of this concern. More recent attention by the media and policy officials has focused on the impact of food industry mergers on changes in the structure of the economy, particularly on how changes in employment and wages affect the sustainability of rural communities.

What Is the Issue?

The effect of a merger on local employment and wages is not readily apparent. Mergers can cause lost jobs and reduced wages when new ownership attempts to lower production costs by shedding workers. Mergers and acquisition can, however, preserve and even increase employment when a firm is saved from bankruptcy and plant closure or when new ownership expands output and hires more workers by capturing productivity gains through increased economies.

During the 1980s and 1990s, 100,000 workers in seven food-related industries—meatpacking, meat processing, cheese, fluid milk, flour milling, feed, and oilseed processing (soybean, corn, and cottonseed processing) lost their jobs. At the same time, the pace of mergers and acquisitions accelerated in these industries, leading some observers of the food industry to conclude that mergers and acquisitions encouraged worker dislocations.

What Did the Project Find?

Empirical analysis of mergers and acquisitions in eight food industries during two distinct merger waves, 1977-82 and 1982-87, does not support the commonly held view that mergers and acquisitions necessarily caused worker dislocations and lost wages. Workers experienced a modest increase in the number of job opportunities but little change in wages relative to their peers. Findings from this report show that mergers and acquisitions led small plants in the food industries studied to add workers during the first merger wave of 1977-82 but not during the second merger wave, 1982-87. Similarly, mergers and acquisitions generally had a small but positive effect on wages during the period 1977-82 and little discernible effect during the second merger wave, 1982-87. We also found that mergers and acquisitions encouraged large meat and poultry and oilseed plants to exit their industries during the 1977-82 period and feed and oilseed plants to close over 1982-87.

Substantial labor strife marked both merger waves for the meatpacking and meat processing industries. In some cases, unions acceded to management demands for wage concessions, but in others, union workers were either replaced or the plant closed. Employment gains occurred in the newly acquired plants in the earlier period because plant buyers shifted production from less efficient, antiquated facilities producing carcasses to newer, more productive ones producing boxed meats and poultry parts. With availability of abundant labor, there was little pressure on the owners of newly acquired plants to raise wages. In the later period, the technological change and

production shifting in the meat and poultry sector had pretty much run its course, causing employment and wage growth in newly acquired plants to be no greater than that in other plants.

Large cheese, flour, feed, and oilseed processing plants with high labor costs relative to their total costs were more likely to exit over 1977-82, and large plants in all industries, except meat processing and fluid milk, with high wage costs were more likely to exit over 1982-87. The differences for meatpacking and poultry slaughter and processing in the earlier period can be attributed to a major transformation of industry output to boxed meat products and poultry parts requiring relatively more labor. Plants that continued to produce carcasses rather than boxed meat products had lower labor costs but had to accept a much lower price for their output. Many of the large plants that produced carcasses were built for an earlier era and either disappeared or changed their product mix as boxed meat and poultry production came to dominate the output mix of large plants.

How Was the Project Conducted?

This report examines employment and wage effects and the causes of plant closures among meat and poultry, dairy, and grain milling/oilseed processors. Within these three major groupings, eight industries—meatpacking, meat processing, poultry slaughter and processing, cheese, fluid milk, flour milling, feed, and oilseed processing (soybean, corn, and cottonseed processing) are examined. These industries were selected because they (1) are cost-driven industries in which production cost economies play a prominent role in a merger decision, (2) underwent dramatic structural changes, and (3) are important to farmers who look to them as an outlet for their products, consumers who view them as providers of final products, and other manufacturers who regard them as sources of ingredients for their food or animal products. We use the most recent Census of Manufacturers data. These data capture all plants producing food products and include variables for output, employment, and production costs for individual U.S. manufacturing establishments.

Plants are evaluated over the two most recent merger waves in the food industry, 1977-82 and 1982-87. The study compares pre-merger and post-merger wages and employment. For 1977-82, data from 1977 is used as a gauge of the pre-merger performance of plants that were acquired over 1977-82 and 1987 as a measure of post-merger performance. Two periods are used as a check on the robustness of the results.

Introduction

For many years mergers and acquisitions in the food industry have been viewed with skepticism. The primary concern was the promotion of anti-competitive behavior resulting from fewer firms and increased concentration. Senate hearings on the effect of mergers and acquisitions in meatpacking and slaughter are a good example of these concerns. More recent attention by the media and policy officials has focused on the impact of mergers and acquisitions in the food industry on changes in the structure of the economy, and particularly how changes in employment and wages affect the sustainability of rural communities.

Over 1972-92, the number of workers decreased by more than 100,000 (20 percent), and the number of plants declined by about one-third in seven food industries in the meat, dairy, and grain and oilseed processing sectors. Amidst a period of labor strife in the meatpacking and meat processing industries, mergers and acquisitions rose sharply over two census periods 1977-82 and 1982-87 and then dropped (Ollinger et al., 2005).

Productivity can be increased and profitability enhanced by laying off workers, dismissing managers, closing plants, abrogating pension benefits, and reducing wages.[1] This may make shareholders better off, but workers and the communities in which they live can be devastated due to bleak employment opportunities and lost tax revenues. The effect of mergers and acquisitions (M&As) on local communities is particularly important for agricultural processing because food product plants often locate in very small communities that depend on a few large employers for their survival.

[1]The public image of massive layoffs among hostile takeovers appears to be shaped by a small number of cases. Recent work by Gauchely, Groshen, and Neumark (1994) finds that the effects of hostile takeovers on workers are mostly compositional: Hostile takeovers do not reduce workers' shares of the total rents to the firm, but they do reduce payments to senior workers by reducing their employment and flattening wage-seniority profiles.

Previous research on the effect of M&As on plant closures, employment, and wages has been mixed. Brown and Medoff (1988) found that, except for divestitures, M&As had little effect on employment and wages for small firms in Michigan. Lichtenberg and Seigel (1992), who used a sample of mostly large manufacturing plants from the Longitudinal Research Database at the Census Bureau, found that M&As led to reductions in both employment and wages at central offices but had little effect at production establishments. More recently, McGuckin et al. (1997) found that M&As positively affected the likelihood of plant closures and wages and employment growth in the entire U.S. food and beverage manufacturing industry. Finally, Davis and Wilson (2003) found that M&As led to wage increases at railroad companies after deregulation in 1980.

While the just-mentioned studies provide valuable insights into the effect of M&As on the labor market, they either used data for the entire U.S. manufacturing sector (Lichtenberg and Siegel, 1992), for a single State (Brown and Medoff, 1988), after deregulation (Davis and Wilson, 2003), or for a broadly defined industry (McGuckin et al., 1997). Thus, the results may not hold for unregulated firms existing in more narrowly defined industries or for more than one period. Here, we consider the effect of mergers and acquisitions on plant closures, employment, and wages over two periods—1977-82 and 1982-87—in eight important food industries: meat packing, meat processing, poultry slaughter and processing, cheese, fluid milk, flour milling, feed, and corn/soybean (oilseed) processing. We evaluate wages and employment over a 10-year period to compare pre-merger and post-merger wages and employment. For 1977-82, we use data from 1977 as a gauge of the pre-merger performance of plants that were acquired over 1977-82 and 1987 as a measure of post-merger performance. We consider two periods to check the robustness of our results and chose the 1977-82 and 1982-87 periods because they encompass the most recent merger waves in the food sector.[2] We focus on the eight industries because of their dramatic structural changes and their importance to farmers who look to them as outlets for their products, consumers who view them as providers of final products, and manufacturers who regard them as sources of ingredients for food products or animal feed.

The eight industries produce commodity products in cost-driven industries that require little advertising or research expenditures. These characteristics make Census of Manufacturers data ideally suited for the analysis because these data contain detailed information on value of shipments, production costs, and employment.

[2]There is no reason to believe that conclusions drawn from a study using more current data (if they were available) would be any different.The results for this report were robust for the two merger periods examined.If merger incentives remain unchanged, these results should be valid for current and future mergers and acquisitions.We have no reason to suspect that merger incentives have changed.

Merger and Acquisition Activity

The ERS report, *Structural Change in the Meat, Poultry, Dairy, and Grain Processing Industries* (Ollinger et al., 2005), makes it clear that consolidation in the food industry over 1977-92 caused a major reduction in employment in seven of the eight food industries and a drop in the number of plants by about a third. Since the consolidation coincided with a wave of mergers and acquisitions, it appears plausible that food industry mergers caused job reductions and a decline in wages. Job reductions can come from closing plants and abolishing jobs or laying off workers at existing plants. First, we consider whether M&As caused plant shutdowns.

