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THE GROCERY STORES' WAGE DISTRIBUTION: A SEMI-PARAMETRIC ANALYSIS OF THE ROLE OF RETAILING AND LABOR MARKET INSTITUTIONS

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ABSTRACT

How and why has the wage distribution in U.S. grocery stores changed between 1984 and 1994? Unlike other industries in this time period, the important change in the wage distribution is not rising inequality, but that real wages fell across the entire wage distribution. Changes in labor market institutions explain more than half of the change in the wage distribution in grocery stores. Specifically, the decline in the real value of the minimum wage explains little of the decline in the mean real wage but much of the change in the *shape* of the distribution between 1984 and 1994, and 95 percent of the decline at the lowest 10th percentile. The decline in union coverage in grocery stores and the narrowing of the union-nonunion wage gap explain much of the decline above the 25th percentile. A third institutional change, the use of part-time employees, is not associated with changes in grocery industry wage outcomes.

One might think that the major changes in operations and technologies that occurred during this period are at least contributing factors, but we find quite the contrary. If average store size, weekly operating hours, and the use of scanning technology had remained at their lower 1984 levels, the real wage decline would have been even greater than that actually seen, and for the entire wage distribution. Changes in grocery retailing prevented an even greater decline in real wages. Again unlike many other industries, skill-biased technological change does not appear important for grocery industry wage outcomes.

The basis of our analysis is a statistical technique which combines nonparametric kernel density estimation with a parametric re-weighting, applied to Current Population Survey data supplemented with secondary data sources on the Grocery industry.

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Introduction

The average net profit margin in the grocery industry is around one percent of sales. Wage and fringe benefit expenses average approximately 10 percent of sales (Food Marketing Institute, various issues). Consequently, it is unsurprising that labor cost concerns are repeatedly cited by supermarket managers and executives as a leading concern (Progressive Grocer, various issues). In the last two decades, the grocery industry has also experienced a dramatic increase in the use of technology while stores have become larger and more diverse. At the same time, union density and the real value of the minimum wage have declined. What are the implications for wage outcomes?

On an aggregate level, it has been well-documented that wage inequality in the United States has significantly increased since 1980 (Levy and Murnane, 1992; Gottschalk and Smeeding, 1997). Potential explanations for the observed increase in inequality include supply-side determinants such as human capital investment, immigration, cohort size, and female labor force participation; demand-side determinants such as skill-biased technological change, international trade, and a changing industrial structure; and institutional factors such as declining unionization and real minimum wage values.[1] But what has happened in the grocery industry?

The analysis below indicates that in the U.S. grocery industry, real wages have declined over the last 20 years while wage inequality does not exhibit any clear trend. To assess the relative importance of

[1] See Autor, Katz, and Krueger (1998), Burtless (1995), DiNardo, Fortin, and Lemieux (1996), Gottschalk (1997), Johnson (1997), Juhn (1999), Lee (1998), and Topel (1997) and the references cited therein.

various factors changing the industry wage distribution over time, we apply the methodology of DiNardo, Fortin, and Lemieux (1996) to the grocery industry. In short, probabilities, calculated from logit models, that different characteristics appear in different time periods are incorporated into kernel density estimation so that counterfactuals can be constructed. With these counterfactuals, one can analyze, for example, what the wage distribution would have looked like in 1994 if education remained unchanged during the 1980s, and therefore assess the relative importance of various factors in explaining the observed changes in wage outcomes.

With this focused within-industry analysis, we can better understand wage determinants, and therefore labor cost pressures, in the grocery industry. Moreover, by examining a specific industry we are better positioned to assess the role of technology, especially increases in the use of scanners, and other operational changes such as increased store hours. Technological and operational change have been hotly debated in the aggregate research literature on wage inequality, but can only be understood by within-industry analyses.[2]

Changing Grocery Operations

Continuing trends dating to the early 1900s, supermarkets in the last 20 years have become larger, more diverse, open longer, and more likely to be part of a chain operation.[3] Using data from the industry trade publication *Progressive Grocer* merged with a Current Population Survey (CPS) sample of Grocery

[2] The aggregate research also studies changes in international trade and the broad industr structure. Focusing on retail food excludes both of these dimensions from consideration which potentially allows a better evaluation of the remaining factors.

[3] Supermarkets consistently represent about 75 percent of retail grocery sales.

Stores employees (see below), Table 1 documents these trends for 1984-94.[4] The increasing dominance of chain stores is illustrated in column 1 of Table 1 in which the fraction chain remains stable at around 66 percent for 1984-87, but then increases to nearly 75 percent in 1994 (see also Mayo, 1993).

Columns 2-7 of Table 1 present various measures of store size – and each indicates steady and significant growth in this time period. Average total store area increases 45 percent from 23,829 square feet to 34,735, the number of items stocked (SKUs) increases 84 percent, the average number of checkouts increases 27 percent, average real weekly transactions increase 34 percent, and the average number of full- and part-time employees increase 59 and 71 percent. As stores have grown larger, they have also become more diverse by offering more prepared foods and adding bakeries, salad bars, pharmacies, video rentals, and other food and non-food items (see Progressive Grocer, various issues; Walsh, 1993; Weaver, 1998).

Another important operational change in the grocery industry is increased store hours. As shown in column 8 of Table 1, the average of median store hours per week has increased from 95 hours to 125. In addition, the fraction open on Sunday (column 9 of Table 1) has continued to increase while the fraction open 24 hours doubled between 1984 and 1994 (see also Mayo, 1993).

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[4] Table 1 is restricted to 1984-94 due to data availability. More specifically, the analys subsequent sections requires within-year variability and for 1984-91 and 1994, the *Progressive Grocer Annual Report (*appearing in the April issue), and especially the chart "Store Operations – by region," reports operating measures for chains and independents for six regions. The chain and independent figures are weighted using the fraction chain (by sales) by state to get weighted, state-specific operating measures and are merged with the CPS sample of Grocery Stores employees. The six regions are the following CPS regions: New England and Middle Atlantic; East North Central; West North Central; South Atlantic; South Central; and Mountain and Pacific. Chains are defined as firms operating 11 or more stores.

It is common to ascribe these changes to changing consumer demographics and behavior (Kinsey, 1994; Kinsey et al., 1996; Weaver, 1998). However, it is important not to overlook the drive to reduce labor costs. From the development of the first self-service market in 1916 to the introduction of self-service meat counters in the late 1930s to redesigned checkout counters in the 1970s, the history of the grocery industry is marked by a number of labor-saving innovations (Mayo, 1993). Probably the most visible and dramatic innovation over the last 20 years has been the adoption of scanning technology.

Scanners read Universal Product Code (UPC) symbols and automatically record the price of each item (as well as providing important information for ordering and promotions) so that the cashier does not have to manually enter the price into the cash register. An early study estimated that this technology could save more than five percent of operating costs primarily via increased cashier productivity and accuracy (see Bloom, 1972). While scanning technology dates to the early 1970s, column 11 of Table 1 indicates the adoption became widespread in the late 1980s and early 1990s. In fact, between 1984 and 1994, the fraction of stores using scanners nearly tripled from around 30 percent to about 90 percent and it has continued to grow since then. Point of sale devices, including scanners, is the largest category of information technology expenditure in grocery stores (Moody, 1997).

In sum, the grocery industry is a dynamic industry which has witnessed significant operational changes the last 20 years. In particular, the importance of chain stores continue to increase, store size (in terms of physical size, items stocked, transactions, or employees) continues to grow, stores are staying open longer, and there has been a dramatic increase in the use of scanning technology. It is against this backdrop that we investigate wage outcomes.

