

**"It's Where You Work:
Increases in the Dispersion of Earnings across Establishments and Individuals
in the U.S."**

Abstract

This paper analyzes the role of establishments in the upward trend in dispersion of earnings that has become a central topic in economic analysis and policy debate. It decomposes changes in the variance of log earnings among individuals into the part due to changes in earnings among establishments and the part due to changes in earnings within-establishments. The main finding is that much of the 1970s-2010s increase in earnings inequality results from increased dispersion of the earnings *among* the establishments where individuals work. Our results direct attention to the role of establishment-level pay setting and economic adjustments in earnings inequality.

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The defining feature of the distribution of US earnings from the mid 1970s through the 2000s is the huge increase in inequality. Analysis of individual earnings show that inequality increased among workers with different observed measures of skill such as education, age, and occupation and that earnings increased more at higher percentiles of the earnings distribution than at lower percentiles even among workers with the same measured skill (see, e.g., Autor, Katz and Kearney 2008; Lemieux 2006).

This paper examines earnings inequality along a dimension that previous research has largely ignored: the establishments that employ the worker. Viewing inequality through an establishment lens, we find that most of the increased variance in earnings among individuals is associated with increased variance of average earnings among the establishments where they work. Our findings direct attention to the role of establishment and firm pay setting and labor market adjustments by place of work in the rise in inequality.¹

To analyze the effect of establishment earnings on the trend increase in inequality, we combine several data sets: the March Current Population Surveys (CPS) files that record annual earnings and weeks worked of individual workers; the Census Bureau's Longitudinal Business Data Base (LBD), which is the longitudinal version of the Census business register with data on establishment payroll and employment (see Jarmin and Miranda 2002); the Longitudinal Employer-Household Dynamics data (LEHD) which contains data on the earnings of millions of workers and their place of work from unemployment insurance files. We link the LBD and LEHD through establishment identifiers and use the linked data file to decompose the inequality

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Previous work on the employers' role in wage setting include Groschen (1991), Davis and Haltiwanger (1991), Abowd et al (1999), Hellerstein et al (1999), Lane et al (2007), and Gruetter and LaLive (2009) following the early works on inter-industry wage differentials, Bell and Freeman (1991), Dickens and Katz (1987), Krueger and Summers (1998) and Gibbons and Katz (1992). Lazear and Shaw (2009) made the observation that across firm differences appeared to be growing over time for a significant number of countries, as for instance seen in the contribution on Sweden by Nordström Skans, Edin and Holmlund (2009) in their volume. Card et al (2013) find a growing contribution of plant heterogeneity in wages in Germany between 1985 and 2009.

of earnings among workers into the part that occurs among establishments and the part that occurs within establishments. Since the LEHD data does not include information on individuals' education, we link individuals on the LEHD to their responses on the 1990 and 2000 Census long-form sample and 1986-98 March CPS files to determine workers' years of schooling.

Section one of the paper estimates the contribution of changes in the dispersion of average earnings across establishments to the rise in inequality. Section two connects the distribution of establishment earnings to returns to measured skills and individual characteristics, and to the sorting of workers among establishments. Section three estimates the contribution of establishment earnings to the growth of earnings at each percentile of the earnings distribution and to the increased gap between top earners and other workers. Section four assesses the pathways behind the widening distribution of establishment level earnings.

Section 1: Earnings among establishments and earnings inequality among workers

Analysis of the link between growing earnings inequality among workers and changes in the distribution of earnings among establishments requires earnings data for individuals and establishments and links between individual and establishment earnings. We measure individual earnings by weekly earnings (annual earnings/ weeks worked) from the internal Census version of the March CPS files², and use the variance of log weekly earnings as our measure of inequality. The internal Census CPS has higher top codes for income and thus more accurate earnings at the top of the distribution than publicly available files³. We measure establishment

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The pattern of change in log weekly earnings resembles the pattern in the widely studied log hourly earnings from the CPS Outgoing Rotation group files. Lemieux (2006) compares CPS-based inequality measures.

