Occupational Concentration, Wages, and Growing Wage Inequality

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I. Introduction

Income, earnings, and wage inequality have been growing for US workers since the late 1970s. This growth can be observed in a variety of measures – in total annual income (e.g. Piketty & Saez, 2003), in total compensation (e.g. Pierce, 2001, 2008), and in hourly wages (e.g. Katz and Autor, 1999 and Lemieux, 2006). While the largest rise in this inequality, particularly in the lower half of the earnings and income distributions, occurred during the 1980s, income and earnings have continued to grow less equal in the upper parts of the distribution in recent years.

An enormous literature has examined the composition and sources of this growing inequality, particularly in the 1980s, using data on individual workers and their characteristics. This work has addressed the changing composition of the workforce and changing returns to education and experience (Bound and Johnson, 1992, Katz and Murphy, 1992, Lemieux, 2006), and the growing inequality within education and skill groups (Juhn, Murphy, and Pierce, 1993, Katz and Autor, 1999). Growing inequality has been attributed to many sources. These include the differential impact of technology on differing portions of the worker skill distribution, referred to as 'Skill Biased Technology Change' (Juhn, Murphy, and Pierce, 1993, Acemoglu, 2002, Autor, Katz, and Kearney 2006, 2008), changing labor market institutions such as declining unionization levels (e.g. Lemieux, 2008), the declining real value of the minimum wage (e.g. Card and DiNardo, 2002, Lee, 1999), and the growing fraction of workers subject to performance-based pay from their employers (e.g. Lemieux, MacLeod, and Parent, 2009). Although these explanations for growing inequality are concerned with the policies and incentives faced by employers, this literature uses worker microdata with little if any information on the businesses employing these workers.

A second, smaller literature has used employer data to study growing wage inequality. This work builds on the evidence showing that establishments play an important role in determining individual wages (Groshen, 1991a, 1991b, Bronars and Famulari, 1997, Abowd, Kramarz, and Margolis, 1999, Lane, Salmon, and Spletzer, 2007, Card, Heining, and Kline, 2013). Several authors have used employer microdata to study growing variability in earnings in the U.S. from the mid-1970s to the early 2000s, and have found that the increasing variability is due more to variation between establishments than to variation within establishments (Davis and Haltiwanger, 1991, Dunne, Foster, Haltiwanger, and Troske, 2004, and Barth, Bryson, Davis, and Freeman, 2009). This literature has relied on combining measures of total variation in wages from worker microdata with measures of establishment mean wages from employer microdata, with limited information on the distribution of worker characteristics within these establishments in the United States, making it difficult to compare these results with those mentioned above.[1]

We believe that employer-based explanations of increasing wage inequality warrant further investigation, because much of the recent rise in inequality cannot be explained by the changing composition of the workforce or by many of the other changes mentioned above.

[1] There is a large and growing literature on wage inequality growth in Europe, based on employee-employer linked data, most notably Card, Heining, and Kline (2013), who emphasize the role of increased worker sorting between employers in explaining wage inequality growth in Germany.

Broad institutional forces such as the changing real value of the minimum wage or de-unionization may play a role in understanding the growth of inequality during the 1980s, but these do not appear to be as relevant for explaining the recent trends in inequality (Lemieux, 2008). In this paper, we examine the role that establishment characteristics play in explaining increasing wage inequality. In particular, our analysis focuses on the role of the composition of employment by occupation within establishments. Whether rising inequality is driven by skill-biased technological change, by changes in labor market institutions, or by changes in employer-specific pay policies, such changes may impact the composition of occupations within and between establishments.

To address this subject, we use the microdata of the Occupational Employment Statistics (OES) Survey. The OES data is collected from a large annual survey of establishments, and contains information both on establishment characteristics and on the wage and occupational distributions of the employees within surveyed establishments. The OES data allow us to decompose increasing wage inequality in the U.S. into its within and between establishment components using a single source of wage information. They allow us to assess the impact of changing employer characteristics (industry, size, and location) on the overall distribution of wages and in particular, on the between-establishments component of variation. They also allow us to assess the contribution of the changing distribution of employment by occupation within establishments on the wage distribution.

This paper has three major findings. First, we find that occupational concentration, by several different measures, is related to wages. Workers in establishments that are more concentrated in occupations (except those concentrated in typically high-wage occupations) are paid lower wages. This relationship holds even after controlling for workers' own occupations and the industry of their employers, and has been increasing somewhat during 2000-2011. Second, during this period, there has been an increase in the concentration of occupations within establishments, particularly in the fraction of workers who are employed in very highly occupationally concentrated establishments. Third, this increase in occupational concentration can explain a substantial amount of the increase in private-sector wage inequality observed in the OES data over the 2000-2011 time period.[2] Including these measures of occupational concentration, we can explain as much as 52% of overall wage inequality growth (63% of wage inequality growth between employers), while changes in the distributions of occupations, industries, establishment sizes, and the geography of employers can explain no more than 36% of overall wage inequality growth (46% of wage inequality growth between employers).

II. Overall Inequality trends in the OES Data

This paper builds on previous work that has documented the adjustments to the Occupational Employment Statistics necessary to use these microdata to study changes over time, and work that has shown overall inequality trends in the adjusted microdata of the Occupational Employment Statistics largely mirror trends observed in the Current Population Survey. This section summarizes this previous work, as well as the results of additional

[2] The OES data *cannot* measure wage inequality in the uppermost tail of the wage distribution.

comparisons between inequality trends observed in the Occupational Employment Statistics and those observed in other employer-based datasets from the United States. The remainder of this paper is devoted to analyses not possible using other datasets from the United States.

The Occupational Employment Statistics (OES) survey is designed to measure occupational employment and wages in the United States by geography and industry, and is the only such survey of its size and scope. Since 1997, the OES has covered all establishments in the United States except for those in agriculture, private households, and unincorporated self-employed workers without employees. Every year, approximately 400,000 private and local government establishments are asked to report the number of employees in each occupation paid within specific wage intervals. An abridged version of an OES survey form is shown in Figure 1.[3]

The OES survey is not designed to produce time series statistics. To reduce variance and include data in each estimate from large employers that are surveyed only once each three years, published estimates from the OES program are based on the previous three years of data. Over each three-year survey cycle, large establishments are sampled with certainty, and no establishment is sampled more than once. Before using the OES data for the work described in this paper, much preparatory work was devoted to the creation of appropriate weights in order to have the OES data in each individual panel be self-representing. Using the methodology described in Abraham and Spletzer (2010a), we reweight the data to November (or May) benchmarks of total employment by detailed industry and by broad industry and establishment size groups from the Quarterly Census of Employment and Wages (QCEW). This reweighting forces the establishments in each separate panel to match the overall distribution of establishments during that November (or May), by detailed industries and by size groups within broad industries. As described in Abraham and Spletzer (2010b), this reweighting performs well for national-level estimates for broad categories of industries and occupations, but would be inappropriate to use for more detailed levels of geography, industry, or occupation.

In a companion paper (Handwerker & Spletzer, forthcoming), we compare wage data in the OES with wage data from the merged outgoing rotation groups of the CPS, and have two main findings. First, we show that the interval nature of wage collection in the OES has essentially no impact on measures of overall wage inequality trends; we put the CPS wage data through the "filter" of the OES wage intervals, and the continuous CPS wage data and the intervalized CPS wage data show extremely similar wage inequality trends. Second, we show that the reweighted OES data can be used to broadly replicate basic CPS wage inequality trends, beginning in 1998. Overall wage distributions in each year are similar, as

[3] The OES survey form is a matrix, with occupations on the rows and wage intervals on the columns. For large establishments, the survey form lists 50 to 225 detailed occupations; these occupations pre-printed on the survey form are selected based on the industry and the size of the establishment. Small establishments receive a blank survey form and write in descriptions of the work done by their employees. These employer-provided descriptions are coded into occupations by staff in state labor agencies (as part of the OES Federal-State partnership). Wage intervals on the OES survey form are given in both hourly and annual nominal dollars, with annual earnings being 2080 times the hourly wage rates. To calculate average wages, the OES program obtains the mean of each wage interval every year from the National Compensation Survey (NCS). These mean wages are then assigned to all employees in that wage interval.

well as overall variance trends, variance trends by sector, industry groups, and occupation groups. In both the OES and the CPS, industry groups alone explain 15-17% of wage variation, although industry groups explain slightly more of the variation in the (employer-reported) OES than in the (employee-reported) CPS. Occupational groups alone explain more of the variation in wages in the OES (about 40%) than these same variables explain in the CPS (about 30%). This phenomenon was also noted by Abraham and Spletzer (2009), who attribute it to more accurate reporting of occupation by employers who answer the OES than by individuals who answer the CPS. We also find that the amount of wage variance explained by occupation is growing more quickly in the OES than in the CPS.