Grocery Stores Wage Trends, 1979-98

The primary data source for this study is the Current Population Survey (CPS) which is a monthly survey of approximately 60,000 households that includes labor market information representative of the U.S. noninstitutional population aged 16 and older (see U.S. Department of Labor, 1992). From the CPS Annual Earnings Files (the outgoing rotation groups), we select individuals employed in SIC 601 (Grocery Stores). For comparison, we also construct a similar sample for Manufacturing.

Table 2 presents annual real wage trends for Grocery Stores employees in the CPS between 1979 and 1998.[5] Column 1 contains the average hourly real wage which declines from $10.16 in 1979 to $8.02 in 1990-91 and $7.98 in 1997 before rebounding to $8.42 in 1998. For comparison, the real value of the minimum wage is nearly identical to the Grocery Stores 10th percentile (column 4) up to 1987 and is about 10-20 cents less than the 10th percentile after 1987.[6] Each of the percentiles follows the same downward trend as the mean real wage. In other words, the entire real wage distribution in Grocery Stores has shifted downwards since 1979.

Graphically, this result can be seen for 1984 to 1994 in the top panel of Figure 1. The dashed line is the estimated density of the log real wage distribution in 1984 and the solid line is the density for 1994.[7]

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[5] Employment in the Grocery Stores industry is shown in column 15 of Table 2. This industry employed over 3.1 million workers in 1998 – nearly a 50 percent increase from 1979. U.S. aggregate employment increased by 35 percent in this time period while aggregate Retail Trade employment increased by 39 percent. Manufacturing employment decreased by over 6 percent.

[6] It is not uncommon to find subminimum wage observations (Card and Krueger, 1995) due to a combination of noncompliance and imperfect coverage.

[7] These densities are calculated using kernel density estimation (equation 1 described below) with a Gaussian kernel, a bandwidth of 0.05, and 200 evaluation points.

The two vertical lines represent the 1984 and 1994 values of the log real minimum wage. At nearly every point, the 1994 distribution is to the left of the 1984 distribution.

The same is not true for Manufacturing (see the lower panel of Figure 1). Relative to the Grocery Stores industry distributions, the Manufacturing wage distribution is more symmetrical and not anchored by the minimum wage. Moreover, note that the 1994 distribution is wider than the 1984 one: the upper tail has increased as has the lower.

Standard summary measures of wage inequality such as the standard deviation and Gini coefficient echo the results in Figure 1. In Manufacturing, there has been a clear increase in wage inequality (e.g., the Gini coefficient increases from 0.257 to 0.302 between 1979 and 1998) whereas the trend in Grocery Stores is not transparent. Between 1984 and 1994, there is a slight increase in Grocery Stores wage inequality, but the trend between 1979 and 1998 does not show a consistent increase (see columns 2-3 of Table 2). This is an important result in that not all industries have experienced the same wage trends which underscores the importance of industry-specific analyses.

Consequently, the central focus of the present study is to analyze Grocery Stores wage distribution changes between 1984 and 1994 as presented in Figure 1. One aspect of retail employment that receives a lot of attention in the popular press is part-time work. Column 7 of Table 1 shows that part-time employment in this industry has been relatively stable over the last 20 years and has perhaps even declined. Comparison of these figures with Northrup and Storholm (1967, Figure 3-2) suggests that the rise in part-time work in the Grocery Stores industry in fact occurred during the 1950s and early 1960s (but see Hughes (1999) for a specific counterexample).

Two other factors receiving much attention in aggregate analyses are education and unionization (e.g., Juhn, 1999; DiNardo and Lemieux, 1997). While average years of education in Manufacturing, for example, increased by more than one year between 1979 and 1998, column 10 of Table 2 illustrates that the increase in average educational attainment in the Grocery Stores industry has been much more modest. Moreover, the return to education, as measured by the OLS regression coefficient in a log wage regression, has remained fairly constant at around 0.035 (column 11). In Manufacturing, the OLS returns to education coefficient in 1979 is 0.056 and in 1998 is 0.094. These casual comparisons suggest that changes in educational attainment are not as important in the Grocery Stores industry as in other industries for understanding changing wage outcomes.

The trend in unionization (columns 12-13) suggest a different, albeit preliminary, conclusion. Union density in Grocery Stores declines substantially from 33 percent down to 24 percent between 1983 and 1998. At the same time, the union wage premium, as measured by the OLS regression coefficient in a log wage regression, also decreases quite significantly. Relative to 1983, there are relatively fewer unionized employees and their wage premium is much smaller. This suggests that unionization might be an important factor in understanding changing wage outcomes.

Since the focus of the analysis will be a comparison of 1984 and 1994, Table 3 presents additional summary statistics for the CPS Grocery Stores industry sample for these two years. The question of interest is to what extent can the demographic changes captured in Table 3, the declining real value of the minimum wage, and the operational changes described in the preceding section explain the observed changes in the Grocery Stores wage distribution between 1984 and 1994 (as presented in Table 2 and Figure 1).

Empirical Methodology

The foundation of the empirical methodology is nonparametric kernel density estimation. More specifically, the Rosenblatt-Parzen estimate of the density function at a point x is

$$\hat{f}(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - X_i}{h}\right) \tag{1}$$

where h is the bandwidth, $X_1,\ldots,X_n$ are observations, and K(·) is a kernel function (see Silverman, 1986). The kernel function is simply a weighting function so that, for example, observations closer to the point of interest x are weighted more heavily than observations farther away from x. For graphical display, the density function estimate is calculated for a number of equally-spaced evaluation points. In the analysis below, the observations of interest are individuals' log real wages and we use a Gaussian kernel function with 200 evaluation points and a bandwidth of 0.05. Note that a significant advantage of this methodology is that we can examine the entire wage distribution in contrast to standard summary measures of wage inequality such as the Gini coefficient or standard deviation.

To analyze the importance of changes in unionization, minimum wages, and other factors in causing changes in retail food industry wage distributions, we utilize the semi-parametric methodology of DiNardo, Fortin, and Lemieux (1996). The centerpiece is the construction of a counterfactual density estimate

$$\hat{f}_c(x) = \frac{1}{h}\sum_{i=1}^{n} \Psi(z_i) K\left(\frac{x - X_i}{h}\right) \tag{2}$$

where $\Psi(\cdot)$ is a re-weighting function based on individual attributes z_i. For example, to construct the counterfactual density for 1994 if characteristics remained as they were in 1984, $\Psi(\cdot)$ re-weights the

individual 1994 wage observations to reflect the 1984 distribution of individual characteristics.[8] Estimates of various functions $\Psi(z_i)$ can be constructed from logit models. To decompose changes in the wage distribution between two points in time, the re-weighting is done sequentially for different factors.

The first dimension considered is the minimum wage. It is assumed that there are no spillover effects of the minimum wage to those earning more than the actual and counterfactual minimum wage, the shape of the density of wages below the minimum wage depends only on the real value of the minimum wage, and there are no employment effects of minimum wage changes.[9] With these assumptions, the counterfactual density for 1994 wage observations if the 1984 minimum wage rate prevailed can be constructed by replacing the portion of the 1994 wage distribution that is below the 1984 minimum wage level with the analogous portion from the actual 1984 distribution (re-scaled so that the sum of the total density is one).