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See the data section. The top coding in the internal CPS affects less than half a percent of the sample. See Burkhauser et al (2011). The LBD and LEHD data are not top coded.

earnings by annual earnings per worker (payroll before deductions/number of employees) in the LBD and measure inequality by the variance of log annual earnings per worker.

Panel A of Figure 1 displays estimates of the variance of log weekly earnings for individuals from the March CPS and the variance of log annual earnings among establishments from the LBD. The top line shows a substantial increase in the variance of March CPS earnings that is similar in magnitude to increases found in other CPS-based earnings data. The middle line gives the variance of log average earnings among establishments, weighted by establishment employment to be comparable with the CPS variance for individuals. The variance of establishment earnings lies below the variance of individual earnings because the establishment variance excludes variation within establishments whereas the variance of individual earnings includes the variance within establishments as well as among establishments. The bottom line gives the residual variance from regression estimates of log earnings on the worker characteristics specified in the table note. Reflecting the role of human capital and demographic factors in earnings, the residual variance lies below the unadjusted variance among individuals and below the variance of establishment earnings as well.

To focus attention on the similarity in changes among the three measures, figure 1B displays the accumulated change in variances of log earnings over time, scaled at 0 in 1977. The 1977-2009 increase for individual earnings is 0.170 log points. The increase in the earnings equation residuals is 0.147 log points. These estimates imply that 86% (0.147 points/0.170 points) of the overall trend is due to the residuals while 14% is associated with the observable attributes of workers.⁴ The variance of establishment earnings increased by the same 0.147 points as the variance of residuals. Thus, if we take the increased variance in establishment earnings

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Age and education explain most of the 14% of the increased variance due to observable worker attributes.

and the 0.023 point increase in the variance due to observable worker attributes we get the entire increase in the variance of individual earnings. The exact accounting is happenstance, but the calculation demonstrates our main finding: that increased variance of establishment earnings is a major pathway of for the increased variance in individual earnings⁵.

Given that the variances in figure 1 come from different earnings series the analysis falls short of an ANOVA decomposition of the trend increase in inequality into its between-establishment and within-establishment components. An ANOVA requires a single earnings series with identifiers for individuals and establishments, which the LBD and CPS do not have. The absence of data on the earnings of workers in establishments manifests itself in our estimate of the variance of establishment earnings. Absent earnings with individual and establishment identifiers, we use the variance of the *log average* establishment earnings instead of the variance of the *average log* worker earnings in an establishment appropriate to a complete variance decomposition.

How much does this distort the calculations? To estimate the magnitude of the distortion we applied Aitchison and Brown's (1962, p. 8) formula for the difference between the variance of log average establishment earnings and the variance of the average of log earnings when data are distributed log-normally⁶. Appendix Table A-1 estimates the differences in the two variances and finds only modest differences in the levels of the variances and virtually identical *changes* in the variances over time. As long as the log-normal assumption holds, using the variance of log average earnings rather than the variance of the average log of earnings for the establishment

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See Davis and Haltiwanger (1991) and Dunne et al (2004) for early observations of this relationship for manufacturing establishments.

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In the Appendix, we use LEHD data to adjust the variance of log average establishment earnings to approximate the variance of the log of average earnings using: $\ln E(w) = \mu_f + \sigma_f^2/2$, where μ_f is μ and σ_f^2 is the within-establishment variance of log earnings. The 1992-2007 variance increase is 0.070 (adjusted) and 0.075 (unadjusted).

variance does not substantively distort the figure 1 results. To examine this further without the lognormal assumption we computed inequality measures over time from the CPS for individuals and from the LBD for establishments and also find that the increased dispersion of earnings among establishments is close in magnitude to the increased dispersion of earnings among individuals. Table A-2 reports these results for decile measures of dispersion and for the Gini coefficient calculated on CPS individual earnings and LBD establishment average earnings. The patterns of change are again similar between the establishment averages and individual earnings.