The OES data also broadly replicates findings from the literature on the role of establishments in overall wage inequality. Bronars and Famulari (1997), using data from a supplement to the 1989 and 1990 White Collar Pay survey, found that 45 percent of variance is between establishments. Barth, Bryson, Davis, and Freeman (2009) use individual data from the 1977-2002 CPS and establishment data from the 1977-2002 Census Bureau's Longitudinal Business Database (LBD), and find that 55-70 percent of the variance in log earnings is between establishments, with growth in the between-establishment variance at least as large as the growth in overall wage dispersion between individuals. As shown in Figure 2, we find that over the period of Fall 1998 through November 2011, 55% of Fall/November wage variance is between establishments, while 74% of the growth in overall wage variance from Fall 1998 to November 2011 was between establishments.[4]

Using the OES data, we have confirmed the strong and growing role of both employers and occupations in explaining wage variation, as found by many previous authors. The importance of both employers and occupations in explaining wage variation leads us to study the interactions between employers and the distribution of occupations, and the impact of this interaction for the changing distribution of wages.

III. One form of employer effects: Occupational Concentration

A large literature shows that wages are explained in part by individual establishments, in addition to the amount of wage variation explained by measurable characteristics of establishments and employees. Groshen (1991b) lists five explanations for why wages can vary between employers: sorting, compensating differentials, random variations, efficiency wages, and rent sharing. Abowd, Kramarz, and Margolis (1999) emphasize employer differences in productivity and capital intensity. Using German data, Card, Heining, and Kline (2013) emphasize the rising assortiveness of workers to establishments in explaining

[4] Other authors of related studies have focused on wages within manufacturing industries, and here also we find broadly consistent results. Davis and Haltiwanger (1991), find that 50 to 58 percent of wage variance in manufacturing is between plants, and 48 percent of variance growth in manufacturing is between plants. Dunne, Foster, Haltiwanger, and Troske (2004) find that 53 to 69 percent of wage variance in manufacturing is between establishments, and 90 percent of variance growth in manufacturing is between establishments. Barth, Bryson, Davis, and Freeman (2009) find that on average 62 percent of variance in manufacturing is between establishments, and 27 percent (.034/.125 in Table 2) of variance growth in manufacturing is between establishments. We find in the OES data from 1998-2011 that on average 47% of manufacturing wage variance is between establishments, while 63% of the growth in manufacturing wage variance is between establishments.

the growth of wage inequality. We examine one particular form of worker assortiveness to employers, which to our knowledge has not been studied before: the distribution of occupations within establishments.

IIIa: Our measures

We examine two forms of occupational concentration within establishments—the occupational concentration across all occupations, and the occupational concentration of particularly high and low-paid occupations:

(1a) For each establishment, the Herfindahl index of occupational concentration for all detailed occupations, $H = \sum_{k=1}^{829} \left(\frac{Detailed\ \ Occupation_k\ Employment}{Total\ Employment} \right)^2$, using all 829 occupations at the 6-digit level of the Standard Occupational Classification system that are included in the OES. This index varies from 1/829 (equal representation of all occupations) to 1 (perfect concentration). It measures the degree of occupational concentration among all possible occupations.

(1b) For each establishment, the Herfindahl index of occupational concentration for all major occupation categories, $H = \sum_{k=1}^{22} \left(\frac{Occupation\ Category_k\ Employment}{Total\ Employment} \right)^2$, using the 22 major occupational categories at the 2-digit level of the Standard Occupational Classification system included in the OES. This index varies from 1/22 (equal representation of all categories) to 1 (perfect concentration). It measures the degree of occupational concentration over broad occupational categories. For example, dentists (occupation 29-1020) and dental hygienists (occupation 29-2021) are in the same broad occupational category.

(2a) For each establishment, the fraction of workers who are classified in minor occupation categories (3-digit SOC levels) in which mean wages in 1999[5] were below the 30th percentile of the overall wage distribution. These occupations are shown in Appendix A. We selected the 30th percentile of the overall wage distribution to classify occupations as "typically low-wage" because classifications at the 25th percentile or lower select largely workers with occupations involving food and beverages, and we are interested in a measure of low-wage workers that might apply to a broad group of industries.

(2b) For each establishment, the fraction of workers who are classified in minor occupational categories (3-digit SOC levels) in which mean wages in 1999 were above the 70th percentile of the overall wage distribution (chosen for symmetry with the 30th percentile cut-off for "typically low-wage" occupations). These "typically high-wage" occupations are shown in Appendix B.

IIIb: Relationships between Occupational Concentration Measures and Wages

[5] The OES began collecting data using the Standard Occupational Classification System in 1999. In order to use the 1998 data in making multi-year estimates, OES staff converted the 1998 data to the SOC, but many occupations were converted only at the 2-digit level. Thus, we cannot use 1998 data for measures (2a) or (2b).

Both our measures of Occupational Concentration are very significantly related to wages. These relationships are shown graphically in Figure 3, using regressions of the form $Ln(wage) = \alpha OccConcenGroup$, where we round each Occupation Concentration variable to the nearest hundredth and plot the set of α coefficients for wages in each hundredth-group, and $Ln(wage) = \alpha OccConcenGroup + \chi Survey\ date\ \ fixed\ \ effects + \delta X$, where we show the wages for each group after controlling for observable characteristics. This figure clearly shows that increasing Herfindahl indices of occupational concentration and increasing fractions of low wage workers in an establishment are associated with lower wages, while increasing fractions of high wage workers in an establishment are associated with higher wages. All of these relationships remain (although they are lessened) when we control for the survey date, the occupation of the employees observed, the industry of the employers, the size class of the employer, and the state of location.

These relationships are documented with more parametric regressions in Table 1. The regressions are of the form $Ln(wage) = \alpha OccConcen + \beta OccConcen * Date + \chi Survey\ date\ \ fixed\ \ effects + \delta X$, where X includes occupation fixed effects, detailed industry fixed effects (broad industry groups are available across all years, but detailed NAICS codes are only available from 2000 forwards[6]), state fixed effects, and establishment size (we use fixed effects for establishment size classes as well as a continuous measure of establishment size). Estimates of the coefficients α from these regressions without the X variables show that increased occupational concentration is associated with lower wages (except for increased concentration of typically high-wage occupations). Estimates of the coefficients β (shown here in decade units of time) show that all these relationships have quite significantly strengthened over time. Each addition of more detailed controls ameliorates the strength of the relationship between occupational concentration and wages, but all of these relationships remain very significant. With two exceptions, these relationships have unchanged signs.[7]

The strength and direction of the relationships between occupational concentration and wages is not constant across the occupational distribution, as we show in Tables 1a – 1c, discussed below. This means that changes in occupational concentration have different impacts on wages for different groups of workers.

Table 1a shows the wage-concentration relationships for workers in typically high-wage occupations only. For these workers, the relationship between wages and the fraction of the establishment in typically-high wage occupations is only positive when we control for occupation. Moreover, after controlling for occupation, the relationship between the wages for these workers and the fraction of workers in typically-low wage workers is much stronger than it is for the full set of workers (although this relationship has been weakening over time). However, the relationships between the other measures of occupational concentration and wages are much weaker for this group of workers. After including the full set of controls, for

[6] Beginning with the 2002 OES survey, establishments were classified by 6 digit NAICS, and the OES staff converted much of the previous years' samples from SIC to 6 digit NAICS codes as well.

[7] The exceptions are the change over time in the relationship between the Herfindahl of major occupational categories and wages and the change over time in the relationship between the fraction of the establishment in typically low-wage occupations age wages. Both signs reverse when we add detailed occupational controls.

these workers, there appears to be a positive relationship between Herfindahl indices of occupational concentration and their wages.

Table 1b shows the wage-concentration relationships for workers in neither typically high-wage nor typically low-wage occupations. For these workers, the relationships between wages and the fraction of the establishment in either typically-high wage or typically low-wage occupations have signs that vary by the set of controls we include.

Table 1c shows the wage-concentration relationships for workers in typically low-wage occupations only. For these workers, the estimates α of the relationships between wages and all measures of occupational concentration are particularly strong, both as raw relationships and as relationships after we include controls for occupations, industry, firm size, and state. However, for these workers, the estimates β have opposite sign from the estimates of α, indicating that all of these relationships have been weakening over time.

In combination, these results show that there are very strong relationships between occupational concentration—by both of our measures—and wages. Overall, these relationships are only partially explained by occupation and employer characteristics, and they have been strengthening over time. Tables 1a-1c further show that occupational concentration is a particularly important determinant of wages for low-wage workers. For workers in typically high-wage occupations, by contract, the only one of our measures of occupational concentration that appears to play a significant role in wage determination is the presence of large numbers of workers in typically low-wage occupations.

IIIc: Trends in Occupational Concentration measures

The mean values for our measures of occupational concentration by survey date are shown in the upper panels of Figure 4. Overall, mean values have been increasing over time, with a great deal of variability from survey date to survey date.[8] In the lower panels of figure 4, we plot coefficients α from regressions of the form $OccConcen = \alpha Survey\ date + \beta DetailedOcc + \chi Industry + \delta SizeClass + \varepsilon Size + \phi State$. These figures show that after controlling for occupation, detailed industry, size class, and state, the mean fraction of workers in higher-wage occupations has steadily risen over time, but other measures of occupational concentration have no clear time trend in mean values. These raw and regression adjusted differences in the means of our measures of Occupational Concentration over time are also shown in Table 2.