More specifically, the counterfactual is constructed via equation (2) using the appropriate re-weighting function $\Psi(\cdot)$:

$$\Psi_m(z_i) = \frac{P(t_i = 94|z_i, w_i < m_{84})}{P(t_i = 84|z_i, w_i < m_{84})} \bullet \frac{P(t_i = 84)}{P(t_i = 94)} \tag{3}$$

where $P(\cdot)$ denotes probability, t_i is a dating variable for observation i, and $w_i < m_{84}$ indicates that individual i's real wage is less than the real minimum wage in 1984. To construct $\Psi_m(\cdot)$, the conditional probabilities

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[8] A traditional Oaxaca decomposition answers the question "what would the average wage have been in 1994 using the 1984 characteristics." The counterfactual densities generalize this idea to the entire wage distribution.

[9] See DiNardo, Fortin, and Lemieux (1996) for a discussion of these assumptions and evidence that they are conservative.

in equation (3) are generated from a logit model for all of the observations below the 1984 minimum wage using year as the dependent variable and various demographic attributes z_i (see Table 3) as independent variables.[10]

Second, consider the effect of declining union density. To examine the extent to which this institutional change is related to changes in the distribution of wages, it is instructive to compare the actual 1984 distribution and the 1994 distribution that would have been observed if unionization remained unchanged. In other words, we want to construct a counterfactual wage density using the 1994 wage structure with 1984 unionization rates.

In terms of equation (2), the counterfactual density can be created by using the appropriate re-weighting function $R(C)$: for union workers, $R_u(C)$ = P(union in 1984 | z_i) / P(union in 1994 | z_i) and for nonunion workers, $R_u(C)$ = P(nonunion in 1984 | z_i) / P(nonunion in 1994 | z_i). These conditional probabilities are estimated by a logit model for union status using various attributes as independent variables. Note that if union density, and therefore the probability of being unionized, does not change between 1984 and 1994, then $R_u(C)$=1. In contrast, if union density declines between 1984 and 1994, then $R_u(C)$ re-weights 1994 unionized individuals more heavily than in the observed 1994 distribution and re-weights 1994 nonunion individuals less to simulate the 1984 ratio of unionized to nonunion individuals.

The third factor we consider in sequence after minimum wages and unionization is part-time work. As demonstrated above, part-time work is quite common in retail food and is an important feature the labor

[10] Note that nonparametric kernel estimation in equation (2) is therefore being combined with a parametric logit model to generate the appropriate counterfactual weights $R(C)$. The overall estimation method is thus semi-parametric.

market to analyze in the context of changing wage distributions. Methodologically, the technique is the same as for union status: estimate a logit model for part-time status, calculate values for the part-time re-weighting function $R_p(C)$ from predicted probabilities from a logit model, and create the counterfactual for 1994.

Finally, there are a host of other attributes that may change between 1984 and 1994 and which may influence the nature of the observed wage distributions in retail food. For example, education, age, ethnicity, the occupational structure, and industry-specific operating features are changing during the time period. But again, the thought experiment is the same: what would the 1994 wage distribution look like if these underlying characteristics were as they were in 1984? To create this counterfactual density, the observations in the kernel density estimator are re-weighted:

$$\Psi(z_i) = \frac{P(t_i = 84|z_i)}{P(t_i = 94|z_i)} \bullet \frac{P(t_i = 94)}{P(t_i = 84)} \tag{4}$$

For these attributes, the re-weighting values are calculated from a logit model for year (1984 or 1994) using the group of attributes (plus union and part-time status) as the independent variables. Thus, in this fourth step, we consider the importance of various attributes jointly as a group in contrast to the previous three cases in which the minimum wage, union status, and part-time employment were considered as individual steps.

Finally, note carefully that this procedure is sequential and that the re-weighting functions are cumulative. Thus, to construct the counterfactual wage density for union status, the minimum wage and union status re-weighting functions are both used. For the final step analyzing other attributes, $R_{nk}(C)$,

$R_u(C)$, $R_p(C)$, and $R_A(C)$ are all used. Again, interested readers are referred to DiNardo, Fortin, and Lemieux (1996) for additional details and to DiNardo and Lemieux (1997) for another example using this methodology.

We also extend this methodology in two distinct ways. One, the union density counterfactual re-weights observations to replicate the 1984 union density, but implicitly uses the 1994 union wage premium. As illustrated in the previous section, the union wage premium is declining over time so a simple re-weighting may underestimate the true importance of unionization in explaining wage changes. Thus, we also add a counterfactual after the union density re-weighting in which the actual 1994 log real wages for unionized individuals are replaced by predicted log real wages based on their 1994 characteristics and the estimated union wage premium from 1984.

Two, the re-weighted counterfactuals created by the DiNardo, Lemieux, and Fortin (1996) semi-parametric methodology provide point estimates of different points of the wage distributions, but there are no standard errors. We calculate standard errors using a bootstrap procedure in which we repeat the creation of the counterfactuals 1,000 times by sampling with replacement from the CPS sample. This procedure yields 1,000 estimates of each statistic, for example the mean wage for the minimum wage counterfactual, from which the standard deviation of each statistic is calculated.

Wage Distribution Changes, 1984-94

To analyze the change in the Grocery Stores industry wage distribution between 1984 and 1994 as illustrated in Figure 1, we want to construct a counterfactual density based on the observed 1994 wage outcomes under the assumption that the minimum wage, union density, and other factors are at their 1984 values (equation 2). The real value of the federal minimum wage declined by over 11 percent between

1984 and 1994 and the first counterfactual density constructed simulates the 1994 wage distribution without this decline (holding unionization and other attributes at their 1994 values). The upper-left graph in Figure 2 presents the actual 1994 wage distribution for Grocery Stores and the counterfactual distribution using the 1984 minimum wage. By comparing this graph with Figure 1, it should be apparent that the re-weighting described above effectively replaces the actual 1994 distribution with the 1984 distribution below the 1984 minimum wage, but the 1994 distribution above the 1984 minimum wage is unaffected.

The results presented in column 3 of Table 4 indicate that the declining real value of the minimum wage had little to do with the decline in the mean real wage, but very much to do with the increased wage dispersion in this industry. First, consider the first row which presents the mean log real wage. The actual mean in 1984 is 2.056 and in 1994 is 1.968. If the change in the minimum wage explains much of this decrease in the average wage, then the average of the counterfactual density should be close to the 1984 actual mean. However, column 3 (Panel A) illustrates that this is not the case: the counterfactual mean is 1.973 which implies that the average wage in 1994 would be quite similar to the 1994 observed mean if the real value of the minimum wage remained at its 1984 level. As presented in Panel B, the mean wage declines by 0.088 log points between 1984 and 1994; if the minimum wage had remained unchanged, the results indicate that the mean wage decline would have been 0.005. In other words, the minimum wage decline only explains 5.682 percent of the actual mean wage decline.[11]

[11] The decompositions in Panel B can be interpreted like traditional Oaxaca decompositions: the actual mean decline between 1984 and 1994 is 0.088. Using 1984 minimum wage characteristics (weights) and 1994 returns (wages), the decline is estimated to be 0.005. Adding all of the effects (columns 3-6) yields an estimated increase, relative to 1984, of 0.029 for the 1994 mean wage using 1984 weights. Thus, the unexplained change is -0.088 - 0.029 = -0.117 for the mean wage. The thought experiment for the other rows is the same.