LEHD earnings

The LEHD allows us to do better by linking earnings to individual workers and to the establishments where they work⁷, which is necessary to for a genuine ANOVA decomposition of log earnings into its between and within establishment components. In this analysis, we measure individual earnings by yearly earnings for workers employed in all four quarters of a year in the nine states that provide such information from 1992 to 2007.⁸

To see if the LEHD earnings are representative of the US we compared the variance of log yearly LEHD earnings to the variance of log March CPS weekly earnings for the nine states. We obtained similar levels of variance and nearly identical changes in variances.⁹ We then compared the CPS variance of log earnings in the nine states to the variance for the whole

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The LEHD and LBD link identifies the firm that employs workers and the establishment in which they work when firms have one establishment in a locality. When firms have multiple establishments in a locality the Census uses a probabilistic worker assignment to estimate the establishment in which the worker was employed. We use the Census's probabilistic assignment to identify the establishment location of all workers. See Abowd et al (2002, 2003, and 2007) for details and methods regarding the use of LEHD data.

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See data section for details.

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The LEHD variance for 1992 is 0.506 and 0.588 for 2007 (table 1). The CPS-based variance for the same states is 0.538 in 1992 and 0.618 in 2007. The increases in the LEHD-based variance (0.082) and CPS-based variance (0.080) are also nearly identical.

country and also found similar levels and nearly identical changes.¹⁰ Thus, analysis of the LEHD for the nine states should generalize to the entire country.¹¹

Given these assurances, we decompose the LEHD earnings into their within and between establishment components and calculated changes in the components over time. Denote $\ln w_{ip}$ as the log earnings of worker i in establishment p ; $\text{Eln}w_{ip}$ as the mean log earnings for workers in establishment p ; V_w as the within component of variance, and V_b as the between component. The variance decomposition of log earnings is:

$$(1) V(\ln w_{ip}) = V_w + V_b = V(\ln w_{ip} - \text{Eln}w_{ip}) + V(\text{Eln}w_{ip}),$$

Table 1 records the decomposition from 1992 to 2007. The between establishment earnings are weighted by their employment so that they give greater weight to establishments with more workers. In both 1992 and 2007 log earnings varied more within establishments than among establishments. But the increase in the between-establishment variance (0.056) is over twice the increase in the within-establishment variance (0.027), so that the between component accounts for 67.5% of the increased variance among all workers¹². The 67.5% estimate falls short of figure 1's 87% estimated establishment share but is sufficiently large to support the claim that increased inequality among establishments is the major pathway for increased inequality among workers.

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Appendix Table A-1b gives a CPS-based variance of log earnings for the US of 0.546 in 1992 and 0.633 in 2009. The CPS-based variance for our nine states is 0.538 in 1992 and 0.623 in 2009. The 1992-2007 change for the US (.087) is almost identical to that for the nine LEHD states (.085).

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We also examined the pattern of change in other states that the LEHD covered over shorter periods and found similar results to those in our sample of states.

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The calculation is $0.056 \text{ points} / 0.083 \text{ points} = 67\%$. The results are similar if we take earnings for the larger sample of workers who appear in at least a single quarter (the 2nd quarter of the year in our calculation). They are also similar for 22 states that appear in the data for a shorter time period. See appendix table A-2.

Stayers

The longitudinal nature of the LEHD allows us to estimate the relation between the dispersion in average establishment earnings and dispersion in individual earnings in another way. This is by decomposing the change in the variance of log earnings for workers who *stay* in the same establishment one year to the next into its between and within establishment components. Analysis of changes in inequality among *stayers* holds fixed the time invariant characteristics of workers and establishments, including characteristics for which we have no observable measures. This analysis pins down the impact of the widening establishment earnings on individual earnings in a way that sidesteps complications due to the connections between earnings, labor mobility, exit and entry of establishments, and matching of workers and establishments.

To see how data on stayers illuminates the role of establishments, consider two establishments, all of whose workers are stayers. In this case, inequality of worker earnings could increase because of: increased earnings differentials between the establishments, with unchanged relative earnings within establishments; increased relative earnings within establishments, with unchanged differentials between establishments; or some mixture of between and within-establishment changes. The decomposition for stayers arithmetically measures the between establishment and within establishment effects on stayers inequality.