Table 1 shows an apparent linkage between M&As and industry contraction, indicating that twice as many M&As occurred over the 1977-81 and 1982-86—6.7 and 7.7 percent, respectively, of all plants (last row of first panel)—than over 1972-76 or 1987-91—2.5 and 4.9 percent, respectively. It also shows that the exchange of market share from seller to buyer amounted to about 20 percent over the 1977-81, 1982-86, and 1987-91 periods but only 7 percent over the first period, and there were 20- and 10-percent reductions in the number of plants over the two middle periods but only 6- and 3-percent reductions in the first and last timespans.

Now consider different perturbations of firm acquisition behavior. Firms can sell some plants and buy others or strictly buy, sell, or do neither. Tables 2 and 3 provide the disposition of three types of plants: acquired plants, plants owned by acquiring (buyer) firms, and plants owned by nonbuyer firms. The bottom row of each panel shows the total number of plants in that category, and the bottom row of the table shows the number of all plants owned by firms in each of the eight food industries. Since we are considering all plants owned by the firm, the number of plants owned exceeds the number of plants in the industry because firms may own plants outside their industry. For example, meatpacking firms owned 2,977 plants, but only 2,590 of them were meatpacking plants.

The first row of the top panel of table 2 shows the number of acquired plants that firms kept for the entire 10-year period (1977-87). The next two rows show the number of acquired plants that buyer firms either sold or closed over 1977-82. Firms kept about half the plants they acquired, closed about 25 percent, and sold about 25 percent. Although firms held and closed higher percentages of plants over 1982-87, the overall pattern remained similar (table 3). By contrast, those same buying firms kept 35 percent of the plants that they held in 1977, sold 30 percent, and closed the others; nonbuying firms kept about 40 percent of their plants, sold less than 10 percent, and closed the others (table 2). A similar pattern holds true for 1982-87 (table 3). Not surprisingly, the two industries with the greatest consolidation—meatpacking and fluid milk—had the highest rates of plant closures over 1977-82 (more than 60 percent). Overall, nonbuyer plants had plant closure rates greater than 50 percent. For 1982-87, only meatpacking, meat processing, and cheese had nonbuyer firm plant closure rates of 50 percent or more. These data suggest that acquired plants were bought and held for a longer period than the plants that either buyers or nonbuyers held at the beginning of the merger periods. However, these descriptive data do not provide conclusive evidence that M&As did not cause massive numbers of plant shutdowns and worker dislocations over 1977-92 because a number of intervening factors, such as labor productivity, also have roles in plant shutdown decisions. Thus, we built an empirical model explaining plant shutdown decisions in eight food industries. Before we present our model, we discuss the source of the data and the unit of analysis.

Table 1

Acquisitions and market shares during 5 years leading up to the census year in eight food industries, census years 1977-92[1]

Industry	1972-76	1977-81	1982-86	1987-91	Total	Mean
			Number			
Plants acquired:						
Meat packing	32	81	50	49	222	55.5
Meat processing	30	44	62	39	175	43.8
Poultry slaughter/processing	50	76	72	39	237	59.3
Cheese products	18	48	31	56	153	38.3
Fluid milk	40	138	100	54	332	83.0
Flour milling	19	27	33	22	101	25.3
Feed	45	82	165	75	367	91.8
Oilseeds	8	31	32	6	77	19.3
Total plants acquired	242	527	545	340	1,654	413.5
Total plants	9,874	7,858	7,053	6,841	31,626	7,906
			Percent			
Mean percent of initial count	2.5	6.7	7.7	4.9	5.2	5.2
Market share of acquired plants:						
Meat packing	4.5	38.9	19.3	42.6	105.3	26.3
Meat processing	5.1	14.7	21.3	10.8	51.9	13.0
Poultry slaughter/processing	11.1	20.4	26.8	10.5	68.8	17.2
Cheese products	9.1	25.5	12.0	36.1	82.7	20.7
Fluid milk	4.3	21.6	22.1	11.7	59.7	14.9
Flour milling	8.5	D	13.4	D	21.9[2]	10.9[2]
Feed	3.5	7.0	18.6	7.2	36.3	9.1
Oilseeds	6.9	10.3	26.9	D	44.1[3]	14.7[3]
Total	53.0	138.4[4]	160.4	118.9[5]	470.7	126.8[6]
Mean market share	6.6	19.8[4]	20.0	19.8[5]	66.2	15.9[6]

Notes: Census year is the year the census is taken. These have occurred every 5 years since 1967—i.e., 1967, 1972, 1977, etc.

D = Not revealed due to potential conflict of confidentiality.

[1]The first panel gives the number of acquisitions by industry and Census year over 1977-92; the second panel gives their corresponding market share. The column headed by acquisitions in 1977 gives the number of acquisitions over 1972-76. The other columns headed by 1982, 1987, and 1992 give mergers and acquisitions over 1977-81, 1982-86, and 1987-91. Plants with no reported financial data were dropped. Industries include meatpacking, meat processing, poultry slaughter, fluid milk, cheese, flour milling, feeds, and the combined industry of soybeans, wet corn milling, and cottonseed.

[2]Based on the 3 years in which data are reported.

[3]Based on the 4 years in which data are reported.

[4]Based on seven industries for which data are reported.

[5]Based on six industries for which data are reported.

[6]Means and totals may not add up because of the way disclosure violations are handled.

Source: U.S. Department of Agriculture, Economic Research Service estimates based on census data.

Table 2

Plant disposition over 1977-87 of plants existing in 1977 by ownership status in eight food industries

Disposition of plants	Meatpacking	Meat processing	Poultry	Cheese	Fluid milk	Flour	Feed	Oilseeds	Total
					Number				
Plants acquired by 1982:									
Plant kept 1977-87	118	70	157	119	197	178	215	170	1,224
Plant sold by 1987	56	66	94	43	99	38	106	55	557
Plant closed by 1987	77	42	61	59	109	67	118	66	599
Total acquired plants	251	178	312	221	405	283	439	291	2,380
Plants owned by buyer firms in 1982:									
Plant sold by 1987	209	*	135	*	278	*	275	*	897[1]
Plant kept 1977-87	210	*	235	*	337	*	290	*	1,072[1]
Plant closed by 1982	187	*	85	*	216	*	171	*	659[1]
Plant closed by 1987	78	*	63	*	140	*	96	*	377[1]
Total buyer plants	684	*	518	*	971	*	832	*	3,005[1]
Plants owned by nonbuyer firms in 1982:									
Plant kept in 1982 but sold by 1987	35	197[2]	26	52[2]	37	266[2]	37	143[2]	793[2]
Plant kept 1977-87	610	604[2]	169	482[2]	494	578[2]	628	318[2]	3,883[2]
Plant closed by 1982	1,073	395[2]	160	292[2]	641	319[2]	502	80[2]	3,462[2]
Plant closed by 1987	324	430[2]	87	152[2]	249	187[2]	252	152[2]	1,833[2]
Total nonbuyer plants	2,042	1,626[2]	442	978[2]	1,421	1,350[2]	1,419	693[2]	9,971[2]
Total plants	2,977	1,804	1,272	1,199	2,797	1,633	2,690	984	15,356

*Buyers and nonbuyers are combined due to potential for disclosure violations.

[1]Does not include buyer plants in which there are disclosure violations.

[2]Includes buyers and nonbuyers for cells in which there were insufficient observations for one to stand alone and not be a disclosure violation.

Source: U.S. Department of Agriculture, Economic Research Service estimates based on census data. Industries include meatpacking, meat processing, poultry slaughter, fluid milk, cheese, flour milling, feed, and the combined soybean, wet corn, and cottonseed milling (oilseeds) industries.