However, changing the minimum wage back to its 1984 value explains 16 percent of the increase in the standard deviation and over half of the change in the Gini coefficient. While not responsible for much of the average wage decline between 1984 and 1994 in Grocery Stores, the decline in the real value of the minimum wage appears significant for explaining some of the increase in wage dispersion. Moreover, the changes over time in different parts of the wage distribution evident in Figure 1 cannot be explained by the same factor: the minimum wage change explains 95 percent of the change in the 10th percentile, but none of the change in the other percentiles.

Finally, while quite informative, none of these measures can capture changes in the entire distribution. Thus, consider the Kullback and Leibler (1951) measure of the distance between two distributions f_1 and f_2:

$$J = \int [\, f_1(w) - f_2(w)] \ln \frac{f_1(w)}{f_2(w)} dw \tag{5}$$

By this measure, the total difference between the 1984 and 1994 wage distributions for Grocery Stores is 0.262. The difference between the counterfactual 1994 density with the 1984 minimum wage and the actual 1984 density is 0.162. Thus, the minimum wage counterfactual accounts for 62 percent of the total difference between the 1984 and 1994 wage distributions. However, as indicated in Figure 2 and Table 4, this explanatory power is confined to the lower part of the wage distribution.

Next, consider the hypothetical situation in which the 1994 wage structure is combined with the 1984 minimum wage and the 1984 union density. The smoothed kernel density estimate of this counterfactual is presented in the upper-right graph of Figure 2 and the numerical measures are presented

in column 4 of Table 4.[12] The graphical differences are slight, however the numerical results are useful. Note carefully that the decompositions reported in Panel B of Table 4 (and subsequent tables) are the marginal contributions of the factors of interest. Thus, correcting for the decline in union density increases the average wage to 1.989 and accounts for 18 percent of the decline in the average real wage. The change in unionization is also a very significant factor in explaining the change in the median real wage and explains a portion of the decrease in the 75th and 90th percentiles. According to the Kullback-Leibler statistic, the union density change explains five percent of the overall difference between the 1984 and 1994 wage distributions.

These results also imply that if union density had remained at 1984 levels, wage inequality actually would have increased more than it actually did. In essence, keeping union density constant would have prevented an erosion in the upper part of the wage distribution, but wage inequality would have increased because as the minimum wage falls, the lower part of the wage distribution is also falling.

As indicated in Table 4, part-time employment does not have explanatory power relevant to changes in the Grocery Stores wage distribution, with the exception of the standard deviation. Part-time is omitted from the graphical presentation in Figure 2 because no changes are visible. Thus, consider the final step of the re-weighting procedure which is to re-weight on the basis of observed demographic, occupational, and geographical attributes.[13] The results are presented in column 6 of Table 4 and in Figure 2. Essentially, the addition of these attributes to the counterfactual causes the distribution to move in the

[12] In the figures, "before" indicates the counterfactual density before accounting for the relevant factor and "after" denotes the counterfactual density including the relevant factor.

[13] More specifically, "other attributes" includes the variables in Table 3 plus age squared and region effects.

"wrong direction" – i.e., the counterfactual distribution moves farther away from the actual 1984 distribution *rather* than closer to it. The Kullback-Leibler statistic increases by 15 percent and each percentile is predicted to decrease further rather than increasing towards the higher, actual 1984 percentiles. These results imply that the increase in average education, age, frequency of supervisors, and the like between 1984 and 1994 prevented real wages, across the entire distribution, from declining even more than they are observed to have fallen.[14]

To obtain an indication of the variability associated with these point estimates, we employ a bootstrap procedure with 1,000 replications. The estimated standard errors generally less than 0.01 for the means and 10th and 25th percentile values and between 0.01 and 0.02 for the remaining percentiles. Thus, the 10th percentile minimum wage counterfactual change would be statistically significant as would the median union density counterfactual and many of the other attributes counterfactuals. Other counterfactuals differences, such as the mean wage change for the minimum wage counterfactual, are small relative to the estimated standard error.

For the Kullback-Leibler statistics, the estimated standard errors are 0.029 for the 1984-1994 overall difference and close to 0.022 for the counterfactual differences. Consequently, the minimum wage Kullback-Leibler difference can be interpreted as statistically significant while the union density difference may simply be due to sampling error. In the final analysis, however, the computation of standard errors does not change the conclusions of Table 4.

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[14] While this estimation strategy is order-specific, the results do not appear to be driven by the ordering of the steps. For example, omitting the minimum wage step and reversing the order of the union density and part-time counterfactuals do not change the results.

It is also instructive to compare these results to aggregate Manufacturing to reinforce the inter-industry differences apparent in Figure 1. Repeating the semi-parametric construction of counterfactuals for Manufacturing yields results significantly different from the Grocery Stores industry. In Manufacturing, the minimum wage change is essentially irrelevant whereas union status accounts for 30-40 percent of the change in the 10th, 25th, and 50th percentile changes. However, all of the factors together do not account for a large fraction of the Kullback-Leibler difference.

The Union Wage Premium

In the DiNardo, Fortin, Lemieux (1996) methodology, individuals are re-weighted based on their characteristics to mimic the relative weights of the earlier year. As was shown in Table 4, the decline in union density in the Grocery Stores industry accounts for 15-40 percent of the decline in the 50th, 75th, and 90th percentiles and only five percent of the entire wage distribution discrepancy. However, these results may understate the overall effect of changes in unionization because the union wage premium is held constant at its 1994 level (as in a Oaxaca decomposition). In other words, the results in Table 4 account for the fact that there are relatively fewer union members in 1994 than in 1984, but they do not account for the fact that the union wage premium has declined from 0.331 to 0.256 (see Table 2).

Consequently, Table 5 presents the counterfactual decompositions for Grocery Stores for 1984 to 1994 adding an additional step after the union density adjustment. This additional step adjusts for the changing union wage premium by replacing the 1994 wages of unionized workers with their predicted wage if the 1984 union wage gap persisted. If characteristics remained unchanged, this adjustment would amount

to inflating the 1994 wage of unionized workers by 0.331-0.256 = 0.075; in reality, regression analysis is used to account for changing characteristics.[15]

The results reported in column 5 indicate that the declining union wage premium is an important determinant of Grocery Stores wage changes in this period. Over 61 percent of the mean wage change and 40 percent or more of the changes in the upper half of the distribution are accounted for by adjusting the union wage gap. The wage distribution in 1994 is also predicted to have greater inequality if the union wage premium had remained at its 1984 level.

The Kullback-Leibler statistic indicates that the changing union premium explains none of the overall discrepancy between 1984 and 1994. The counterfactual kernel density estimates presented in Figure 4 illustrate why: the partial adjustment around the 75th percentile and the over-adjustment around the 90th percentile are effectively canceling each other out when adding up the change in the overall discrepancy.

Grocery Stores Industry Operating Changes

As described above and detailed in Table 1, the Grocery Stores industry has undergone significant changes in operations in 1984 to 1994. The preceding analysis documents the relationships between wage outcomes, labor market institutions, and demographics, but it also important to investigate the effect of these operating changes. Consequently, we can use the *Progressive Grocer* data from Table 1 and incorporate various operating measures in the creation of counterfactuals.[16]

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[15] More specifically, we estimate two standard log wage regressions using the variables in Table 3: one for unionized individuals in 1984 and one for those in 1994. Predicted wages for unionized individuals in 1994 are generated from each regression and the 1984-1994 difference is used to adjust the actual 1994 wages of unionized workers.