We are concerned not only with changes in the means of these occupational concentration measures, but also with changes in their overall distributions. The lower panel of Table 2 shows the fraction of workers whose establishments are extremely concentrated in occupation, having Herfindahl indices of .85 or higher, or fractions of employment in typically high or low-wage occupations of .85 or higher. We run regressions of the form $I(OccConcen > .85) = \alpha Survey\ Date + \beta DetailedOcc + \chi Industry + \delta SizeClass + \varepsilon Size + \phi State$, and find that there are substantial increases in the fraction of observations with measures of

[8] We do not know why the mean Herfindahl index of occupational categories was so low in November 2010.

occupational concentration above .85—for all our measures—even after controlling for changes in detailed industries, occupations, firm sizes, and geography. We have repeated this exercise using cut-off values for "extreme concentration" of .8, .9, and .95, and results are quite similar to those shown in Table 2.

Overall, we find evidence that mean occupational concentration has been increasing over time, but only for the fraction of employment in typically high-wage occupations is this increase unexplained by changing occupation and establishment characteristics. There is stronger evidence of an increase in highly concentrated establishments, with particularly high values of occupational concentration, although for some measures of occupational concentration, this increase is sensitive to the time period chosen. Again, the clearest evidence of an increase in high-levels of occupational concentration is for the fraction of employment in typically high-wage occupations.

IV. Occupational Concentration and Wage Inequality growth

The combination of strong relationships between occupational concentration and wages (particularly for workers in typically low-wage occupations) and growth in occupational concentration over time (particularly for the concentration of workers in typically high-wage occupations) suggests that changes in occupational concentration over time may explain some of the growth in wage inequality. In this section, we conduct a reweighting exercise in order to understand how much of increasing wage inequality in the OES from Fall 2000 to November 2011 can be attributed to changes in the employment composition of observable characteristics such as industry, establishment size, geography, and occupation, as well as our measures of occupational concentration. We use the method of DiNardo, Fortin, and Lemieux, 1996 (DFL)[9] to calculate counterfactual wage distributions based on the OES wage intervals, as well as counterfactual variance estimates. This allows us to observe which parts of the wage distribution are affected by changes in each observable characteristic.

An example may illustrate what we hope to learn from this reweighting exercise. We know that there has been employment polarization during the last 10-20 years: see Autor, Katz, and Kearney (2006), Goos and Manning (2007), Goos, Manning, and Salomons (2009), and Abraham and Spletzer (2010a). Using the OES data, and defining "jobs" by industry and occupation, Abraham and Spletzer show that the share of both low-wage and high-wage jobs has risen from 1996 to 2004, whereas the share of middle-wage jobs has fallen (employment growth has polarized). These changes in the distribution of occupations should lead to increased wage inequality. The reweighting exercise allows us to hold constant the employment composition of occupations and industries at their 2000 values when calculating the variance of log real hourly wages in 2011, and the resulting counterfactual wage variance

[9] The DiNardo, Fortin, and Lemieux (1996) methodology of creating counterfactual distributions for a later year if observable characteristics were held fixed at their distribution in an earlier year is to (1) combine the data for the earlier and later years and run a probit regression of the probability that an observation with a particular set of observable characteristics came from the earlier year and then (2) use the predicted values from this probit regression to create new weights for each observation in the later year.

quantifies the magnitude of polarized employment growth on the increasing wage variance, as well as showing where in the wage distribution this explained increase in variance appears.

We run DFL-type reweightings for the observable characteristics of detailed industry (at the 4-digit NAICS level), state, employer size, occupation (at the 3-digit SOC code level), and both variations of both our measures of occupational concentration. We run these reweightings for all possible sub-sets of these 8 variables—a total of 255 possible combinations. Results of reweightings for each observable characteristic alone are shown in Table 3, and results of reweightings for selected combinations of observable characteristics are shown in Table 4.

As shown in Table 3, occupation (at the 3-digit SOC level), and the fraction of employees in each establishment in typically high-wage occupations are the variables which alone explain the largest amount of overall wage variance growth from Fall 2000 to November 2011. Reweighting observations in November 2011 to the Fall 2000 distribution of the fraction of employees in each establishment in typically high-wage occupations would reduce overall ln wage variance in 2011 from the measured variance of .4018 to .3865 (the final row of Table 3). This decrease represents 31% of all ln wage variance growth from Fall 2000 to November 2011. It represents 26% of ln wage variance growth between establishments, and 53% of ln wage variance growth within establishments. Similarly, reweighting observations in November 2011 to the Fall 2000 distribution of occupations explains 33% of the growth in overall ln wage variance, and 41% of ln wage variance growth between establishments. In Table 3a, we see that reweighting the November 2011 data to the Fall 2000 distribution of the fraction of employees in each establishment in typically high-wage occupations increases employment in the lower portions of the wage distribution and decreases employment in the middle portions of the wage distribution, but also decreases employment in the upper portion of the wage distribution. Reweighting the November 2011 data to the Fall 2000 distribution of occupations decreases employment in both the upper and lower portions of the wage distribution, while increasing employment in the lower-middle.

Changes in the distributions of employment by detailed industries and states can also explain some of overall ln wage variance growth. Occupation is the single variable that alone explains the greatest amount of between-establishment wage variance growth. Changes in the distributions of employment by size classes and by other measures of occupational concentration do not explain any of overall ln wage variance growth, although (except for changes in the employer size distribution) they do explain some of the growth of wage variance between establishments, and (except for changes in the employer state distribution) of the increase in employment in the lower tail of the wage distribution.

In Table 4, we show reweightings for selected combinations of observable characteristics. The largest amount of overall wage variance growth explained (52%) can be explained by four different combinations of observable characteristics, labeled (1) - (4). All four of these combinations contain the observable characteristics of industry, state, the fraction of establishments' employment in typically high-wage occupations, and the fraction of establishments in typically low-wage occupations—they differ only in whether or not they include the Herfindahl indices of occupational concentration within establishments. Adding

in additional reweighting variables does not always increase the amount of wage variance explained—using all of our possible reweighting variables, as in line (8), results in much less overall variance explained than in combinations (1)-(4).

Table 4a shows that reweightings by these 4 combinations of characteristics moves the distribution of employment from both the upper and lower tails to the center of the distribution. Specifically, for reweighting combinations (1)-(4), we show in Table 4a, that if industry, state, and occupational concentration patterns in 2011 mirrored the distributions of these variables in 2000, there would be 3-4% less employment in the lowest wage interval, 3-4% less employment in the 7th wage interval, 7% less employment in the 8th wage interval, 9-10% less in the 9th, 11-12% less in the 10th, 12-13% less in the 11th, and 13-14% less employment in the 12th wage interval, with commensurate increases in employment in the remaining wage intervals. The impact of reweighting (2) on the overall wage distribution is shown graphically in Figure 6.

Table 4 also shows that the largest amount of wage variance growth (63%) between establishments can be explained by the combination of observable characteristics labeled (5). The largest amount of wage variance growth (60%) within establishments can be explained by the combination of observable characteristics labeled (6). This combination includes only state, and the fraction of establishments' employment in typically high-wage occupations. We think it notable that only one of the "best" combinations of reweightings labeled (1) - (6) includes occupation as one of the reweighting variables: although occupation alone is the best single-variable explanation for the growth in wage variance, as shown in Table 3, the impact of changes in this variable on the wage distribution are completely captured by the combined impact of changes in the distribution of employment by state, sometimes industry, and our measures of occupational concentration.

The combination of observable characteristics that best explains overall wage inequality growth without any of our measures of occupational concentration is shown in line (7) of Table 4. This combination is industry, state, and 3-digit occupation, which coincidentally are variables available in household surveys such as the CPS. This combination explains 36% of overall wage variance growth—a difference of 16% from combinations (1) – (4). This same combination of variables also gives the best explanation of between-establishment wage inequality growth without our measures of occupational concentration. This combination explains 46% of between-establishment wage variance growth—a difference of 17% from combination (5).

V. Conclusion

In this paper, we believe we are the first to examine the concentration of occupations within establishments, the relationship between occupational concentration and wages, changes in occupational concentration over time, and the impact of changes in occupational concentration on wage inequality growth. We find that there is a strong relationship between every measure of occupational concentration and wages, particularly for workers in typically low-wage occupations. By and large, these relationships have been strengthening over time.

We also find that by our measures, occupational concentration has been increasing over time. For most of our measures, this increased concentration can be explained by changes in industry, occupation, and state, but the concentration of workers in typically high-wage occupations has been increasing in ways that are not explained by these other changes. These changes in occupational concentration are consistent with ideas that companies are "de-verticalizing" by outsourcing functions that are not integral to employers' missions, particularly if these outsourced tasks are done by workers paid lower wages than the "core workers" in the establishment. The movement of workers in typically low-paid occupations from higher-wage establishments to lower-wage establishments may be measured as changes in the industries employing typically low-paid occupations, and in the concentration of workers in typically higher-wage occupations remaining in these higher-wage establishments.

By including measures of occupational concentration, we can explain as much as 52% of overall wage inequality growth (63% of wage inequality growth between employers), while changes in the distributions of occupations, industries, establishment sizes, and the geography of employers can explain no more than 36% of overall wage inequality growth (46% of wage inequality growth between employers). This important role for occupational concentration in wage inequality growth does not fit neatly into either the "technological change" or "institutional factors" dichotomy. Perhaps occupational concentration is only made possible by technological changes that allow employers to more easily outsource certain tasks. Perhaps the outsourcing of certain tasks can be considered a change in the wage-setting institutional framework.