Table 3
Plant disposition over 1982-92 of plants existing in 1982 by ownership status in eight food industries

Disposition of plants	Meatpacking	Meat processing	Poultry	Cheese	Fluid milk	Flour	Feed	Oilseeds	Total
				Number					
Plants acquired by 1987:									
Plant kept 1982-92	145	190	184	75	142	268	273	297	1,574
Plant sold by 1992	21	99	94	50	77	81	**	49	371
Plant closed by 1992	60	92	76	50	114	131	129	107	759
Total acquired plants	226	381	505	175	333	480	402[1]	453	2,804
Plants owned by buyer firms in 1987:									
Plant kept in 1987 but sold by 1992	*	99	*	*	*	*	*	*	99
Plant kept 1982-92	195	271	260	152	221	217	274	*	1,590
Plant shut down by 1987	63	137	154	*	170	*	121	*	645
Plant shut down by 1992	*	54	44	*	85	*	43	*	226
Total buyer plants	258[1]	561	408	152[1]	476	217[1]	438	*	2,560[1]
Plants owned by nonbuyer firms in 1987:									
Plant kept in 1987 but sold by 1992	45[2]	18	97[2]	92[2]	169[2]	62[2]	62[2]	129[2]	674
Plant kept 1982-92	541	598	178	247	422	416	626	492[2]	3,520
Plant shut down by 1987	479	355	120	254[2]	271	265[2]	350	205[2]	2,299
Plant shut down by 1992	318[2]	205	50	155[2]	152	123[2]	221	95[2]	1,319
Total nonbuyer plants	1,383[2]	1,176	445[2]	748[2]	1,014[2]	866[2]	1,259[2]	921[2]	7,812[2]
Total plants	1,867	2,078	1,207	1,079	1,823	1,563	2,099	1,374	13,176

*Buyers and nonbuyers are combined due to potential for disclosure violations.

**Combined with acquired in 1987, closed by 1992 due to potential disclosure violation.

[1]Does not include buyer plants in which there are disclosure violations.

[2]Includes buyers and nonbuyers for cells in which there were insufficient observations for one to stand alone and not be a disclosure violation.

Source: U.S. Department of Agriculture, Economic Research Service estimates based on census data. Industries include meatpacking, meat processing, poultry slaughter, fluid milk, cheese, flour milling, feed, and the combined soybean, wet corn, and cottonseed milling (oilseeds) industries.

Data

Data come from the Longitudinal Research Database (LRD) and the Ownership Change Database (OCD) at the U.S. Bureau of the Census. The LRD include 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 include total employees and production workers and their wages and production worker hours.

An important feature of the LRD is its plant classification and identification information: firm affiliation, location, product and industry, and various status codes that identify birth, death, and ownership changes. These identifying codes are used in developing plant linkages across time and common ownership. For a more complete description of the LRD, see McGuckin and Pascoe (1988).

We use only the census years in the LRD, which occur in 1972, 1977, 1982, 1987, and 1992 because those data contain all plants (the LRD contains only a sample of plants in noncensus years). We chose the period 1977-92 because it encompasses the beginning and ending years of the latest merger movement. It also allows us to evaluate the performance of plants 5-9 years after their acquisition, providing sufficient time for the acquiring firm to integrate acquired plants into their operations or to dispose of them.

The OCD is a plant-level database that contains U.S. manufacturing plants that were acquired at least once. For a detailed discussion of the identification of ownership changes (through M&As), see Nguyen (1998).

We combined the OCD and the LRD by first using the OCD to identify all meat, poultry, dairy, grain, and oilseeds plants that were acquired during 1977-82 and 1982-87. Then, we merged the OCD into the LRD by firm identifier. The resulting dataset included all of the plants owned by acquiring and nonacquiring firms at the beginning of 1977 or 1982 in the eight food industries in our sample. Not all of the plants processed meat, poultry, dairy, grain, or oilseeds because acquiring firms owned plants inside and outside their designated food industries.

Plant Versus Firm-Level Analysis

There has been some debate about the appropriate unit of analysis in M&A studies. This report uses a plant-level analysis because, as pointed out by McGuckin and Nguyen (1995), firm-level data confound the analysis in two ways. First, an acquiring firm can be both a buyer and a seller because it can buy an entire firm, all plants of a firm in one industry, some plants a firm owns in one or more industries, or a single plant, while at the same time, sell some of its plants. Second, firm performance is average plant performance across all plants. Yet, a firm could have one plant that performs superbly and others that fare poorly. A plant-level analysis avoids both of these problems because it can accommodate plants owned by firms that sell only one plant or all of their plants or are both buyers and sellers. Additionally, plants stand alone, so the performance of one does not affect the performance of others.

A Model of the Effect of Mergers and Acquisitions on Plant Closures

The descriptive data suggest that M&As may not have been the prime reason for plant shutdowns (and the worker layoffs that would follow) over 1977-92. However, those data do not indicate the role, if any, that M&As did have nor show why some plants prospered and others failed. To answer those questions, we construct a model of plant closures that closely follows one used by McGuckin et al. (1997).

As claimed by a number of economists, including Anderson et al. (1998) and Muth et al. (2002), plant closures can be viewed as a measure of profitability and incorporated into a Probit regression. Let Y = 1 if a plant closes (i.e., is not profitable) and Y = 0 if it survives (remains profitable), and let X be defined as a vector of independent variables that measures whether the plant was acquired, decreases plant technology, and controls for other factors. Mathematically, this is written as:

$$\text{Prob}\ (Y_i = 1) = \text{Prob}\ (\prod_i < 0), \tag{1}$$

where longrun profits $\prod_i$ equal $\beta'\mathbf{X}_i + \varepsilon_i$, with X_i equal to a vector of characteristics that affect profitability and ε_i is a random error term:

$$= \text{Prob}\ (\beta'\mathbf{X}_i + \varepsilon_i < 0) = \text{Prob}\ (\varepsilon_i > \beta'\mathbf{X}_i) \tag{2}$$

$$= 1 - F(B'\mathbf{X}_i) \tag{3}$$

where $F(B'\mathbf{X}_i)$ is a cumulative distribution. Marginal effects are estimated separately as:

$$\frac{\partial E[y]}{\partial x} = \left\{ \frac{dF(\beta' x)}{d(\beta x)} \right\} \beta = f(\beta' x)\beta \tag{4}$$

where f (.) is the density function that corresponds to the cumulative distribution, F(.). For technical details, see Greene (1993, p. 643).

The technology variables include relative labor productivity, plant size, and plant age. McGuckin et al. (1997) have shown that relative productivity affects plant survival and Dunne et al. (1989), Baldwin (1991), and Dunne and Roberts (1990) determined that plant size and age strongly affect plant closure. The dummy variables include whether the plant is owned by an acquiring (buyer) or nonacquiring (nonbuyer) firm, industry type, and whether the plant is part of a multiplant firm. Finally, since MacDonald et al. (2000) document a large reduction in labor costs over 1972-92, we consider the effect of labor costs.

The empirical model is expressed as follows:

$$\text{Prob}\ (PC_t) = a_0 + a_1\ \text{Pr}\ (AC_t) + a_2\text{Ln PROD}_{t-1} + a_3\ \text{Ln SIZE}_{t-1} + a_4\text{AGE72} + a_5\text{AGE77} \tag{5}$$

$$+ a_6\text{Ln WAGE\_SHARE}_{t-1} + a_7\text{BUYER\_PLANT} + a_8\text{MULTI} + a_9\text{OUTSIDE}$$

$$+ a_{10}NOT\_FOOD + a_{10} \, Pr\,(AC_t){*}Ln\,SIZE_{t-1}$$
$$+ a_{11}Ln\,PROD_{t-1}{*}Ln\,SIZE_{t-1}$$

$$+ a_{12}Ln\,WAGE\_SHARE_{t-1}{*}Ln\,SIZE_{t-1} + a_{13}AGE72{*}Ln\,SIZE_{t-1}$$
$$+ a_{14}AGE77{*}Ln\,SIZE_{t-1}$$

$$+ a_{15}BUYER\_PLANT{*}Ln\,SIZE_{t-1} + a_{16}MULTI{*}Ln\,SIZE_{t-1}$$
$$+ a_{18}OUTSIDE{*}Ln\,SIZE_{t-1}$$

$$+ a_{19}NOT\_FOOD{*}Ln\,SIZE_{t-1} + \varepsilon_{zi},$$

where PC_t equals 1 if the plant was closed by year *t* and zero otherwise. Since M&As are influenced by plant productivity and size and both of those attributes are included in our model, we use an instrumental variable—the estimated probability of ownership change—to represent ownership change Pr (AC). The other variables are defined as follows: PROD is relative plant labor productivity and is discussed in detail below, SIZE (plant size) equals the number of plant employees, AGE72 equals 1 if the plant first appeared in the data in 1972 and zero otherwise, AGE77 is identical to AGE72 except it is for 1977, WAGE_SHARE is worker compensation costs as a share of total costs, BUYER_PLANT is a dummy variable defined as 1 for plants owned by buyer firms and zero otherwise, MULTI is a dummy variable equal to 1 if the plant is owned by a firm that owns other establishments and zero otherwise, OUTSIDE equals 1 if the plant produces food but is not in the industry of plant *i* and zero otherwise, and NOT_FOOD equals 1 for plants that do not produce food products and zero otherwise.