[16] We also used the Census of Retail Trade to construct state-level measures of sales p employee, and the growth in sales and employees for Grocery Stores, and similar growth rates for Retail

Table 6 reports the results of repeating the above analysis adding the fraction chain measure (column 1 of Table 1) to the other attributes group (which still includes the variables from Table 3). Recall from Table 4 that the addition of the other attributes group shifted the counterfactual farther to the left – if demographic characteristics had remained at their 1984 levels, real wages along the entire wage distribution, would have fallen even more than they actually did. The inclusion of the fraction chain variable (column 6 of Table 6) yields the same results, but even stronger. For example, the counterfactual mean log real wage declined by 0.05 after adjusting for demographic variables in Table 4 and declines by 0.077 after adjusting for demographic variables and the fraction chain in Table 6. In Table 4, the total discrepancy (the Kullback-Leibler statistic) increases by 0.04 whereas it increases by 0.08 in Table 6. If the importance of chain stores did not increase between 1984 and 1994, real wage levels would have been lower in 1994 than they actually were – across the entire distribution.

Unfortunately, a closer examination of the trends for the other measures in Table 1 reveals a significant problem for empirical analysis. More specifically, the increase in all of these measures from 1984 to 1994 is so drastic that there is insufficient variability within each time period to distinguish these measures from a time trend. For example, consider column 11. In 1984, 33.32 percent of chain stores reported using scanners. By 1994, the analogous figure was over 91 percent. Moreover, the standard deviations reveal the lack of within-year variability. The highest fraction in 1984 is 46 percent and the lowest fraction in 1994 is 76 percent. Thus, in a logit model to construct the re-weighting probabilities, the scanner use

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Trade in general. The Census of Retail Trade occurred in 1982 and 1992 so we use the 1982 data for 1984 and the 1992 data for 1994. As additional indicators of labor market competition, we also constructed the state-average log real wage for Retail Trade excluding retail food from the CPS for 1984 and 1994. Including these measures as additional attributes did not change the results reported above.

variable perfectly predicts year. Therefore, scanner technology cannot be identified separately from everything else that is changing on an aggregate basis between 1984 and 1994. The change in technology adoption is so great that it makes this type of analysis impossible. The same can be said for all of the other measures in Table 6 except fraction chain.

Compressing the time period to 1987 and 1994 creates sufficient overlap for the three store hours variables (columns 8-10). The results are similar to those presented in Table 6: adding other attributes including store hours yields a decline in predicted real wage outcomes ranging from a 0.005 (log points) decline at the 10th percentile to a 0.118 decline at the 90th percentile. Results for measures of store size are similar. If store hours and size had remained at their lower 1987 values, real wage outcomes would have fallen even more than they did – across the entire distribution. While lacking direct evidence as to what underlies this result, an intuitive explanation is labor market competition. As stores, and presumably other retail operations as well, increase their store hours and size, demand for labor increases and so do wage rates.

The increase in scanner adoption has been so quick and uniform that the time period needs to be compressed to two-year intervals to obtain sufficient overlap for analysis. However, the qualitative conclusions are the same as for the other operating measures. Creating counterfactuals for 1984 and 1986, if scanner use had remained at its lower 1984 level, real wages would have declined even more by 1986. Repeating the analysis for 1992 and 1994 yields the same results. Again, the predicted wage decline from holding scanner use constant, or the implied real wage increase from increased scanner adoption, is consistent across the entire wage distribution.

Conclusion

While there has been much research on changing wage inequality on a broad, across-industry basis, this paper conducts a focused examination on the U.S. Grocery Stores industry between 1984 and 1994. Applying the semi-parametric methodology of DiNardo, Fortin, and Lemieux (1996) to retail food, we decompose changes in the wage distributions into four factors: the minimum wage, unionization, part-time work, and other attributes (especially demographic, occupational, and operating characteristics).

The results imply that labor market institutions are the most important determinants of real wage changes in the Grocery Stores industry. The changing real value of the minimum wage explains a majority of the overall discrepancy between the 1984 and 1994 wage distributions and also explains 95 percent of the decline in the 10th percentile. The decline in union density coupled with the decline in the union wage premium explain much of the changes above the 25th percentile.

Changes in retailing and operating characteristics are also important. In particular, the results imply that if store size and hours, the fraction chain, and the use of scanning technology had remained at their lower 1984 levels, the real wage decline in this industry would have been even greater than the eight percent decline witnessed. Moreover, while the magnitudes vary, this decline would have been greater for the entire wage distribution.

The results for 1984 to 1994 reinforce the value of employing a methodology in which the entire wage distribution is analyzed. For example, the change in the real value of the minimum wage has significant power in explaining observed wage changes between 1984 and 1994, but only for portions of the wage distribution *below* the 25th percentile. Moreover, unionization changes are significant, but only *above* the 25th percentile. The differences between the Grocery Stores industry and Manufacturing also demonstrate

that the wage outcomes in different industries have undergone significantly different changes. This underscores the need for industry-specific research.

An anticipated benefit of within-industry analyses is the ability to better measure, and therefore evaluate, technology and operational changes which are difficult, if not impossible, to measure on an aggregate, inter-industry basis. However, in many cases the pace of technological and operational change, at least as measured by summary measures, is so quick that analysis is difficult. For example, the utilization of scanning technology was so quick and uniform that it cannot be distinguished from a time trend when considering more than a few years at a time. Nevertheless, without focused intra-industry research, the nature of employment outcomes will never be truly understood.

Finally, much of the wage inequality literature has focused on skill-biased technological change. The Grocery Stores industry results are not consistent with an important role of skill-biased technological change. Change of this sort increases the gap between the upper and lower portions of the wage distribution. Unlike Manufacturing, the entire Grocery Stores wage distribution has shifted down. Moreover, there has not been an increase in the returns to education. Changes in scanner use and other retailing changes being driven by new technologies (e.g., store size can increase because of ordering efficiencies with new technologies) are making lower paid, unskilled workers more productive (Mayo, 1993; Walsh, 1993) and wages are increasing across the entire distribution. Skill-biased technological change does not appear significant for this industry.

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Table 1
Supermarket Operating Trends: Means and Standard Deviations of Regional Measures