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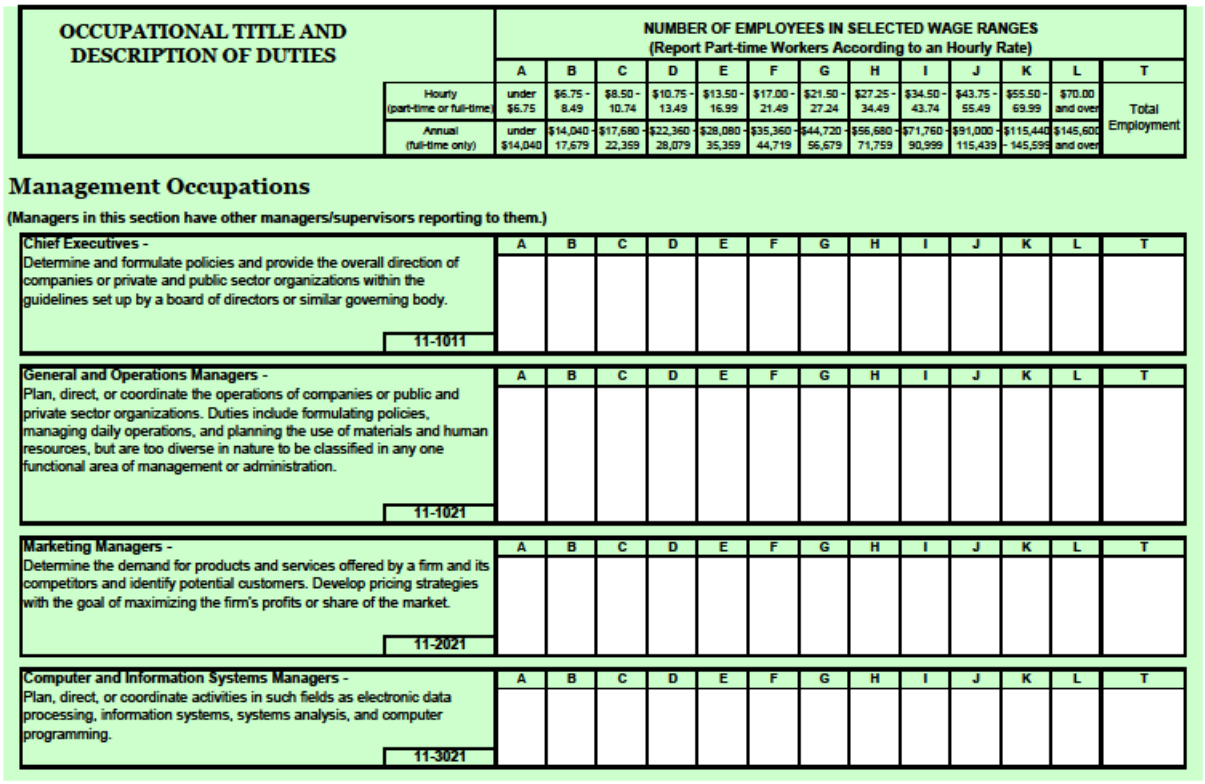
Appendix A: "Typically low-wage Occupations"

3-digit SOC code	*Minor Occupational Category*
353	Food and Beverage Serving Workers
359	Other Food Preparation and Serving Related Workers
393	Entertainment Attendants and Related Workers
352	Cooks and Food Preparation Workers
412	Retail Sales Workers
372	Building Cleaning and Pest Control Workers
536	Other Transportation Workers
452	Agricultural Workers
399	Other Personal Care and Service Workers
311	Nursing, Psychiatric, and Home Health Aides
392	Animal Care and Service Workers
516	Textile, Apparel, and Furnishings Workers
395	Personal Appearance Workers
259	Other Education, Training, and Library Occupations
339	Other Protective Service Workers
373	Grounds Maintenance Workers
394	Funeral Service Workers
537	Material Moving Workers
513	Food Processing Workers
379	Other Building and Grounds Cleaning and Maintenance Occs

Appendix B: "Typically high-wage Occupations"

3-digit SOC code	*Minor Occupational Category*
231	Lawyers, Judges, and Related Workers
532	Air Transportation Workers
112	Advertising, Marketing, PR, and Sales Managers
111	Top Executives
172	Engineers
113	Operations Specialties Managers
291	Health Diagnosing and Treating Practitioners
151	Computer Specialists
152	Mathematical Science Occupations
192	Physical Scientists
159	Other Computer and Mathematical Occupations
119	Other Management Occupations
191	Life Scientists
153	Other Computer and Mathematical Occupations
193	Social Scientists and Related Workers
251	Postsecondary Teachers
331	First-line Supervisors/Managers, Protective Service Workers
131	Business Operations Specialists
471	Supervisors, Construction and Extraction Workers
414	Sales Representatives, Wholesale and Manufacturing
132	Financial Specialists
491	Supervisors of Installation, Maintenance, and Repair Workers
171	Architects, Surveyors, and Cartographers
413	Sales Representatives, Services
511	Supervisors, Production Workers
173	Drafters, Engineering, and Mapping Technicians
252	Primary, Secondary, and Special Education School Teachers
518	Plant and System Operators
531	Supervisors, Transportation and Material Moving Workers
431	Supervisors, Office and Administrative Support Workers
333	Law Enforcement Workers
273	Media and Communication Workers
451	Supervisors, Farming, Fishing, and Forestry Workers
272	Entertainers and Performers, Sports and Related Workers
194	Life, Physical, and Social Science Technicians
492	Electrical and Electronic Equipment Mechanics, Installers, and Repairers
239	Legal Occupations, Not Elsewhere Classified
232	Legal Support Workers

Figure 1: OES Survey Form (abridged)



OCCUPATIONAL TITLE AND DESCRIPTION OF DUTIES		NUMBER OF EMPLOYEES IN SELECTED WAGE RANGES (Report Part-time Workers According to an Hourly Rate)												
		A	B	C	D	E	F	G	H	I	J	K	L	T
	Hourly (part-time or full-time)	under $6.75	$6.75 - 8.49	$8.50 - 10.74	$10.75 - 13.49	$13.50 - 16.99	$17.00 - 21.49	$21.50 - 27.24	$27.25 - 34.49	$34.50 - 43.74	$43.75 - 55.49	$55.50 - 69.99	$70.00 and over	Total Employment
	Annual (full-time only)	under $14,040	$14,040 - 17,679	$17,680 - 22,359	$22,360 - 28,079	$28,080 - 35,359	$35,360 - 44,719	$44,720 - 56,679	$56,680 - 71,759	$71,760 - 90,999	$91,000 - 115,439	$115,440 - 145,599	$145,600 and over	

Management Occupations

(Managers in this section have other managers/supervisors reporting to them.)

Chief Executives - Determine and formulate policies and provide the overall direction of companies or private and public sector organizations within the guidelines set up by a board of directors or similar governing body. **11-1011**	A	B	C	D	E	F	G	H	I	J	K	L	T

General and Operations Managers - Plan, direct, or coordinate the operations of companies or public and private sector organizations. Duties include formulating policies, managing daily operations, and planning the use of materials and human resources, but are too diverse in nature to be classified in any one functional area of management or administration. **11-1021**	A	B	C	D	E	F	G	H	I	J	K	L	T

Marketing Managers - Determine the demand for products and services offered by a firm and its competitors and identify potential customers. Develop pricing strategies with the goal of maximizing the firm's profits or share of the market. **11-2021**	A	B	C	D	E	F	G	H	I	J	K	L	T

Computer and Information Systems Managers - Plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, and computer programming. **11-3021**	A	B	C	D	E	F	G	H	I	J	K	L	T