Productivity can either be measured for each input, such as labor (labor productivity), or for all inputs, total factor productivity (TFP). Theoretically, TFP is superior to labor productivity because it takes into account all inputs, but, because plant capital data are not available, we use relative labor productivity—the ratio of plant labor productivity (value of output in current dollars, divided by the total work hours) to average industry labor productivity.[3] We would have preferred to define labor productivity as real output divided by labor inputs, but we do not have output prices and the value of output varies across plants and over time due to price dispersion and inflation.[4]

[3]This relative productivity ranking approach was suggested by Christensen et al. (1981) and has been applied in recent productivity analyses using plant-level data from the LRD (e.g., Olley and Pakes, 1992; Bartelsman and Dhrymes, 1992; Bailey et al., 1992; and McGuckin and Nguyen, 1995). An important property of this productivity measure is that it does not depend on an output deflator because output in all plants is measured in current-year dollars. Accordingly, it can be used in intertemporal comparisons (see Bailey et al., 1992, p. 192).

[4]Using plant-level 1982 Census of Manufactures data, Abbot (1989) found that seven-digit product-level prices vary substantially across plants.

Empirical Results for the Effect of Mergers and Acquisitions on Plant Closures

The estimated coefficients for the probability of ownership change for 1977-82 are negative for the three meat and poultry industries and the fluid milk, feed, and oilseed industries (tables 4, 5, and 6). In four of those instances, the coefficient is also significant. The interaction of plant size and acquisitions is opposite that from acquisitions alone in all industries, except fluid milk and feed. The pattern is distinctly different for 1982-87. Ownership change has a positive effect on plant closures in all industries, except feed and oilseeds. The sign on the coefficient for the interaction of acquisitions and plant size reverses itself for all the industries.

These statistical results suggest that the merger waves of 1977-82 and 1982-87 were distinctly different and match anecdotal evidence. Meatpacking and meat processing underwent a major transformation in the earlier period, as entrants and upstarts replaced many well-established, large manufacturers. As a result, many large factories came onto the merger market and many of these were outdated. At the same time, growth in per capita beef and pork consumption dropped, making production cutbacks necessary. The inevitable result was a massive industrial consolidation with an unusually high number of large plants being shut down. Similar fates befell fluid milk and feed (the feed industry is directly tied to the slaughter industry through ownership and supply links).

Results on plant closures differ from McGuckin et al. (1997) in that they found that acquired plants were consistently less likely to be closed, whereas we find that to be the case only for smaller meat and poultry, fluid milk, and feed plants for 1977-82 and larger plants in all industries, except feed and oilseeds for 1982-87. One major difference between the studies is that we use narrowly defined industries; so, we can control for more industry-specific characteristics.

Results also show that during 1982-87 large plants in all industries with higher labor cost shares, except meat processing and milk, were more likely to exit their industries. For 1977-82, only large cheese, flour, feed, and oilseed plants with high labor costs were more likely to exit. The 1982-87 results make sense because large plants produce more commodity products that garner economies of scale that should yield lower labor costs and small plants tend to produce more niche products that require greater labor inputs. We attribute the difference for 1977-82 in meat and poultry to a shift in plant processing technologies in large plants away from the production of carcasses in multispecies plants to the production of boxed meat and poultry parts in single-species plants (MacDonald et al., 2000). Many of the large plants were designed for a different era in which large plants produced lower value carcasses that had lower labor costs and were not readily adaptable to a new environment in which large meat and poultry plants produced boxed meat and poultry parts. Eventually, many of the carcass producers either disappeared or changed their product mix as boxed meat and poultry parts came to dominate production from large slaughter facilities. See MacDonald et al. (2000) and Ollinger et al. (2000) for details of this shift.

Other findings are consistent with previous research. Similar to Dunne et al. (1989), plant size (employment) and plant size interacting with labor productivity negatively affected plant exits in 11 and 9 cases out of 16. Plant age also consistently discouraged plant exit, possibly because more experienced management could more readily adapt to the changing economic environment.

Table 4
Probit regression of plant closures for meat and poultry, 1977-82 and 1982-87

Dependent variable	1977-82			1982-87		
	Meatpacking	Meat processing	Poultry slaughter	Meatpacking	Meat processing	Poultry slaughter
Intercept	2.007*** (0.175)	1.600*** (0.234)	4.249*** (0.278)	-0.160 (0.158)	0.593*** (0.161)	0.403* (0.228)
Pr (AC)	-2.372*** (.760)	-3.847*** (.574)	-6.486*** (.689)	0.424 (0.571)	5.847*** (.676)	2.219** (1.077)
BUYER_PLANT	1.243*** (.146)	.766*** (.164)	.615*** (.141)	.222 (.141)	.115 (.125)	-.076 (.127)
Ln PROD	.473*** (.058)	.222** (.097)	1.013*** (.119)	-.089** (.038)	-.012 (.046)	.053 (.098)
Ln SIZE	-.480*** (.043)	-.668*** (.056)	-1.098** (.064)	.122** (.049)	-.371*** (.042)	.019 (.073)
Ln WAGE_SHARE	.478*** (.067)	.687*** (.111)	1.595*** (.129)	-.041 (.054)	-.266*** (.069)	.042 (.096)
AGE72	-.103*** (.021)	-.097*** (.029)	-.137*** (.039)	-.098*** (.027)	-.017 (.030)	-.100** (.043)
AGE77	n.a.	n.a.	n.a.	-.108*** (.032)	-.070** (.035)	-.054 (.048)
MULTI	.427*** (.134)	.338** (.140)	.635*** (.182)	.377** (.152)	.771*** (.134)	.547* (.336)
OUTSIDE[1]	-1.097*** (.157)	-.278*** (.031)	.072 (.147)	.159 (.173)	-.756*** (.179)	-1.579*** (.202)
NOT_FOOD	.003 (.793)	-1.137 (.207)	-1.025*** (.199)	.597** (.295)	.058 (.152)	1.457*** (.206)
Pr (AC)∗Ln SIZE	.173 (.117)	.557*** (.106)	.707*** (.112)	-.206** (.088)	-.677*** (.116)	-1.014*** (.135)
BUYER_PLANT∗Ln SIZE	-.192*** (.032)	-.060 (.038)	-.116*** (.031)	-.024 (.029)	.025 (.027)	.098*** (.027)
Ln PROD∗Ln SIZE	-.090*** (.015)	-.092*** (.024)	-.275*** (.029)	.072** (.013)	-.017 (.013)	.053** (.024)
Ln WAGE_SHARE∗Ln SIZE	-.064*** (.016)	-.183*** (.027)	-.362*** (.032)	.082*** (.016)	-.041** (.017)	.104*** (.027)
MULTI∗Ln SIZE	.022 (.031)	.033 (.033)	-.039 (.039)	-.107*** (.031)	-.160*** (.029)	-.040 (.055)
OUTSIDE∗Ln SIZE	.157*** (.034)	-.277*** (.031)	-.046 (.032)	-.073** (.036)	.028 (.035)	.456*** (.047)
NOT_FOOD∗Ln SIZE	.150 (.130)	.356 (.047)	.304*** (.046)	-.198*** (.066)	.030 (.034)	-.409*** (.059)
Log likelihood	-12,779	-6,798	-3,768	-9,188	-8,718	-4,867
OBS	3,066	1,803	1,276	2,090	2,108	1,169

Numbers in parentheses = Standard errors. n.a. = Not applicable. *, **, and ***Significant at 90-, 95-, and 99-percent levels. Notes: Dependent variable = Plant closure (1,0). [1]OUTSIDE = One for plants outside the industry in question (meatpacking, meat processing, and poultry slaughter and processing) and zero otherwise.