Year	Percent Chain by Sales (1)	Total Store Area (sq. feet) (2)	SKUs (number) (3)	Checkouts (number) (4)	Weekly Transactions (1994 $) (5)	Full-time Employees (6)	Part-time Employees (7)	Median Hours Open per Week (8)	Percent Open on Sunday (9)	Percent Open 24 Hours (10)	Percent Using Scanners (11)
1984	66.77	23829	11077	6.90	9329	20.90	32.24	95.05	90.27	15.48	33.32
	(14.15)	(2019)	(755)	(0.53)	(729)	(1.39)	(7.30)	(3.54)	(2.66)	(4.06)	(7.93)
1985	66.65	24150	13181	6.95	9779	21.65	34.91	98.34	92.49	16.72	40.86
	(13.94)	(1982)	(1145)	(0.57)	(843)	(1.78)	(8.35)	(3.28)	(2.21)	(5.23)	(8.42)
1986	66.79	24653	13706	7.03	9979	23.18	36.78	100.91	94.14	19.74	47.21
	(13.81)	(2092)	(796)	(0.54)	(580)	(1.14)	(8.05)	(3.99)	(2.08)	(4.68)	(7.95)
1987	66.76	26925	15351	7.24	10345	24.39	41.19	106.05	95.29	28.09	57.04
	(14.13)	(3648)	(1320)	(0.54)	(767)	(2.16)	(6.58)	(4.72)	(2.22)	(7.76)	(13.66)
1988	67.68	28315	17369	7.61	11245	27.16	45.69	110.80	95.52	31.11	66.34
	(13.81)	(2612)	(1776)	(0.57)	(992)	(2.31)	(7.90)	(11.36)	(1.58)	(8.46)	(9.70)
1989	67.71	27859	17617	7.55	11022	27.50	45.68	112.68	95.48	29.50	66.69
	(13.36)	(2824)	(1657)	(0.48)	(727)	(2.80)	(7.16)	(11.54)	(1.91)	(8.17)	(11.09)
1990	69.75	28525	16851	7.62	10988	28.30	43.95	110.33	96.67	27.70	73.72
	(13.34)	(2855)	(988)	(0.46)	(927)	(1.97)	(6.07)	(11.39)	(1.29)	(9.07)	(9.72)
1991	71.10	30031	18621	8.01	11785	29.99	49.74	113.70	97.05	30.40	79.55
	(13.17)	(2466)	(818)	(0.51)	(1070)	(2.00)	(10.26)	(10.51)	(0.90)	(6.16)	(6.46)
1992	71.01	31410	19195	8.22	11988	31.02	51.42	117.65	97.08	30.92	83.51
	(12.65)	(2483)	(714)	(0.50)	(996)	(2.49)	(9.80)	(12.85)	(0.89)	(7.51)	(5.53)
1993	72.35	32941	19790	8.49	12248	31.95	53.41	121.04	97.20	31.22	87.30
	(13.11)	(2669)	(742)	(0.56)	(1019)	(3.16)	(9.59)	(15.59)	(0.93)	(8.75)	(4.44)
1994	74.19	34735	20427	8.77	12517	33.29	55.29	125.35	97.32	31.96	91.54
	(12.69)	(2760)	(811)	(0.58)	(1006)	(4.13)	(9.52)	(19.07)	(1.04)	(10.34)	(3.32)

Source: Authors' calculations from Progressive Grocer (various issues) and the Current Population Survey (CPS).

Notes: Columns 2-11 were calculated as weighted averages of reported values for Chains and Independents. All values are weighted by CPS earnings weights. For column 1, the values before 1987 were estimated using the national trend and for 1991 using linear interpolation. For columns 2-11, the values for 1992 and 1993 were imputed using linear interpolation.

Table 2
Annual Wage and Employment Trends in Grocery Stores, 1979-98

	Real Wages (1994 dollars)								Fraction						
		Standard	Gini	Percentiles					Part-	Education		Unionization		Sample	Employment
	Mean	Deviation	Coeff.	10th	25th	50th	75th	90th	Time	Years	Return	Rate	Return	Size	(000s)
Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1979	10.16	5.03	0.26	5.92	6.13	8.17	13.28	17.02	0.40	11.82	0.035	n/a	n/a	3,547	2,114
1980	9.66	4.84	0.26	5.58	5.85	7.66	12.77	16.19	0.42	11.80	0.031	n/a	n/a	4,332	2,210
1981	9.16	4.55	0.26	5.43	5.71	7.34	12.10	15.86	0.44	11.87	0.029	n/a	n/a	4,161	2,235
1982	9.25	4.63	0.27	5.15	5.53	7.45	12.29	15.98	0.42	11.96	0.035	n/a	n/a	3,944	2,314
1983	9.20	4.79	0.27	4.99	5.36	7.44	12.35	16.33	0.43	12.02	0.032	0.33	0.311	4,018	2,376
1984	8.81	4.67	0.28	4.78	5.15	6.91	11.49	15.85	0.45	12.03	0.036	0.30	0.331	3,906	2,472
1985	8.59	4.65	0.28	4.62	5.03	6.89	10.91	15.31	0.43	11.96	0.029	0.29	0.310	3,916	2,459
1986	8.61	4.63	0.28	4.55	5.07	6.76	11.27	15.55	0.42	12.03	0.031	0.27	0.318	4,137	2,621
1987	8.41	5.02	0.29	4.39	4.89	6.52	10.60	15.65	0.44	12.00	0.033	0.27	0.281	4,243	2,663
1988	8.29	5.34	0.29	4.32	5.01	6.27	10.23	15.04	0.42	11.98	0.032	0.27	0.254	4,078	2,708
1989	8.22	4.70	0.28	4.23	4.95	6.52	10.25	14.35	0.42	12.00	0.036	0.25	0.244	4,268	2,861
1990	8.02	4.51	0.27	4.37	4.88	6.35	9.85	14.18	0.41	11.98	0.041	0.25	0.264	4,487	2,891
1991	8.02	4.39	0.26	4.63	4.99	6.53	9.80	14.15	0.44	12.02	0.037	0.27	0.224	4,425	2,877
1992	8.12	4.32	0.27	4.54	5.02	6.34	10.04	14.39	0.43	12.34	0.027	0.27	0.228	4,495	2,947
1993	8.22	4.61	0.27	4.45	5.13	6.41	10.26	14.39	0.43	12.38	0.035	0.25	0.248	4,468	3,034
1994	8.14	5.02	0.29	4.28	5.00	6.25	10.00	14.40	0.40	12.33	0.037	0.26	0.256	3,959	3,071
1995	8.31	6.53	0.30	4.22	4.86	6.34	9.94	14.59	0.38	12.28	0.032	0.26	0.216	3,881	3,018
1996	8.19	5.29	0.29	4.25	4.88	6.48	9.45	14.31	0.38	12.36	0.042	0.24	0.188	3,446	3,074
1997	7.98	4.37	0.27	4.62	5.08	6.46	9.48	13.85	0.37	12.29	0.034	0.24	0.165	3,497	3,153
1998	8.42	5.24	0.28	4.68	5.32	6.59	9.82	14.32	0.37	12.25	0.035	0.24	0.138	3,537	3,133

Source: Current Population Survey.

Notes: Columns 1-14 are from the CPS Outgoing Rotation Groups and column 15 is from Employment and Earnings (various issues).
Columns 11 and 13 are OLS coefficients from log wage regressions controlling for union, education, age and its square, female, married, nonwhite, part-time, occupation, and region.

Table 3
CPS Grocery Store Employees, 1984 and 1994:
Means and Standard Deviations

Variable	1984	1994
Log Real Wage (1994 dollars)	2.056 (0.475)	1.968 (0.481)
Age	30.213 (12.913)	32.454 (13.349)
Completed Education (years)	12.025 (1.732)	12.333 (1.889)
Female	0.475	0.500
Non-White	0.095	0.139
Married	0.473	0.441
Part-Time (< 35 hours per week)	0.448	0.402
Covered by a Union Contract	0.304	0.257
Major Occupations		
Supervisor	0.151	0.174
Cashier	0.362	0.313
Butcher	0.049	0.042
Bagger	0.234	0.217
Sample Size	3,906	3,959

Source: Current Population Survey Outgoing Rotation Groups.
Summary statistics are weighted using CPS earnings weights.