Figure 2: Private Sector Variance Between/Within Establishments in the OES

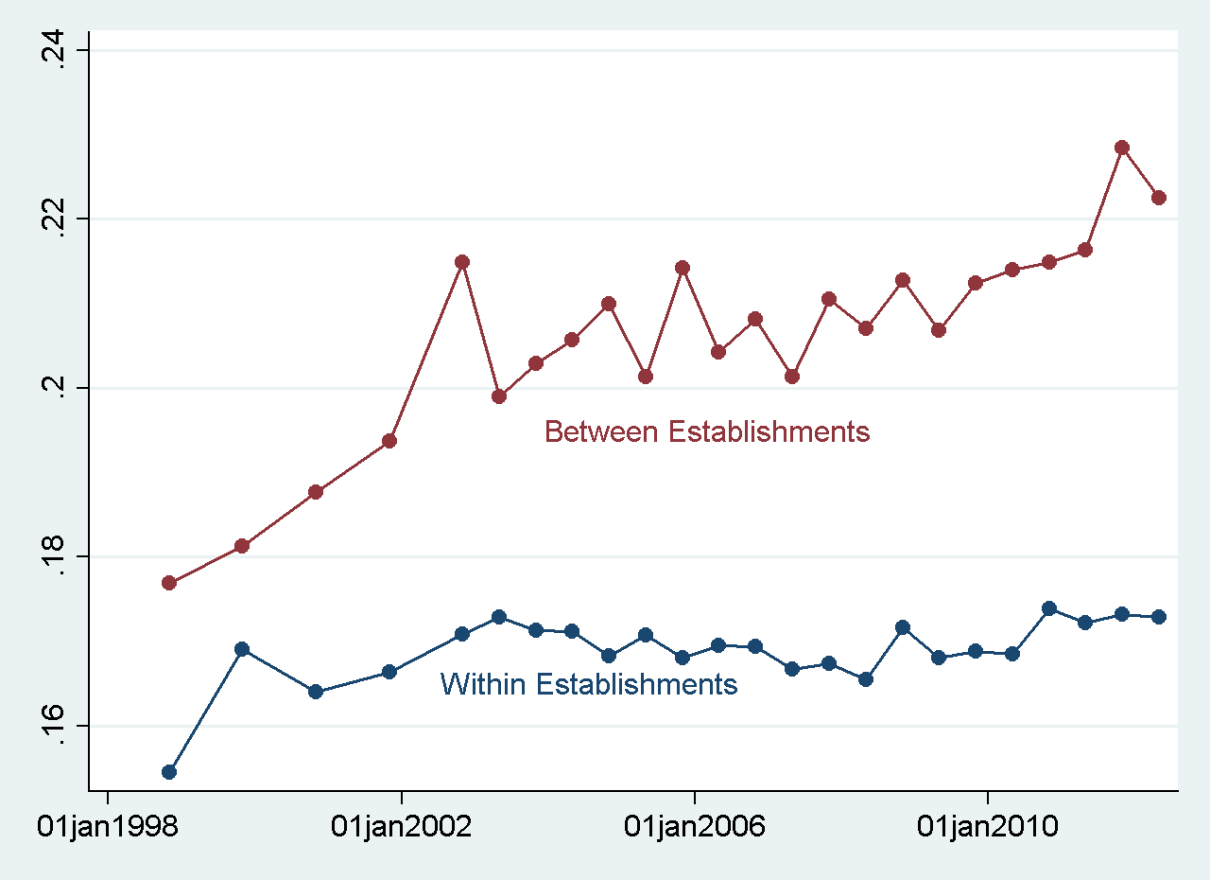
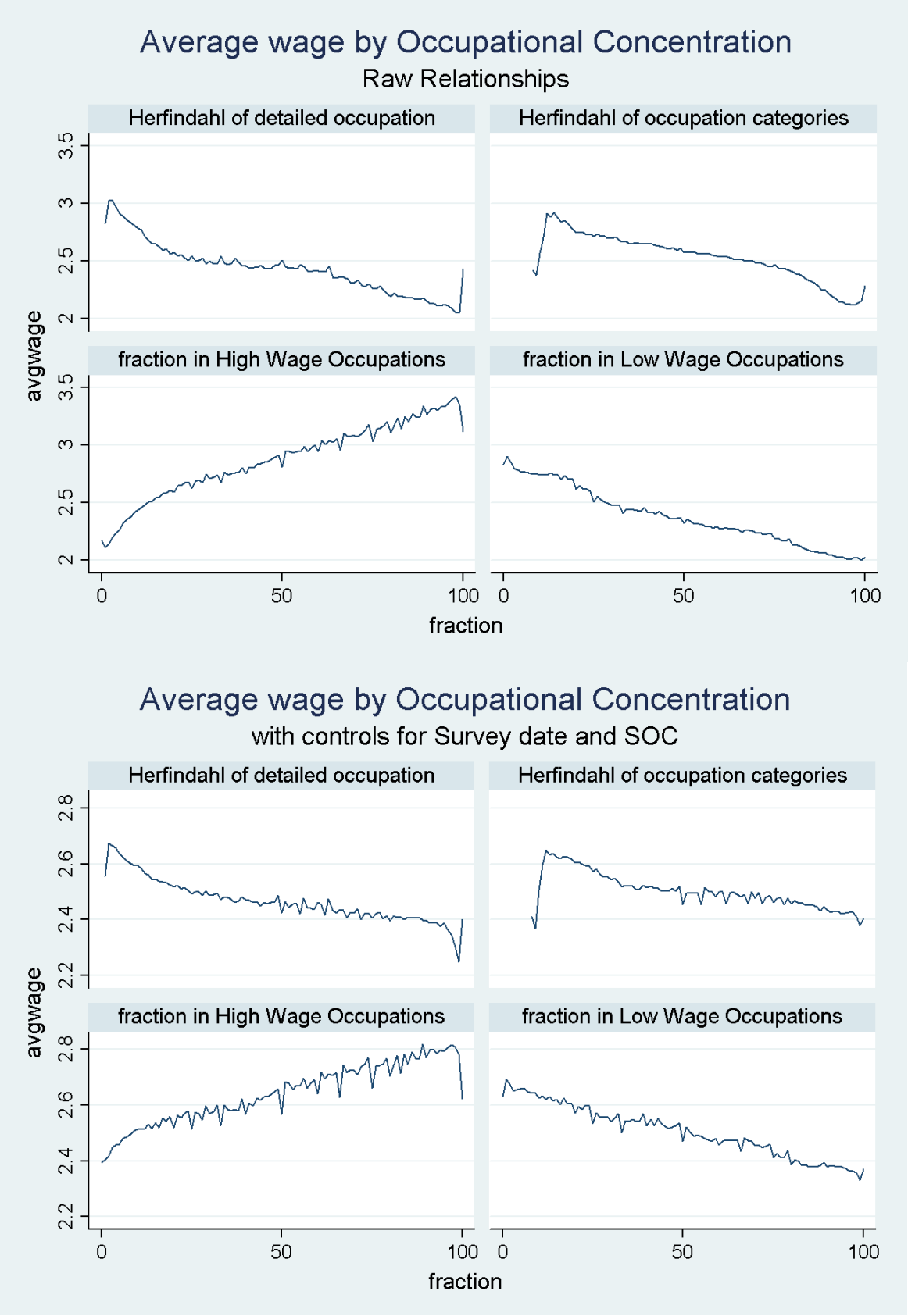


Figure 3: Relationships between Wages and Occupational Concentration



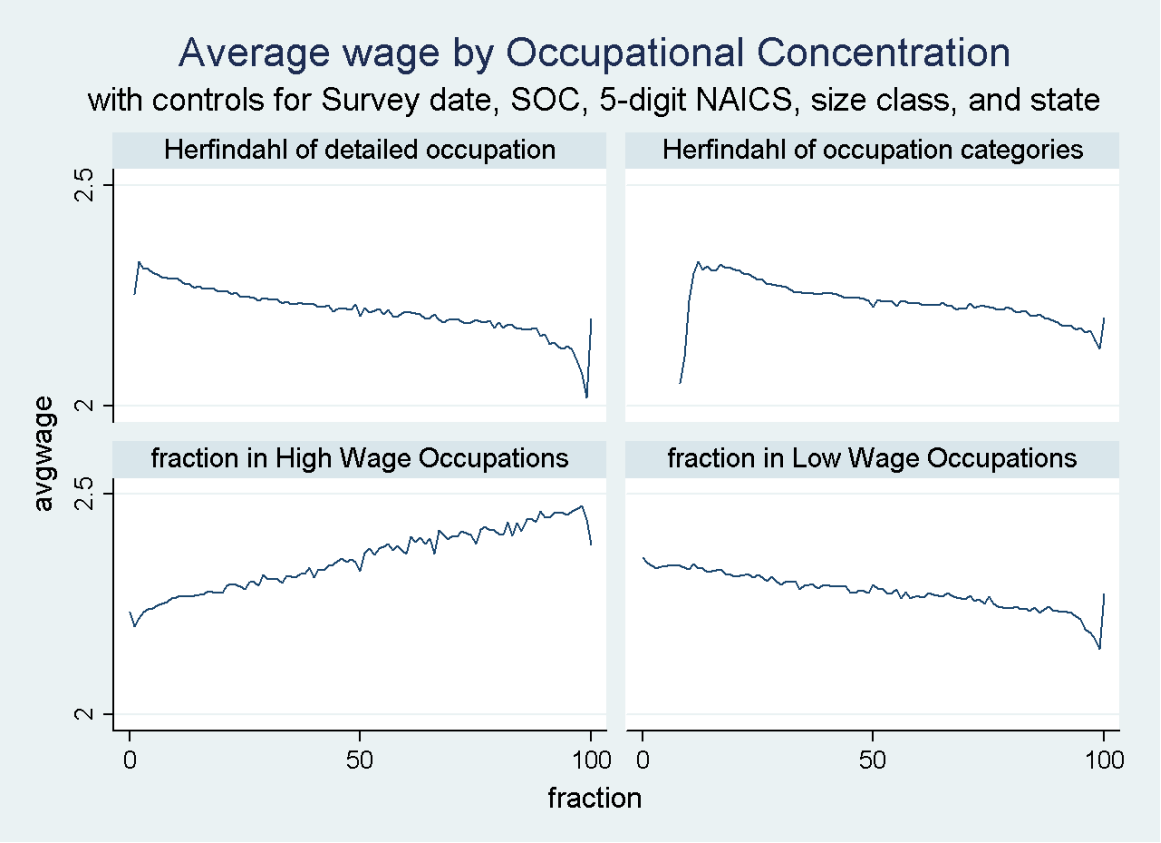

Average wage by Occupational Concentration
with controls for Survey date, SOC, 5-digit NAICS, size class, and state
Herfindahl of detailed occupation
Herfindahl of occupation categories
fraction in High Wage Occupations
fraction in Low Wage Occupations
avgwage
2
2.5
0
50
100
fraction