Line 1 of Table 2 gives our estimates of the *change in variance* of log earnings for stayers from year $t-1$ to t over specified periods. Since workers who stay with an establishment differ from one year to the next we maximize the number of persons in the computation by using a rolling sample. We calculated log earnings for stayers in years $t-1$ and t , computed the variance in both years and then took the change in variances from $t-1$ to t to measure the change in variance.

We repeated the calculation for year t to $t+1$ and ensuing years. The 0.013 in the column labeled 1992 to 1997 sums the change in the variance of log earnings for stayers from 1992-93 to 1996-97. The 0.024 in the 1997-2002 column sums the change in variance from 1997-98 to 2001-02. And so forth. The estimates show moderate increases in variance in 1992-97 and 1997-02 followed by a larger increase in 2002-07. Over the full period the change in variance is 0.061 log earnings points.

How much of the changed variance among stayers is associated with changes in earnings among establishments? The line “changes in between-establishment variance” estimates the change in variance of the average log earnings among establishments. These estimates are the sum of the changed variance of establishment level log earnings of stayers from one year to the next over the specified period. They attribute all of the increased variance among stayers from 1992 to 1997 to the increased between-establishment variance (0.013 points/0.013 points) and attribute smaller but still dominant shares of the increased variance in ensuing periods to the increase in variance among establishments. For the whole period, the 0.048 change in variance due to the changed variance among establishments is 79% of the 0.061 total increase in variance. The remaining 21% of the increase in total variance is the contribution of changes in within-establishment variance.

The bottom part of table 2 summarizes the results of analogous variance decomposition for all employees. Changes in variance are larger for all employees than for stayers because all employees are a more heterogeneous group that includes workers who move from one establishment to another or between employment and non-employment. The variance among all workers increases by 0.083 points, of which two-thirds (0.056/0.083) is between establishments. Dividing the change in total variance for stayers by the change for all employees shows that the

stayers account for nearly three quarters of the increased overall variance. This reflects the fact that most workers stay in the same job from one year to the next. Exit and entry of establishments and movement of workers among establishments and between work and non-work contribute to the variance, but the main driver of the trend in variance for all workers is the increased variance among stayers due to changing establishment differentials.

Section 2: Worker characteristics and establishment premium.

Most studies of earnings inequality focus on the contribution of increased returns to observable characteristics such as education or age. To examine the interaction between establishment earnings and the returns to individual characteristics and sorting of workers by these characteristics among establishments in the rising trend in inequality requires a valid measure of years of schooling, which the LEHD does not provide. To obtain a measure of schooling for individuals we matched the LEHD records to the 1990 and 2000 Census long forms and 1986-1998 March CPS files to obtain Census or CPS years of schooling to add to the LEHD.¹³ We then estimated the following extension of the standard log earnings equation each year from 1992 to 2007:

$$(2) \ln w_{ip} = \mathbf{x}_{ip} \mathbf{b} + \phi_p(i) + u_{ip}, \text{ with } E(u_{ip} | \mathbf{x}_{ip}, \phi_p) = 0$$

In this equation $\mathbf{x}_{ip}$ is a vector of worker characteristics (years of schooling, experience (Mincer), and its square, and dummy variables for non-white and gender) for worker i in establishment p . We interact the independent variables with gender to allow for male-female differences in the relation of the independent variables to log earnings.

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The long form is distributed to approximately 15 percent of the US population every decennial. The combination of Census long form and the CPS allows us to match 18% of the LEHD sample with those files and thus obtain valid education measures for a large number of workers. See data appendix for details..

Our extension of the standard log earnings model is the vector of dummy variables $\phi_p(i)$ for the establishment p where the worker i works. We impose equal establishment effects on workers by omitting the individual subscript from establishment dummy variables but still write the vector as a function of i to highlight that all workers in an establishment share the same establishment effect. This specification puts individual heterogeneity in the establishment effect, (which reflects the quality of the individual and establishment match) into the error term.