Table 4
Decomposing Changes in the log Real Wage Distribution:
Grocery Stores, 1984 - 94

A. Actual and Counterfactual Values

	Actual		Counterfactuals (1994 with 1984 weights)			
log real wage	1984 (1)	1994 (2)	Minimum Wage (3)	Union (4)	Part-Time (5)	Other Attributes (6)
Mean	2.056	1.968	1.973	1.989	1.989	1.939
Standard Deviation	0.475	0.481	0.480	0.482	0.483	0.476
Gini Coefficient	0.116	0.123	0.119	0.120	0.120	0.118
10th Percentile	1.564	1.453	1.559	1.559	1.559	1.549
25th Percentile	1.639	1.609	1.609	1.609	1.609	1.584
50th Percentile	1.932	1.833	1.833	1.872	1.872	1.792
75th Percentile	2.442	2.303	2.303	2.325	2.327	2.262
90th Percentile	2.763	2.667	2.667	2.684	2.688	2.646

B. Decompositions

	Actual Change 1984 to 94 (1)	Unexplained Change (2)	Effect of Minimum Wage (3)	Union (4)	Part-Time (5)	Other Attributes (6)
Mean	-0.088	-0.117	-0.005	-0.016	0.000	0.050
		132.955	5.682	18.182	0.000	-56.818
Standard Deviation (x100)	0.600	0.100	0.100	-0.200	-0.100	0.700
		16.667	16.667	-33.333	-16.667	116.667
Gini Coefficent	0.007	0.002	0.004	-0.001	0.000	0.002
		28.571	57.143	-14.286	0.000	28.571
10th Percentile	-0.111	-0.015	-0.106	0.000	0.000	0.010
		13.514	95.495	0.000	0.000	-9.009
25th Percentile	-0.030	-0.055	0.000	0.000	0.000	0.025
		183.333	0.000	0.000	0.000	-83.333
50th Percentile	-0.099	-0.140	0.000	-0.039	0.000	0.080
		141.414	0.000	39.394	0.000	-80.808
75th Percentile	-0.139	-0.180	0.000	-0.022	-0.002	0.065
		129.496	0.000	15.827	1.439	-46.763
90th Percentile	-0.096	-0.117	0.000	-0.017	-0.004	0.042
		121.875	0.000	17.708	4.167	-43.750
Kullback-Leibler	0.262	0.127	0.162	0.013	0.000	-0.040
		48.473	61.832	4.962	0.000	-15.267

Notes: Other attributes include those listed in Table 3 plus region effects.
In Panel B, the effect of each factor is the amount of the 1984 and 1994 difference explained by replacing the 1994 distribution with a counterfactual. The second entry in each cell is the percent explained. The unexplained difference is that not explained by the factors.

Table 5
Decomposing Changes in the log Real Wage Distribution Including the Union Wage Gap:
Grocery Stores, 1984 - 94

A. Actual and Counterfactual Values

	Actual		Counterfactuals (1994 with 1984 weights)				
	1984	1994	Minimum Wage	Union Density	Union Wage Gap	Part-Time	Other Attributes
log real wage	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean	2.056	1.968	1.973	1.989	2.043	2.043	1.990
Standard Deviation	0.475	0.481	0.480	0.482	0.525	0.526	0.521
Gini Coefficient	0.116	0.123	0.119	0.120	0.130	0.131	0.130
10th Percentile	1.564	1.453	1.559	1.559	1.559	1.559	1.549
25th Percentile	1.639	1.609	1.609	1.609	1.609	1.609	1.593
50th Percentile	1.932	1.833	1.833	1.872	1.915	1.917	1.833
75th Percentile	2.442	2.303	2.303	2.325	2.420	2.420	2.351
90th Percentile	2.763	2.667	2.667	2.684	2.811	2.813	2.789

B. Decompositions

	Actual Change 1984 to 94	Unexplained Change	Effect of Minimum Wage	Union Density	Union Wage Gap	Part-Time	Other Attributes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean	-0.088	-0.013	-0.005	-0.016	-0.054	0.000	0.053
		14.773	5.682	18.182	61.364	0.000	-60.227
Standard Deviation	0.600	5.100	0.100	-0.200	-4.300	-0.100	0.500
(x100)		850.000	16.667	-33.333	-716.667	-16.667	83.333
Gini Coefficent	0.007	0.015	0.004	-0.001	-0.010	-0.001	0.001
		214.286	57.143	-14.286	-142.857	-14.286	14.286
10th Percentile	-0.111	-0.005	-0.106	0.000	0.000	0.000	0.010
		4.505	95.495	0.000	0.000	0.000	-9.009
25th Percentile	-0.030	-0.030	0.000	0.000	0.000	0.000	0.016
		100.000	0.000	0.000	0.000	0.000	-53.333
50th Percentile	-0.099	-0.015	0.000	-0.039	-0.043	-0.002	0.084
		15.152	0.000	39.394	43.434	2.020	-84.848
75th Percentile	-0.139	-0.022	0.000	-0.022	-0.095	0.000	0.069
		15.827	0.000	15.827	68.345	0.000	-49.640
90th Percentile	-0.096	0.050	0.000	-0.017	-0.127	-0.002	0.024
		-52.083	0.000	17.708	132.292	2.083	-25.000
Kullback-Leibler	0.262	0.090	0.162	0.013	-0.000	-0.003	-0.024
		34.440	61.906	4.837	-0.186	-0.997	-9.295

Notes: Other attributes include those listed in Table 3 plus region effects.
In Panel B, the effect of each factor is the amount of the 1984 and 1994 difference explained by replacing the 1994 distribution with a counterfactual. The second entry in each cell is the percent explained. The unexplained difference is that not explained by the factors.

Table 6
Decomposing Changes in the log Real Wage Distribution:
Grocery Stores, 1984 - 94 including fraction chain

A. Actual and Counterfactual Values

	Actual		Counterfactuals (1994 with 1984 weights)			
log real wage	1984 (1)	1994 (2)	Minimum Wage (3)	Union (4)	Part-Time (5)	Other Attributes (6)
Mean	2.056	1.968	1.972	1.991	1.992	1.915
Standard Deviation	0.475	0.481	0.481	0.482	0.483	0.467
Gini Coefficient	0.116	0.123	0.120	0.120	0.121	0.116
10th Percentile	1.564	1.453	1.549	1.559	1.559	1.539
25th Percentile	1.639	1.609	1.609	1.609	1.609	1.563
50th Percentile	1.932	1.833	1.833	1.872	1.872	1.792
75th Percentile	2.442	2.303	2.303	2.335	2.335	2.225
90th Percentile	2.763	2.667	2.667	2.686	2.690	2.590