Figure 4: Trends in Means of Occupational Concentration

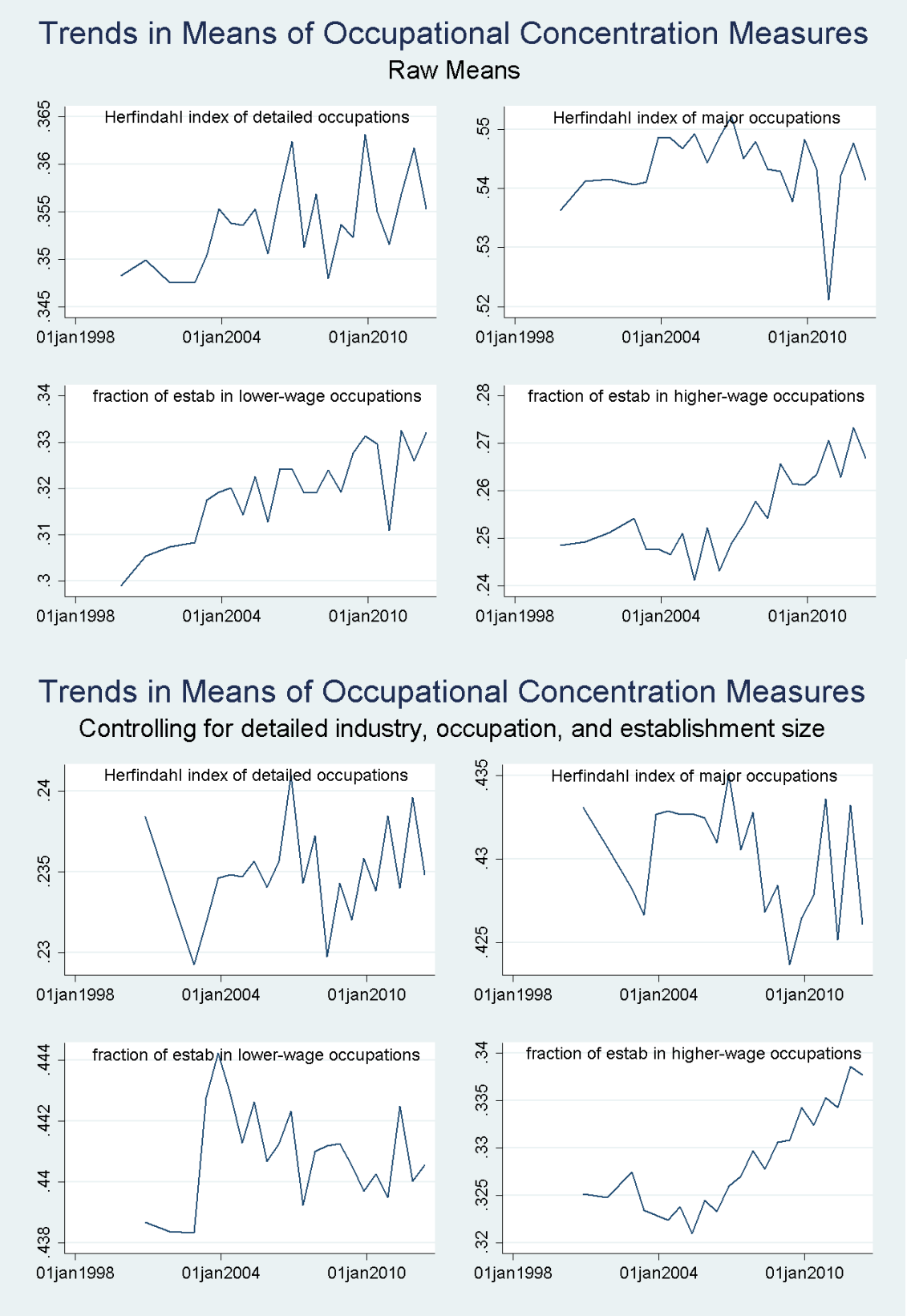


Figure 5: in Traction with Occupational Concentration values above .85

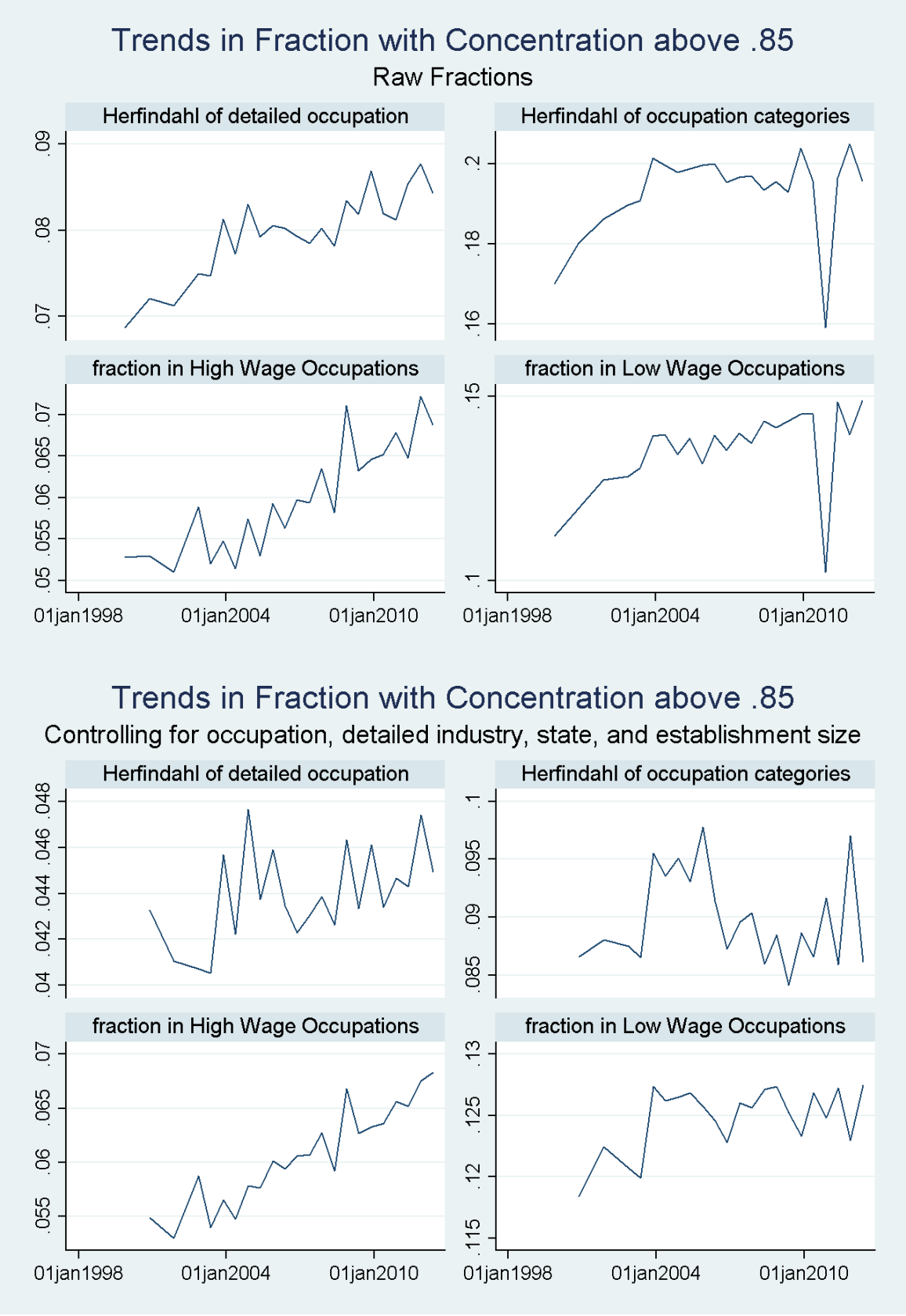
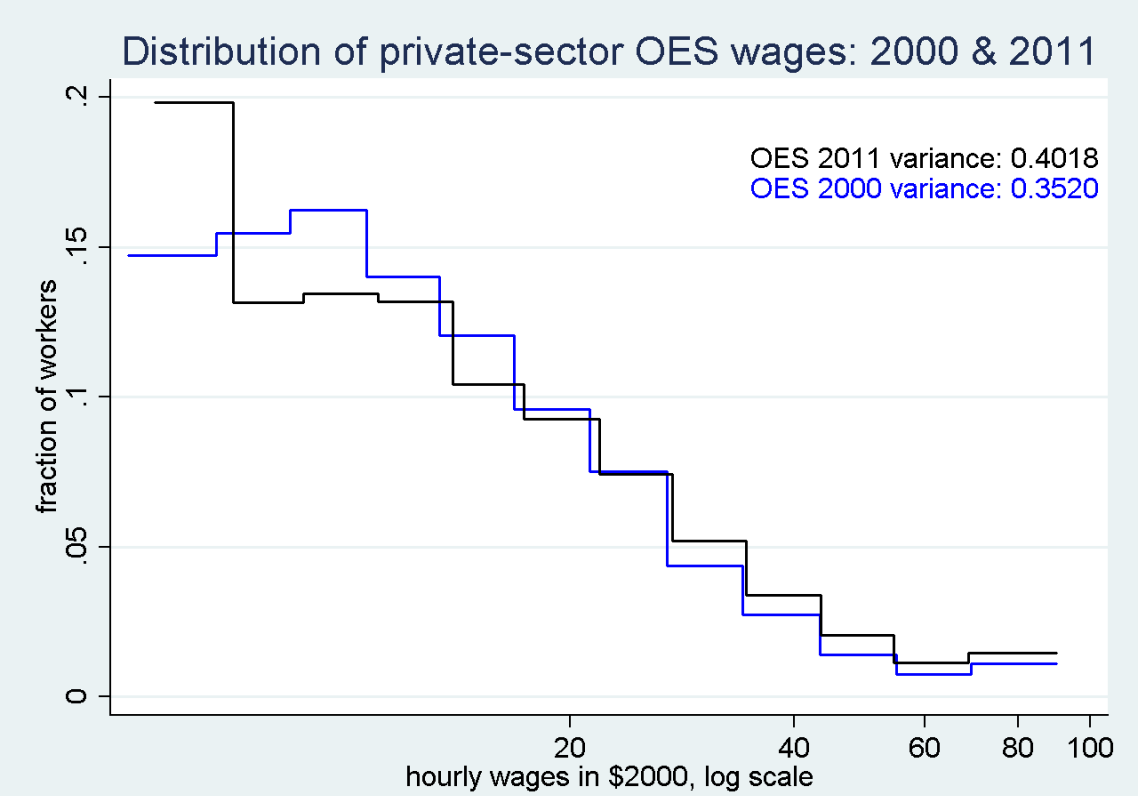