Table 5
Probit regression of plant closures for dairy, 1977-82 and 1982-87

Dependent variable	1977-82 Cheese	1977-82 Fluid milk	1982-87 Cheese	1982-87 Fluid milk
Intercept	0.616* (0.351)	1.750*** (0.152)	2.698*** (0.350)	0.613*** (0.240)
Pr (AC)	.529 (.839)	-.555 (.847)	5.137*** (.776)	.988 (.884)
BUYER_PLANT	-.896*** (.208)	.266** (.126)	.918*** (.189)	.902*** (.139)
Ln PROD	-.061 (.122)	.089 (.067)	-.605*** (.089)	-.240*** (.073)
Ln SIZE	-.289*** (.087)	-.432*** (.037)	.678*** (.095)	-.286*** (.065)
Ln WAGE_SHARE	.043 (.123)	.432*** (.067)	-.797*** (.113)	.178** (.092)
AGE72	-.031 (.044)	-.171*** (.028)	-.077* (.044)	-.096*** (.037)
AGE77	n.a.	n.a.	-.196*** (.056)	-.093 (.047)
MULTI	.791*** (.173)	.618*** (.122)	.937*** (.200)	.830*** (.148)
OUTSIDE[1]	-.352 (.250)	-.895*** (.124)	-1.726*** (.276)	-.846*** (.195)
NOT_FOOD	-3.772*** (.890)	-3.218*** (.925)	1.300*** (.224)	-.011 (.180)
West	.686*** (.165)	.032 (.067)	.878*** (.169)	-.108 (.099)
Pr (AC)∗Ln SIZE	-.225 (.168)	-.177 (.162)	-1.387*** (.160)	-.019 (.160)
BUYER_PLANT∗Ln SIZE	.299*** (.052)	.026 (.030)	-.093** (.043)	-.098*** (.031)
Ln PROD∗Ln SIZE	-.017 (.031)	-.038** (.017)	.136*** (.025)	.030 (.019)
Ln WAGE_SHARE∗Ln E_{77}	.069** (.031)	-.038** (.018)	.268*** (.030)	-.017 (.024)
MULTI∗Ln SIZE	-.171*** (.043)	-.134*** (.029)	-.322*** (.049)	-.258*** (.033)
OUTSIDE[1]∗Ln SIZE	.102 (.065)	.139*** (.029)	.403*** (.067)	.126*** (.040)

See notes at end of table.

Continued—

Table 5
Probit regression of plant closures for dairy, 1977-82 and 1982-87—Continued

Dependent variable	1977-82		1982-87	
	Cheese	Fluid milk	Cheese	Fluid milk
NOT_FOOD*Ln SIZE	.734***	.758***	-.226***	.059
	(.173)	(.175)	(.055)	(.039)
West*Ln SIZE	-.214***	-.039**	-.152***	-.030
	(.047)	(.019)	(.043)	(.024)
Log likelihood	-7,533	10,371	-4,476	-7,806
OBS	1,168	2,756	1,050	1,777

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Notes: Dependent variable = Plant closure (1,0).
[1]OUTSIDE = One for plants outside the industry in question (cheese or fluid milk) and zero otherwise.

Table 6
Probit regression of plant closures for grains and oilseeds, 1977-82 and 1982-87

	1977-82			1982-87		
Dependent variable	Flour milling	Feed	Oilseeds[1]	Flour milling	Feed	Oilseeds[1]
Intercept	-1.241*** (0.363)	-0.717*** (0.197)	-0.460 (0.332)	-0.751*** (0.293)	-0.988*** (0.175)	0.828** (0.407)
Pr (AC)	2.808*** (.444)	-3.394*** (.857)	-.298 (.590)	2.478*** (.619)	-2.537*** (.469)	-1.041* (.665)
BUYER_PLANT	-.192 (.137)	.399*** (.095)	.755*** (.160)	.791*** (.115)	.015 (.092)	.113 (.128)
Ln PROD	-.691*** (.115)	-.392*** (.076)	.288** (.117)	-.380*** (.084)	-.233*** (.056)	.170 (.109)
Ln SIZE	-.055 (.081)	.077 (.050)	-.116 (.074)	-.081 (.080)	.249*** (.056)	-.129 (.106)
Ln WAGE_SHARE	-.683*** (.141)	-.204*** (.025)	.232*** (.107)	-.102 (.095)	-.320*** (.056)	.437*** (.111)
AGE72	-.200*** (.034)	-.097*** (.029)	-.220*** (.052)	.128*** (.044)	-.144*** (.030)	-.008 (.048)
AGE77	n.a.	n.a.	n.a.	-.120** (.052)	-.149*** (.035)	.027 (.062)
MULTI	-.037 (.152)	-.505*** (.094)	.679*** (.215)	.564*** (.146)	.601*** (.121)	.294 (.211)
NOT_FOOD	-.214* (.127)	-4.987*** (.775)	.827*** (.182)	.404*** (.130)	.263** (.137)	.161 (.115)
OUTSIDE[2]	.030 (.167)	.722*** (.125)	n.a.	.143 (.187)	.516*** (.133)	n.a.
Corn	n.a.	n.a.	2.167*** (.341)	n.a.	n.a.	1.667*** (.468)
Cotton	n.a.	n.a.	2.247*** (.315)	n.a.	n.a.	1.064*** (.412)
Soy	n.a.	n.a.	1.958*** (.401)	n.a.	n.a.	2.071*** (.322)
Pr (AC)∗Ln SIZE	-.518*** (.128)	-.165 (.140)	.248** (.126)	-.314*** (.094)	.194** (.090)	.041 (.124)
BUYER_PLANT∗Ln SIZE	-.009 (.032)	-.038 (.024)	-.119*** (.037)	-.167*** (.026)	.102*** (.022)	-.037 (.030)
Ln PROD∗Ln SIZE	.153*** (.027)	.065*** (.019)	-.112*** (.029)	.082*** (.020)	-.233*** (.056)	-.073** (.023)
Ln WAGE_SHARE∗Ln SIZE	.219*** (.032)	.195*** (.019)	.046* (.026)	.083*** (.023)	.157*** (.016)	.041 (.124)
MULTI∗Ln SIZE	.066* (.037)	.092*** (.022)	-.065 (.052)	-.138*** (.037)	-.104*** (.029)	-.111** (.051)

See notes at end of table.

Continued—

Table 6
Probit regression of plant closures for grains and oilseeds, 1977-82 and 1982-87—Continued

Dependent variable	1977-82 Flour milling	1977-82 Feed	1977-82 Oilseeds[1]	1982-87 Flour milling	1982-87 Feed	1982-87 Oilseeds[1]
NOT_FOOD*Ln $SIZE_{77}$	.107***	n.a.	-.148***	-.074**	.132***	-.091***
	(.030)		(.041)	(.031)	(.032)	(.024)
OUTSIDE*Ln SIZE	.048	-.247***	—	.026	-.110***	—
	(.044)	(.041)		(.051)	(.034)	
Corn*Ln SIZE	n.a.	n.a.	-.458***	n.a.	n.a.	-.999***
			(.086)			(.244)
Cotton*Ln SIZE	n.a.	n.a.	-.432***	n.a.	n.a.	-.310***
			(.081)			(.093)
Soy*Ln SIZE	n.a.	n.a.	-.560***	n.a.	n.a.	-.581***
			(.119)			(.085)
Log likelihood	-5,815	-9,818	-2,649	-6,498	-8,117	-5,373
OBS	1,633	2,688	960	1,617	2,017	1,364

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable: = Plant closure (1,0).
[1]Oilseeds include soybean, wet corn, and cottonseed milling.
[2]OUTSIDE = One for plants outside the industry in question (flour or feed) and zero otherwise. Several dummy variables are used to control for different types of oilseeds.

Wage and Employment Equations and Empirical Results

The previous discussion indicates that M&As were not a driving force behind plant shutdown decisions. Indeed, it would not be rational to buy a plant and then shut it down. However, it may make more sense to buy a plant and then cut the workforce and reduce worker wages. Thus, we specify a model of the effects of M&As on plant employment (SIZE) and wages (WAGE) that closely follows a model of the effect of training on workers' earnings and employment used by McGuckin et al. (1997). We evaluate wages and employment plants over a 10-year period to compare pre-merger and post-merger wages and employment. For 1977-82, we use data from 1977 as a gauge of the pre-merger performance of plants that were acquired over 1977-82 and 1987 as a measure of post-merger performance.