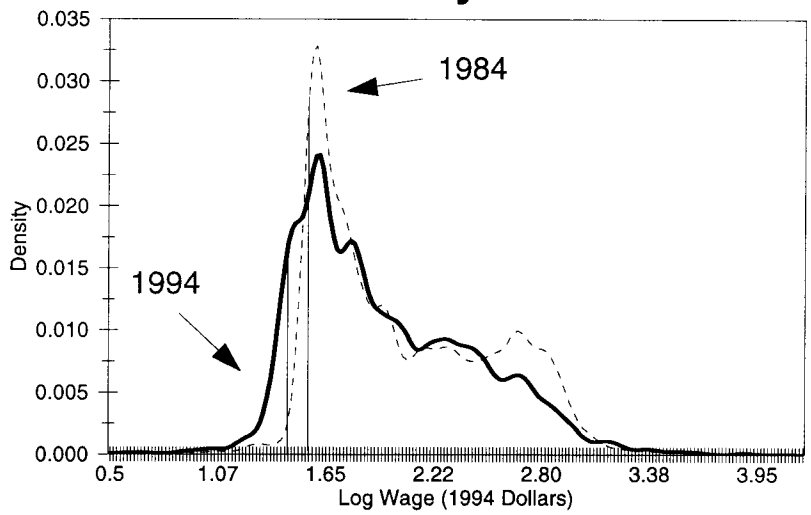
B. Decompositions

	Actual Change 1984 to 94 (1)	Unexplained Change (2)	Effect of Minimum Wage (3)	Union (4)	Part-Time (5)	Other Attributes (6)
Mean	-0.088	-0.141	-0.004	-0.019	-0.001	0.077
		160.227	4.545	21.591	1.136	-87.500
Standard Deviation	0.600	-0.800	0.000	-0.100	-0.100	1.600
(x100)		-133.333	0.000	-16.667	-16.667	266.667
Gini Coefficent	0.007	0.000	0.003	0.000	-0.001	0.005
		0.000	42.857	0.000	-14.286	71.429
10th Percentile	-0.111	-0.025	-0.096	-0.010	0.000	0.020
		22.523	86.486	9.009	0.000	-18.018
25th Percentile	-0.030	-0.076	0.000	0.000	0.000	0.046
		253.333	0.000	0.000	0.000	-153.333
50th Percentile	-0.099	-0.140	0.000	-0.039	0.000	0.080
		141.414	0.000	39.394	0.000	-80.808
75th Percentile	-0.139	-0.217	0.000	-0.032	0.000	0.110
		156.115	0.000	23.022	0.000	-79.137
90th Percentile	-0.096	-0.173	0.000	-0.019	-0.004	0.100
		180.208	0.000	19.792	4.167	-104.167
Kullback-Leibler	0.262	0.170	0.157	0.014	0.001	-0.080
		64.885	59.924	5.344	0.382	-30.534

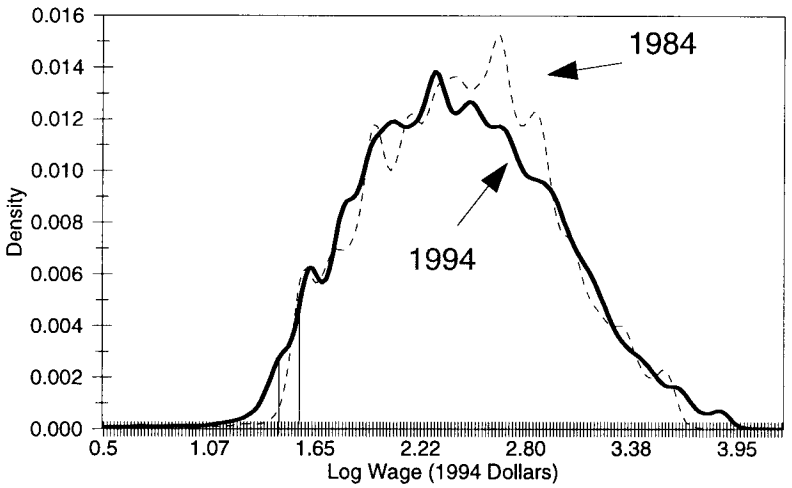
Notes: Other attributes include those listed in Table 3 plus region effects and fraction chain.
In Panel B, the effect of each factor is the amount of the 1984 and 1994 difference explained by replacing the 1994 distribution with a counterfactual. The second entry in each cell is the percent explained. The unexplained difference is that not explained by the factors.

Industry Wage Distributions:
log real wage, 1984 and 1994

Grocery Stores



Manufacturing

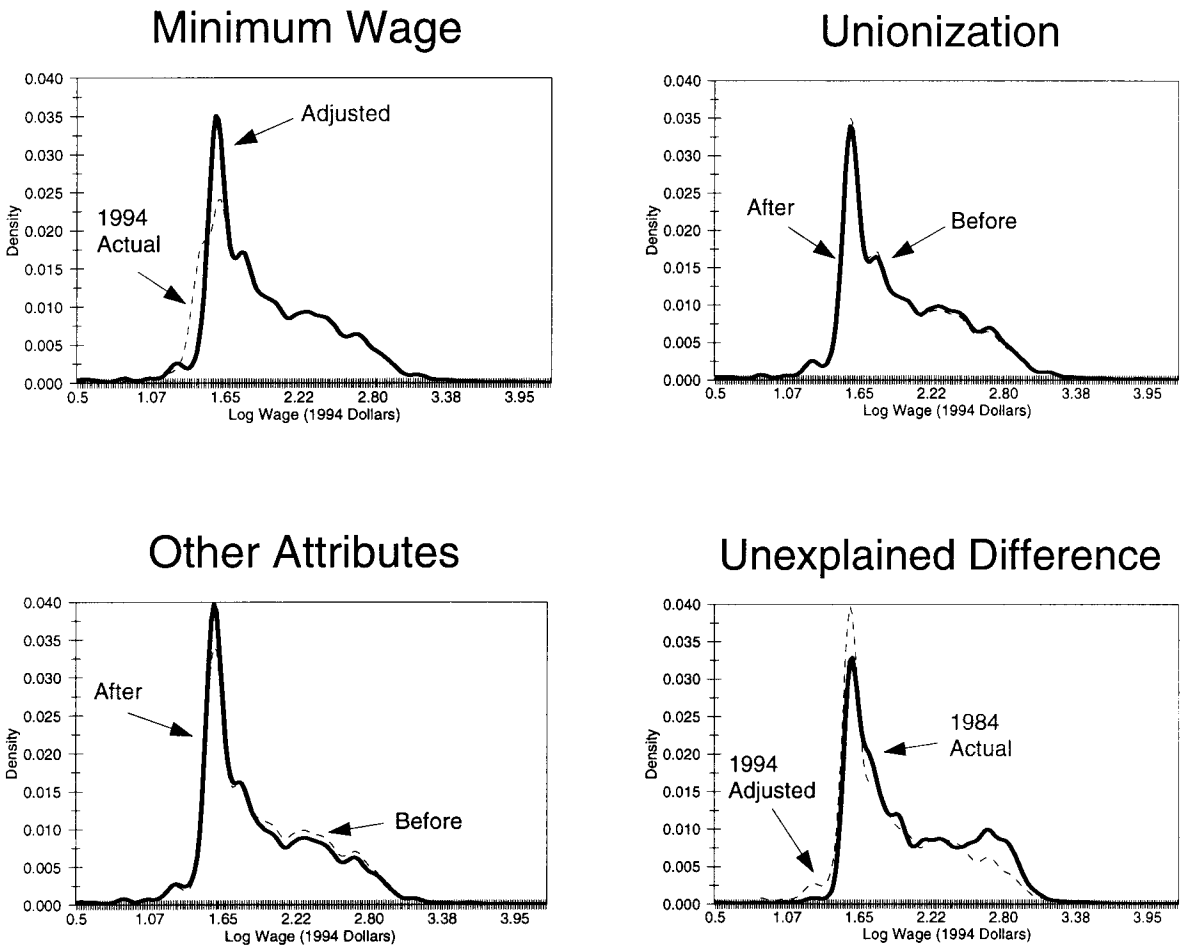


Note: Kernel density estimates using the Gaussian kernel with 200 evaluation points and bandwidth = 0.05. The samples are from the CPS Outgoing Rotation Groups. The dashed vertical lines indicate the real value of the minimum wage for each year.

Figure 1

Counterfactual Distributions: Grocery Stores

log real wage, 1984-94 actual and adjusted



Notes: Kernel density estimates using the Gaussian kernel with 200 evaluation points and bandwidth = 0.05. The samples are from the CPS Outgoing Rotation Groups. A part-time counterfactual is included in the estimation after unionization, but is not displayed in this figure because no changes are visible.

Figure 2