Figure 6: OES Wage distributions in Fall 2000, November 2011, and November 2011 with the "best" reweighting to Fall 2000 characteristics



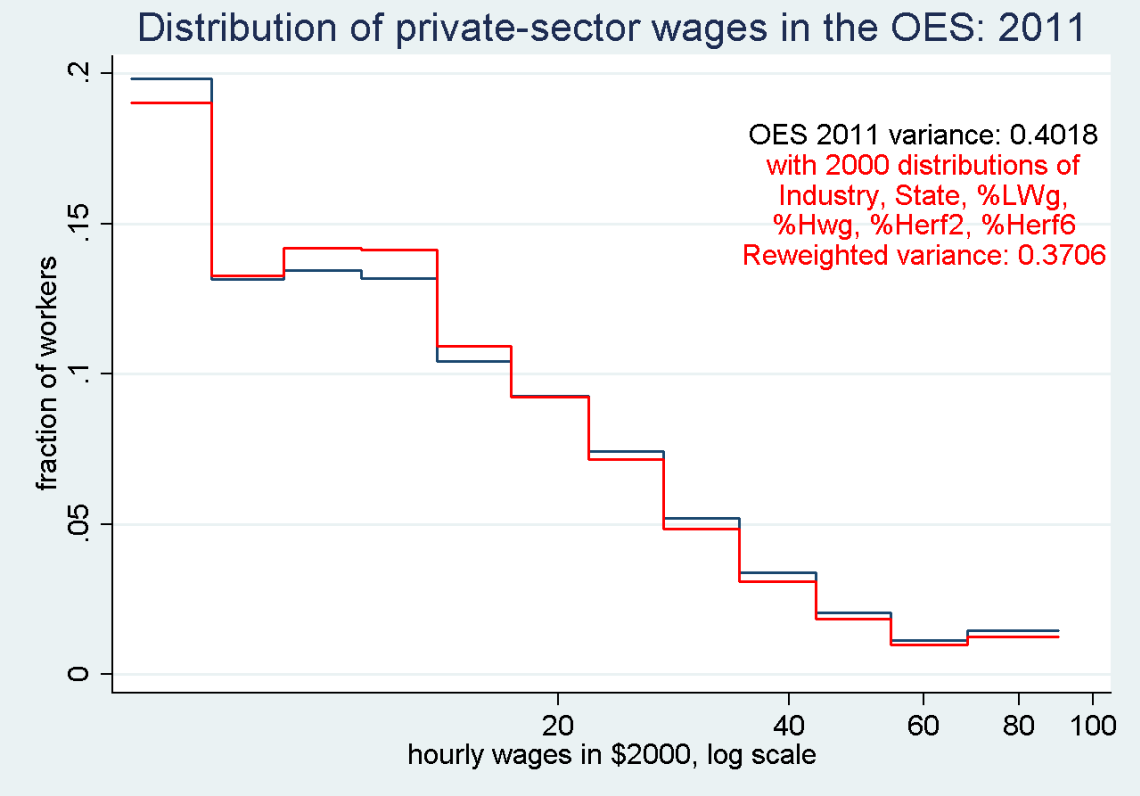


Table 1: Regressions of log wages on measures of Occupational Concentration

All unimputed OES private-sector data from Fall 2000-May 2012

Occupational Concentration Variable	Herfindahl of occupational concentration of the establishment at the detailed-occupation level	Herfindahl of occupational concentration of the establishment at the broad-occupation level	fraction of the establishment in typically low wage occupations	fraction of the establishment in typically high wage occupations
With survey-date fixed effects				
Coefficient on OccConcen	-0.336	-0.611	-0.670	0.739
t-stat	-65.04	-119.03	-199.22	175.17
Coefficient on OccConcen * Date	-0.045	-0.009	-0.042	0.093
t-stat	-41.21	-8.44	-58.32	104.01
With survey-date and 6-digit occupation fixed effects				
Coefficient on OccConcen	-0.217	-0.299	-0.329	0.154
t-stat	-67.27	-92.21	-137.62	49.36
Coefficient on OccConcen * Date	-0.003	0.017	0.010	0.042
t-stat	-3.89	25.14	19.78	64.21
With survey-date, 6-digit occupation, 5-digit NAICS, size class, & state fixed effects, and continuous size				
Coefficient on OccConcen	-0.101	-0.180	-0.119	0.006
t-stat	-33.51	-58.17	-51.23	2.03
Coefficient on OccConcen * Date	-0.004	0.013	0.000	0.044
t-stat	-5.98	19.63	0.42	70.89

Table 1a

Workers in typically high-wage ocupations only

Occupational Concentration Variable	Herfindahl of occupational concentration of the establishment at the detailed-occupation level	Herfindahl of occupational concentration of the establishment at the broad-occupation level	fraction of the establishment in typically low wage occupations	fraction of the establishment in typically high wage occupations
With survey-date fixed				
Coefficient on OccConcen	-0.424	-0.597	-0.460	-0.403
t-stat	-48.93	-64.67	-42.48	-55.65
Coefficient on OccConcen * Date	0.009	0.043	0.000	0.121
t-stat	4.96	22.20	-0.09	79.00
With survey-date and 6-digit occupation fixed effects				
Coefficient on OccConcen	-0.043	-0.166	-0.631	0.027
t-stat	-6.01	-22.15	-71.85	4.63
Coefficient on OccConcen * Date	-0.036	-0.008	0.051	0.047
t-stat	-23.82	-5.04	27.17	37.79
With survey-date, 6-digit occupation, 5-digit NAICS, size class, & state fixed effects, and continuous size				
Coefficient on OccConcen	0.102	-0.001	-0.406	0.010
t-stat	15.37	-0.15	-47.79	1.86
Coefficient on OccConcen * Date	-0.042	-0.020	0.045	0.028
t-stat	-29.92	-13.20	24.98	23.45

Table 1b:

Workers in neither typically high-wage nor typically low-wage occupations only

Occupational Concentration Variable	Herfindahl of occupational concentration of the establishment at the detailed-occupation level	Herfindahl of occupational concentration of the establishment at the broad-occupation level	fraction of the establishment in typically low wage occupations	fraction of the establishment in typically high wage occupations
With survey-date fixed				
Coefficient on OccConcen	-0.086	-0.153	-0.085	-0.012
t-stat	-14.55	-25.24	-14.22	-1.75
Coefficient on OccConcen * Date	-0.016	0.004	-0.034	0.090
t-stat	-12.98	2.76	-26.47	60.52
With survey-date and 6-digit occupation fixed effects				
Coefficient on OccConcen	-0.226	-0.216	-0.167	0.151
t-stat	-45.62	-42.12	-32.54	25.28
Coefficient on OccConcen * Date	-0.002	0.001	-0.005	0.056
t-stat	-1.60	0.72	-4.41	44.13
With survey-date, 6-digit occupation, 5-digit NAICS, size class, & state fixed effects, and continuous size				
Coefficient on OccConcen	-0.116	-0.130	0.059	-0.018
t-stat	-25.72	-27.88	12.40	-3.30
Coefficient on OccConcen * Date	0.002	0.004	-0.023	0.056
t-stat	2.04	4.33	-22.50	48.11