The worker training literature indicates that better trained workers—such as nonproduction workers—earn higher incomes than production workers, training has a positive effect on employment (Block, 1979; Ashenfelter and Kruger, 1994), and plant size and age affect wage and employment (Brown and Medoff, 1988; Dunne and Roberts, 1990). Thus, our model includes the ratio of nonproduction workers to production workers, plant size, and plant age. Also, Dunne and Roberts (1990) found that capital intensity, two-digit industries, and geographic regions are important factors in determining wages. Finally, the model must account for plant specialization because greater specialization can lead to employment reductions due to combining similar tasks:

$$\begin{aligned}\text{Ln SIZE}_t - \text{Ln SIZE}_{t\text{-}1} = {} & a_1 \text{ Pr } (\text{AC}_t) + a_2 \text{ BUYER\_PLANT} + \\ & a_3 \text{ Ln WAGE}_{t\text{-}1} + \\ & a_4 \text{ Ln SIZE}_{t\text{-}1} + a_5 \text{ Ln } (\Delta \text{ NPW/PW})_t + \\ & a_6 \text{ Ln } (\Delta \text{ K/S})_t + a_7 \text{ Ln } \Delta \text{ SPEC}_t + \\ & a_8 \text{ AGE72} + a_9 \text{ AGE77} + a_{10} \text{ MULTI} + \\ & a_{11} \text{ OUTSIDE} + \\ & a_{12} \text{ NOT\_FOOD} + \varepsilon, \end{aligned} \qquad (6)$$

and similarly for wages:

$$\begin{aligned}\text{Ln WAGE}_t - \text{Ln WAGE}_{t\text{-}1} = {} & a_1 \text{ Pr } (\text{AC}_t) + \\ & a_2 \text{ BUYER\_PLANT} + \\ & a_3 \text{ Ln WAGE}_{t\text{-}1} + \\ & a_4 \text{ Ln SIZE}_{t\text{-}1} + \\ & a_5 \text{ Ln } (\Delta \text{ NPWW/PWW})_t + \\ & a_6 \text{ Ln } (\Delta \text{ K/S})_t + \\ & a_7 \text{ Ln } \Delta \text{ SPEC}_t + a_8 \text{ AGE72} + \\ & a_9 \text{ AGE77} + a_{10} \text{ MULTI} + \\ & a_{11} \text{ OUTSIDE} + a_{12} \text{ NOT\_FOOD} + \varepsilon, \end{aligned} \qquad (7)$$

where SIZE is the number of plant employees—both production and nonproduction workers. WAGE is workers' annual salaries and does not include nonwage costs because data on these costs are not available for production and nonproduction workers. Dunne and Roberts (1993) found that "non-wage costs are poorly reported in census data and are often imputed." Real wages are defined as nominal wages deflated by the Consumer Price Index as given by the Bureau of Labor Statistics (2005). The variable Δ NPW/PW is the change in the ratio of the number of nonproduction workers (NPW) to the number of production workers (PW) and is used only in the employment equation to control for changes in the composition of the labor force. The change in the capital to sales ratio (Δ K/S) is used to control for changes in capital intensity, and SPEC is percentage of plant output produced for its "home" industry (e.g., percentage of meat slaughter products produced by meat slaughter plants). In the wage equation, Δ (NPWW/PWW), the change in the ratio of nonproduction worker wages to production worker wages, is used to account for the wage differential between office workers and production workers. All other variables have been defined previously. The ε is the error term.

Columns 1-3 of tables 7, 8, and 9 show the regression estimates of the employment growth equations for the meat, dairy, and grains industries for 1977-87, while columns 4-6 present the estimates for the same industries for 1982-92. The instrumental variable Pr (AC) is positive and statistically significant for the meat, dairy, and feed industries over the 1977-87 period, but negative for flour milling and oilseed crushing. Quite a departure from this finding occurs for 1982-92, with only cheese being significant and positive.

A dramatic consolidation (Ollinger et al., 2005) in the earlier period may account for the changes. During 1977-82, the number of fluid milk, meatpacking, poultry slaughter and processing and cheese plants dropped by more than 25 percent and the number of flour and feed plants declined by more than 10 percent. Consolidation slowed to less than half this rate, and some industries, such as poultry, began to grow over 1982-87. For the earlier period, consolidation enabled some firms to combine output in some plants to enhance productivity in those facilities while closing others. If acquired plants tended to be better assets than the plants the firms held prior to the merger, then output and employment would have grown in these plants and shrunk elsewhere. In the later period, this structural shift had pretty much played itself out, providing fewer opportunities to shift output from less productive existing plants to newly acquired more efficient ones. Thus, acquired plants tended to add employees at a greater rate than plants in the rest of the industry in the first period but not in the second one.

Other results are generally consistent with previous research. Economic theory suggests that higher-than-average wages attract more workers, causing employment to grow. The wage effect holds for meatpacking, meat processing, dairy, and feed but not for poultry and grain industries. An increase in nonproduction workers relative to production workers should cause employment to rise relative to production because nonproduction workers do not directly contribute to output. Results bear this out, showing that a higher ratio of nonproduction workers to production workers caused employment growth in all industries, except poultry. Additionally, larger and older plants in all industries grew more slowly than other plants in their

Table 7
Employment equation for meat and poultry, 1977-87 and 1982-92

Dependent variable	1977-82 Meatpacking	1977-82 Meat processing	1977-82 Poultry slaughter	1982-87 Meatpacking	1982-87 Meat processing	1982-87 Poultry slaughter
Intercept	0.478*** (0.229)	0.264 (0.234)	0.700** (0.292)	-0.318 (0.188)	-0.008 (0.158)	0.846** (0.314)
Pr (AC)	1.529*** (.290)	1.391*** (.466)	.558** (.250)	-.436 (.359)	.248 (.415)	-.053 (.678)
Buyer_Plant	.076 (.082)	-.063 (.097)	.046 (.063)	-.005 (.070)	-.185*** (.055)	-.067 (.057)
Ln $WAGES_{t-1}$	.084 (.086)	.256*** (.092)	-.115*** (.129)	.197*** (.068)	.162*** (.052)	-.101 (.101)
Ln $SIZE_{t-1}$	-.284*** (.088)	-.457*** (.097)	.075 (.128)	-.256*** (.072)	-.249*** (.058)	.045 (.093)
Δ NPW/PW	.076* (.042)	.077** (.033)	-.023 (.018)	.092** (.049)	.031 (.030)	.039 (.034)
Δ K/S	-.010*** (.002)	.015 (.011)	-.009*** (.002)	-.0005 (.0008)	-.0003 (.0005)	-.00005 (.0005)
Δ SPEC	-.003 (.014)	.017** (.008)	-.129** (.065)	.021 (.054)	.035 (.051)	.025 (.079)
AGE72	-.094 (.062)	-.233*** (.069)	-.240*** (.080)	-.187*** (.069)	-.222*** (.059)	-.172* (.090)
AGE77	n.a.	n.a.	n.a.	-.071 (.083)	-.070 (.069)	-.049 (.097)
MULTI	.117 (.096)	.001 (.089)	.096 (.090)	.410*** (.081)	.307*** (.064)	.285*** (.100)
OUTSIDE[1]	.119 (.081)	.111 (.139)	-.282*** (.109)	.232* (.121)	.098 (.112)	-.171 (.184)
NOT_FOOD	-.252** (.127)	-.232 (.148)	-.350** (.145)	.265* (.139)	.186 (.110)	-.210* (.118)
R^2	.140	.142	.104	.045	.061	.100
Observations	916	654	553	850	1,033	605

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable = $Ln(SIZE_t) - Ln(SIZE_{t-1})$.
[1]OUTSIDE = One for plants outside the industry in question (meatpacking, meat processing, and poultry slaughter and processing) and zero otherwise.

Table 8

Employment equation for dairy, 1977-87 and 1982-92

Dependent variable	1977-82 Cheese	1977-82 Fluid milk	1982-87 Cheese	1982-87 Fluid milk
Intercept	-0.278 (0.207)	0.410** (0.184)	0.357 (0.273)	-1.015*** (0.219)
Pr (AC)	.752*** (.250)	1.064*** (.314)	.622** (.307)	-.302 (.406)
BUYER_PLANT	-.0005 (.063)	-.013 (.048)	.019 (.090)	-.041 (.054)
Ln $WAGES_{t-1}$	.049 (.087)	.535*** (.077)	.243*** (.092)	.483*** (.067)
Ln $SIZE_{t-1}$	-.642*** (.095)	-.710*** (.088)	-.252*** (.098)	-.512*** (.075)
Δ NPW/PW	.074** (.031)	.094*** (.015)	.073* (.045)	.039*** (.010)
Δ K/S	-.001 (.007)	-.021*** (.006)	-.0005 (.0009)	.0009 (.005)
Δ SPEC	.046 (.045)	.015 (.012)	.115 (.101)	-.030 (.030)
AGE72	-.262*** (.066)	-.193*** (.065)	-.348*** (.100)	-.207*** (.077)
AGE77	n.a.	n.a.	-.089 (.118)	.042 (.105)
MULTI	-.269*** (.089)	-.182*** (.060)	.020 (.127)	.067 (.065)
OUTSIDE[1]	-.114* (.070)	-.109* (.064)	-.287* (.150)	.035 (.065)
NOT_FOOD	-.116 (.087)	.146** (.071)	.183 (.149)	.021 (.082)
West	-.011 (.076)	.019 (.053)	.067 (.111)	.048 (.055)
R^2	.210	.177	.072	.097
Observations	574	974	457	758

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable = $Ln(SIZE_t) - Ln(SIZE_{t-1})$.
[1]OUTSIDE = One for plants outside the industry in question (cheese or fluid milk) and zero otherwise.

Table 9
Employment equation for grains, 1977-87 and 1982-92

	1977-82			1982-87		
Dependent variable	Flour milling	Feed	Oilseeds[1]	Flour milling	Feed	Oilseeds[1]
Intercept	0.818***	0.327*	0.888**	0.206	-0.067	0.725***
	(0.210)	(0.172)	(0.444)	(0.238)	(0.158)	(0.232)
Pr (AC)	-.094	1.403***	-.601*	.139	-.226	-1.128***
	(.250)	(.326)	(.337)	(.402)	(.374)	(.290)
BUYER_PLANT	-.011	.036	-.010	-.077	-.180***	.012
	(.048)	(.047)	(.059)	(.060)	(.056)	(.045)
Ln $WAGES_{t-1}$	-.094	.111***	-.082	.022	.186***	.040
	(.078)	(.069)	(.135)	(.071)	(.053)	(.065)
Ln $SIZE_{t-1}$	.015	-.287***	.014	-.09	-.266***	.069
	(.084)	(.078)	(.138)	(.070)	(.066)	(.069)
Δ NPW/PW	.028	.085***	.079	.119***	.025	.120***
	(.024)	(.024)	(.036)	(.029)	(.030)	(.024)
Δ K/S	-.009***	-.0006	-.024***	-.0001	-.0004	-.0004**
	(.003)	(.0004)	(.006)	(.0004)	(.0005)	(.0002)
Δ SPEC	.0003	-.008	.009	-.097*	.017	-.046
	(.009)	(.008)	(.013)	(.060)	(.051)	(.034)
AGE72	-.295***	-.221***	-.251***	-.262	-.225***	-.218***
	(.063)	(.054)	(.084)	(.075)	(.059)	(.073)
AGE77	n.a.	n.a.	n.a.	-.144	-.062	-.094
				(.090)	(.069)	(.087)
MULTI	-.051	-.291***	.029	-.021	.304	-.128*
	(.066)	(.063)	(.087)	(.085)	(.251)	(.077)
OUTSIDE[2]	.055	.243***	n.a.	.217***	.035	n.a.
	(.062)	(.064)		(.109)	(.165)	
Corn	n.a.	n.a.	-.030	n.a.	n.a.	-.142
			(.135)			(.106)
Cotton	n.a.	n.a.	-.228*	n.a.	n.a.	-.478***
			(.133)			(.138)
Soy	n.a.	n.a.	-.008	n.a.	n.a.	-.236***
			(.104)			(.074)
NOT_FOOD	-.091	-.561***	-.024	-.026	.268	-.033
	(.058)	(.082)	(.062)	(.061)	(.345)	(.047)
R^2	.095	.125	.107	.070	.059	.080
Observations	730	982	479	807	1,033	768

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
`*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable = $Ln(SIZE_t) - Ln(SIZE_{t-1})$.
[1]Oilseeds include corn, cottonseed, and soy.
[2]OUTSIDE = One for plants outside the industry in question (flour or feed) and zero otherwise. Several dummy variables are used to control for different types of oilseeds.

industries over both periods. These results are consistent with Brown and Medoff (1988) and Dunn and Roberts (1990). The negative effect of capital intensity (K/S) on employment (all industries) is consistent with Dunne and Roberts (1990). Finally, being part of a multiplant firm had a positive effect on employment growth in meat and poultry but not in the other industries.

The regression results for the wage growth equations are in tables 10, 11, and 12, columns 1-3 for 1977-82 and columns 4-6 for 1982-92. The probability of being acquired, Pr (AC), negatively affected wage growth in the meat and poultry industries, both dairy industries, and the feed industry during 1977-87, but reversed its sign for all of these plants, except cheese and feed, during 1982-92. Over each period, the coefficient is significant in two of six cases. Oilseeds were negative in both periods. These results differ markedly from those of McGuckin et al. (1997) who found a significantly positive effect of acquisitions on wage growth over 1977-87.

Two phenomena likely had important effects on wages. In industries, such as meatpacking and meat processing, worker bargaining power diminished due to falling demand, competition from nonunion plants, and the availability of low-cost immigrant labor. Meanwhile, greater scale economies from newer plants in all industries due to organizational and technological changes pressured existing plants, including newly acquired ones, to reduce costs, particularly wages (MacDonald et al., 2000) or face a loss of profitability.

Other results in the wage growth equation are more consistent with previous research. As economic theory would suggest, initial wages are consistently significant and negative across industries, suggesting that high initial wages cause wages to grow at a slower rate. Consistent with Dunne and Roberts (1990), plant size is positive in all but two cases over both periods and significant in six cases (meat and poultry and grain) over 1977-87. The oldest plant age variable (AGE72) has a negative impact on wage growth in 13 of the 16 cases and is negative and significant in 10 instances. The later plant age variable (AGE77) had no effect.

Consistent with Block (1979) and Ashenfelter and Kruger (1994), wage costs rose as the ratio of nonproduction to production worker wages rose. Previous work by Dunne and Roberts (1990) suggested that capital intensity has a negative impact on plant wages, but our results are mixed. In six cases, we find a negative and significant effect, but we also have eight positive but insignificant instances. The multiplant variable and the other variables are generally insignificant.

Table 10
Wage equation for meat and poultry, 1977-87 and 1982-92

	1977-82			1982-87		
Dependent variable	Meatpacking	Meat processing	Poultry slaughter	Meatpacking	Meat processing	Poultry slaughter
Intercept	1.513*** (0.246)	1.394*** (0.264)	1.871*** (0.297)	0.233*** (0.079)	0.334*** (0.083)	0.363*** (0.136)
Pr (AC)	.874*** (.312)	.709 (.516)	.709 (.515)	-.066 (.151)	-.140 (.218)	-.072 (.293)
BUYER_PLANT	.136 (.088)	-.083 (.107)	.063 (.064)	.014 (.030)	-.007 (.029)	.019 (.024)
Ln $WAGES_{t-1}$	-.408*** (.092)	-.250** (.102)	-.491*** (.131)	-.047** (.029)	-.044* (.027)	-.072* (.044)
Ln $SIZE_{t-1}$	.345*** (.094)	.200* (.107)	.478*** (.130)	.028 (.030)	.027 (.030)	.053 (.040)
Δ NtPWW/PWW	.084* (.046)	.078** (.037)	.004 (.018)	.271*** (.021)	.167*** (.016)	.125*** (.015)
Δ K/S	-.009*** (.002)	.017 (.012)	-.009*** (.002)	.0003 (.0003)	.0002 (.0003)	-.0002 (.0002)
Δ SPEC	-.008 (.015)	.020** (.008)	-.155** (.066)	.030 (.023)	.025 (.027)	.025 (.034)
AGE72	-.113* (.066)	-.218** (.076)	-.192** (.081)	-.041 (.029)	-.030 (.031)	.005 (.039)
AGE77	n.a.	n.a.	n.a.	.021 (.035)	.014 (.035)	.044 (.042)
MULTI	.138 (.104)	-.017 (.098)	.061 (.091)	.026 (.034)	.032 (.034)	.008 (.043)
OUTSIDE[1]	.127 (.087)	.028 (.154)	-.018 (.111)	.074 (.051)	.026 (.059)	.008 (.080)
NOT_FOOD	.132 (.137)	-.044 (.163)	.024 (.121)	.132** (.058)	.022 (.041)	.004 (.063)
R^2	.085	.059	.123	.191	.126	.139
Observations	916	654	553	850	1,033	605

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable = $Ln(WAGE_t) - Ln(WAGE_{t-1})$.
[1]OUTSIDE = One for plants outside the industry in question (meatpacking, meat processing, or poultry) and zero otherwise.