Table 1c:

Workers in typically low-wage occupations only

Occupational Concentration Variable	Herfindahl of occupational concentration of the establishment at the detailed-occupation level	Herfindahl of occupational concentration of the establishment at the broad-occupation level	fraction of the establishment in typically low wage occupations	fraction of the establishment in typically high wage occupations
With survey-date fixed				
Coefficient on OccConcen	-0.408	-0.676	-0.925	0.966
t-stat	-61.55	-104.81	-122.48	61.05
Coefficient on OccConcen * Date	0.041	0.082	0.105	-0.050
t-stat	28.93	59.94	65.48	-15.10
With survey-date and 6-digit occupation fixed effects				
Coefficient on OccConcen	-0.354	-0.529	-0.684	0.706
t-stat	-59.24	-89.10	-97.40	48.09
Coefficient on OccConcen * Date	0.025	0.063	0.078	-0.032
t-stat	19.91	50.38	52.23	-10.49
With survey-date, 6-digit occupation, 5-digit NAICS, size class, & state fixed effects, and continuous size				
Coefficient on OccConcen	-0.253	-0.396	-0.464	0.435
t-stat	-46.53	-71.10	-70.72	32.49
Coefficient on OccConcen * Date	0.025	0.053	0.062	-0.021
t-stat	21.41	45.26	45.04	-7.38

Table 2: Changes in Occupational Concentration over time

All unimputed OES private-sector data from Fall 2000-May 2012

Occupational Concentration Variable	Herfindahl of occupational concentration of the establishment at the detailed-occupation level	Herfindahl of occupational concentration of the establishment at the broad-occupation level	fraction of the establishment in typically low wage occupations	fraction of the establishment in typically high wage occupations
Mean values				
in Fall 2000	0.350	0.541	0.305	0.249
in Nov 2011	0.362	0.548	0.326	0.273
growth	3.4%	1.2%	6.7%	9.7%
Regression-adjusted Mean values, controlling for 6-digit occupation				
in Fall 2000	0.345	0.531	0.500	0.146
in Nov 2011	0.354	0.538	0.502	0.159
growth	2.5%	1.2%	0.5%	8.9%
Regression-adjusted Mean values, controlling for 6-digit occupation, 4-digit NAICS codes (available from 2000), size class, size, & state				
in Fall 2000	0.238	0.433	0.439	0.325
in Nov 2011	0.240	0.433	0.440	0.339
growth	0.5%	0.0%	0.3%	4.1%
Fraction with values greater than or equal to .85				
in Fall 2000	0.072	0.180	0.120	0.053
in Nov 2011	0.088	0.205	0.140	0.072
growth	21.7%	13.8%	16.7%	36.3%
Regression-adjusted fraction with values greater than or equal to .85, controlling for 6-digit occupation				
in Fall 2000	0.078	0.152	0.173	-0.002
in Nov 2011	0.089	0.170	0.179	0.010
growth	14.8%	12.3%	3.1%	-600.8%
Regression-adjusted fraction with values greater than or equal to .85, controlling for 6-digit occupation, 4-digit NAICS codes (available from 2000), size				
in Fall 2000	0.043	0.087	0.118	0.055
in Nov 2011	0.047	0.097	0.123	0.068
growth	9.6%	12.1%	3.9%	23.0%

Table 3: Results for 2011 Variances of DFL-style reweightings by one observable characteristic at a time

2000 ln wage variance:	0.3520	2000 Btw estab variance:	0.1884	2000 Wtn estab variance:	0.1637
2011 ln wage variance:	0.4018	2011 Btw estab variance:	0.2288	2011 Wtn estab variance:	0.1729
Increase:	0.0497	Increase:	0.0405	Increase:	0.0093

Variances after reweighting 2011 data to 2000 characteristics:								Overall			Between Estabs		Within Estabs	
NAICS4	fips	sizecls	Occ3Dig	herf6	herf2	%lwg	%hwg	Var	Explained	decomp	Var	Explained	Var	Explained
Y								0.3915	21%	0.5599	0.2192	24%	0.1723	7%
	Y							0.3985	7%	0.5689	0.2267	5%	0.1718	12%
		Y						0.4050	-7%	0.5676	0.2299	-3%	0.1751	-24%
			Y					0.3853	33%	0.55083	0.2123	41%	0.1731	-2%
				Y				0.4031	-3%	0.56388	0.2273	4%	0.1758	-31%
					Y			0.4029	-2%	0.56506	0.2276	3%	0.1752	-25%
						Y		0.4042	-5%	0.56521	0.2284	1%	0.1757	-30%
							Y	0.3865	31%	0.56516	0.2184	26%	0.1681	53%

Table 3a: Results for the OES Wage Distribution in 2011 of DFL-style reweightings by one observable characteristic at a time

	Employment change for each of the 12 OES wage intervals in 2011											
	< $9.25	to $11.49	to $14.49	to $18.24	to $22.74	to $28.74	to $35.99	to $45.24	to $56.99	to $71.49	to $89.99	$90 +
Baseline	21,714,038	14,398,175	14,725,048	14,418,431	11,415,070	10,138,683	8,123,080	5,683,268	3,719,482	2,267,495	1,241,866	1,590,526
Industry	-5%	-2%	3%	5%	4%	1%	0%	-1%	-1%	-2%	-2%	-4%
State	1%	1%	0%	0%	0%	0%	-1%	-1%	-2%	-2%	-3%	-2%
Size class	-2%	-1%	-1%	0%	0%	1%	2%	3%	4%	4%	3%	1%
3-digit Occup	-3%	1%	4%	6%	3%	-1%	-4%	-7%	-8%	-7%	-4%	-5%
detailed Herf	-2%	-1%	0%	0%	1%	1%	1%	2%	2%	2%	2%	1%
category Herf	-2%	-1%	0%	0%	1%	1%	1%	2%	2%	2%	2%	1%
% in LWg Occs	-5%	-3%	0%	1%	2%	3%	3%	4%	4%	4%	4%	4%
% in HWg Occs	6%	5%	2%	1%	-2%	-4%	-6%	-8%	-10%	-11%	-12%	-11%

Table 4: Results for 2011 Variances of DFL-style reweightings by selected combinations of observable characteristics

2000 ln wage variance:	0.3520	2000 Btw estab variance:	0.1884	2000 Wtn estab variance:	0.1637
2011 ln wage variance:	0.4018	2011 Btw estab variance:	0.2288	2011 Wtn estab variance:	0.1729
Increase:	0.0497	Increase:	0.0405	Increase:	0.0093

Variances after reweighting 2011 data to 2000 characteristics:									Overall		Between Estabs		Within Estabs	
	NAICS4	fips	sizecls	Occ3Dig	herf6	herf2	%lwg	%hwg	Var	Explained	Var	Explained	Var	Explained
(1)	Y	Y					Y	Y	0.3758	52%	0.2068	54%	0.1689	43%
(2)	Y	Y			Y	Y	Y	Y	0.3759	52%	0.2041	61%	0.1718	13%
(3)	Y	Y			Y		Y	Y	0.3759	52%	0.2041	61%	0.1717	13%
(4)	Y	Y				Y	Y	Y	0.3760	52%	0.2048	59%	0.1711	19%
(5)	Y	Y		Y	Y			Y	0.3804	43%	0.2032	63%	0.1772	-46%
(6)		Y						Y	0.3847	34%	0.2173	28%	0.1674	60%
(7)	Y	Y		Y					0.384	36%	0.2102	46%	0.1739	-10%
(8)	Y	Y	Y	Y	Y	Y	Y	Y	0.385	34%	0.2063	56%	0.1787	-62%

Table 4a: Results for the OES Wage Distribution in 2011 of DFL-style reweightings by selected combinations of observable characteristics

Employment change for each of the 12 OES wage intervals in 2011

	< $9.25	to $11.49	to $14.49	to $18.24	to $22.74	to $28.74	to $35.99	to $45.24	to $56.99	to $71.49	to $89.99	$90 +
Baseline	21,714,038	14,398,175	14,725,048	14,418,431	11,415,070	10,138,683	8,123,080	5,683,268	3,719,482	2,267,495	1,241,866	1,590,526
(1)	-3%	1%	5%	7%	4%	-1%	-4%	-7%	-10%	-12%	-13%	-14%
(2)	-4%	1%	6%	7%	5%	0%	-3%	-7%	-9%	-11%	-12%	-13%
(3)	-4%	1%	6%	7%	5%	0%	-3%	-7%	-9%	-11%	-12%	-13%
(4)	-4%	1%	5%	7%	5%	0%	-4%	-7%	-10%	-12%	-12%	-13%
(5)	-4%	1%	6%	7%	4%	-1%	-5%	-8%	-10%	-9%	-7%	-8%
(6)	7%	5%	3%	1%	-1%	-4%	-6%	-9%	-11%	-12%	-13%	-12%
(7)	-4%	1%	5%	7%	4%	-1%	-5%	-8%	-9%	-7%	-4%	-5%
(8)	-6%	0%	4%	7%	4%	-1%	-4%	-7%	-7%	-6%	-3%	-5%