Table 11

Wage equation for dairy, 1977-87 and 1982-92

Dependent variable	1977-82 Cheese	1977-82 Fluid milk	1982-87 Cheese	1982-87 Fluid milk
Intercept	1.029***	1.194***	0.112	-0.037
	(0.226)	(0.194)	(0.106)	(0.150)
PR (AC)	.088	.213	.054	.734***
	(.267)	(.318)	(.120)	(.277)
BUYER_PLANT	-.047	-.018	.045	.004
	(.068)	(.051)	(.035)	(.037)
Ln $WAGES_{t-1}$	-.115	-.126	.024	.033
	(.094)	(.080)	(.036)	(.046)
Ln $SIZE_{t-1}$	.134	.101	.022	.027
	(.102)	(.092)	(.038)	(.051)
Δ NPWW/PWW	.079**	.098***	.217***	.062***
	(.033)	(.016)	(.018)	(.007)
Δ K/S	.005	-.013**	.0005	.002
	(.008)	(.006)	(.0003)	(.003)
AGE72	-.261***	-.258**	-.107***	-.101
	(.072)	(.069)	(.039)	(.052)
AGE77	n.a.	n.a.	-.079*	.035
			(.046)	(.072)
MULTI	.002	-.010	.052	.024
	(.095)	(.062)	(.050)	(.045)
OUTSIDE[1]	-.071	.042	-.044	.034
	(.074)	(.066)	(.058)	(.044)
NOT_FOOD	.001	-.104	.148***	.006
	(.093)	(.075)	(.058)	(.056)
West	.034	.092*	.017	.059
	(.082)	(.057)	(.043)	(.037)
R^2	.052	.072	.280	130
Observations	566	973	455	758

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable = $Ln(WAGE_t) - Ln(WAGE_{t-1})$.
[1]OUTSIDE = One for plants outside the industry in question (cheese or fluid milk) and zero otherwise.

Table 12
Wage equation for grains, 1977-87 and 1982-92

Dependent variable	1977-82			1982-87		
	Flour milling	Feed	Oilseeds[1]	Flour milling	Feed	Oilseeds[1]
Intercept	1.770*** (0.226)	1.430*** (0.175)	2.749*** (0.454)	0.447*** (0.096)	0.343*** (0.088)	0.627*** (0.116)
Pr (AC)	-.160 (.267)	.610* (.326)	-1.231*** (.344)	.293** (.125)	.263* (.146)	-.446*** (.144)
BUYER_PLANT	.027 (.051)	.056 (.048)	-.057 (.061)	-.038 (.027)	.033 (.026)	.022 (.022)
Ln $WAGES_{t-1}$	-.396*** (.084)	-.291*** (.071)	-.581*** (.137)	-.042 (.031)	.028 (.029)	-.066** (.032)
Ln $SIZE_{t-1}$	.383*** (.090)	.231*** (.079)	.544*** (.140)	-.035 (.032)	-.022 (.029)	.045 (.034)
Δ NPWW/PWW	-.031 (.025)	.092*** (.025)	.041 (.037)	.204*** (.013)	.185*** (.012)	.186*** (.014)
Δ K/S	-.010*** (.003)	.001 (.001)	-.032*** (.006)	.0002 (.0002)	-.0001 (.0001)	-.00013* (.00008)
Δ SPEC	-.001 (.009)	n.a.	.017 (.013)	n.a.	n.a.	.010 (.017)
AGE72	-.275*** (.067)	-.216*** (.055)	-.178** (.085)	.017 (.035)	-.072** (.031)	.006 (.036)
AGE77	n.a.	n.a.	n.a.	.035 (.041)	-.021 (.036)	.025 (.043)
MULTI	.127* (.071)	.083 (.064)	.115 (.089)	.0003 (.036)	.034 (.036)	-.091** (.039)
OTUSIDE[2]	-.017 (.067)	.222*** (.064)	n.a.	-.010 (.038)	.009 (.032)	n.a.
Corn	n.a.	n.a.	.068 (.139)	n.a.	n.a.	-.024 (.053)
Cotton	n.a.	n.a.	-.429*** (.136)	n.a.	n.a.	-.235*** (.069)
Soy	n.a.	n.a.	-.097 (.106)	n.a.	n.a.	-.061 (.037)
NOT_FOOD	.036 (.062)	-.291*** (.084)	.075 (.063)	.058** (.028)	.049 (.037)	-.033 (.024)
R^2	.088	.095	.143	.285	.230	.217
Observations	728	981	479	806	1,087	767

Numbers in parentheses = Standard errors.
n.a. = Not applicable.
*, **, and ***Significant at 90-, 95-, and 99-percent levels.
Note: Dependent variable = $Ln(WAGE_t) - Ln(WAGE_{t-1})$.
[1]Oilseeds include corn, cottonseed, and soy.
[2]OUTSIDE = One for plants outside the industry in question (flour or feed) and zero otherwise. Several dummy variables are used to control for different types of oilseeds.

Discussion of the Link Between Plant Closures and the Labor Market

The finding that small, acquired plants were less likely to be closed over 1977-82 and large ones less likely to be closed over 1982-87 needs further discussion. Some of the change may be due to the shift in meatpacking operations to the West, poultry operations to the Southeast, and cheese production to the West (MacDonald et al., 2000; Ollinger et al., 2000; Manchester and Blayney, 1997). A more important source of differences may have been the radical changes in the technologies of the three meat and poultry industries and the fluid milk and feed industries during the early 1980s. In these industries, stagnating demand conspired with a new technology to force closure of many large plants and the exit of many old-line manufacturers (Ollinger et al., 2005). This trend was particularly true in meat and poultry. In this group of industries, high wages were a contributing factor to plant failures, but plant shutdowns may have been hastened by the move to larger, horizontal flow processing facilities that were better suited for highly specialized processing and the geographic shifts in cattle slaughter from the eastern part of the Corn Belt to lower-cost Great Plains States where they enjoyed closer proximity to their herds (MacDonald et al., 2000). Similarly, hog slaughter plants found it advantageous to obtain hogs under contract from large growers and moved to the Southeast, fluid milk plants consolidated existing plants into larger facilities and moved to the West, and large soybean processing plants were replaced by even larger plants in the Midwest.

The changed industries that emerged during the later 1980s featured much larger plants using more modern technologies and under new management (MacDonald et al, 2000). Since firms tended to buy more productive plants and then improve plant productivity (Ollinger et al., 2005), acquired plants were well-positioned for employment growth. However, acquiring firms did not increase wages beyond that which is the industry standard.

Production work in the food industries requires low-skill workers performing repetitive tasks, so there is no reason for firms to pay higher wages than do other companies hiring low-skill workers. For example, the industry with the greatest job growth, poultry slaughter and processing, added thousands of low-paid meat cutters to staff deboning and part cutup operations. These jobs require dexterity with a cutting knife but few other skills, making the tasks easily trainable and allowing the use of abundant low-skill labor.

Conclusion

In this report, we examined the effect of plant acquisitions on plant closures, employment growth, and wage growth during two merger waves—1977-82 and 1982-87. Results show that M&As decreased the likelihood of small plant closures over 1977-82 and large plant closures over 1982-87. M&As positively affected hiring at acquired plants during 1977-82 but not during 1982-87. Acquisitions generally had a positive but insignificant impact on wage growth over the pre- to post-merger period from 1977-87 and no discernible effect for 1982-92. While these results do not support the view that M&As caused worker dislocations and lost wages, they also do not suggest that being part of an M&A increased wages and employment of the affected workers. At most, workers in acquired plants had a modest increase in job security but no likely change in wages relative to their peers in plants that were not acquired.

Results for wage and employment growth are similar to the McGuckin et al. (1997) study of the entire food industry for 1977-87 but differ sharply for 1982-92. The 1982-92 results more closely match Lichtenberg and Seigel (1992), who found that M&As led to reductions in both employment and wages at central offices but had little effect on production establishments.

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