Taking the variance of (2) we decompose the variance of log earnings into the part due to variance of the predicted wage from observable characteristics among workers, the variance of earnings among establishments, the co-variance between them, and the variance in the error term. To simplify the algebra, denote a worker's predicted wage from observable characteristics as s ($= x\mathbf{b}$, a composite index that depends on worker attributes weighted by the estimated $\mathbf{b}$ coefficients linking attributes to earnings) and denote $V(\phi)$ as the variance of the establishment's effect on wages. This yields:

$$(3) \quad V(\ln w) = V(s) + V(\phi) + 2 \text{cov}(s, \phi) + V(u)$$

Denoting S as the establishment's average level of wages associated with observable characteristics, a natural measure of the similarity of workers in an establishment is $\rho_\phi = \text{cov}(s, \phi)/V(s)$, the extent to which the attributes of individuals that contributes to wages are associated with the establishment effect. The ρ coefficient is Kremer and Maskin's (1996) index of worker-worker segregation across establishments. When establishments hire workers randomly by observable characteristics, $\rho = 0$. When establishments hire so that workers are perfectly sorted and all workers in an establishment have similar wage determining characteristics, $\rho = 1$. When firms hire workers by observable characteristics independently of the establishment earnings factor, $\rho_\phi = 0$.

Given these definitions, the *between-establishment* variance divides into a part due to sorting of workers and a part due to “pure” variation of earnings among establishments:

$$(4) \quad V^b = V(s) (\rho + 2 \rho_\varphi) + V(\varphi).$$

where $V(s) (\rho + 2 \rho_\varphi)$ reflects the contribution to between-establishment variance of both forms of sorting of workers; and where $V(\varphi)$ is the variance of the establishment effect for workers with similar measured characteristics independent of variation in the distribution of workers among establishments.

Similarly, we decompose the *within establishment* part of the variance V^w into:

$$(5) \quad V^w = V(s)(1 - \rho) + V(u).$$

When establishments employ workers with the same characteristics, $\rho = 1$ and the variance of the individual wage index contributes nothing to within-establishment variance. When establishments hire workers irrespective of characteristics, $\rho = 0$. In this case the variance in the distribution of individual attributes contributes to the within-establishment variance but not to the across-establishment variance.

Table 3 gives our decomposition of earnings in the matched LEHD-Census sample. The earnings equation (2) is estimated separately for each of the nine LEHD states, and the table reports employment weighted statistics across the states. The $\text{Var}(\ln w)$ row records the variance of log earnings. The variances for the matched sample are similar to the Table 1 variances for the entire LEHD, with a slightly larger increase.¹⁴ The similarity shows that the matching preserved the pattern of change in dispersion on which we focus.

The row “Ind.char.: $\text{Var}(s)$ ” shows that the variance of the predicted individual earnings, conditional on establishment effects, had a negligible effect on the trend in variance. Since the

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An increase of 0.088 in Table 3 compared to 0.083 in Table 1

education premium was widening (Goldin and Katz, 2008), something else in the index of worker characteristics must have offset its effect on the variance. As we shall see, that something else is a fall in male/female earnings differences.

The estimated sorting coefficients show that worker-worker sorting (ρ) increased by 1.3 percentage points over the 15 year period. Worker-establishment sorting, ρ_ϕ , increased by a larger 6.5 percentage points, as establishments with high earnings increasingly loaded up on high pay workers. But because the sorting effect depends on the variance of the index of individual characteristics, $V(s)$, which fell slightly, sorting has little impact in the decomposition.

What dominates the increased variance of establishment-level earnings is the increased divergence of earnings among establishments. This contributes 0.057 points, or 65 percent, of the increased variance. In turn, the decomposition of the between-establishment effect shows that the increased variance in the establishment effect, ϕ_p , accounts for the vast bulk ($.049/.057 = 86$ percent) of the increase in the between establishment variance.

Finally, the decomposition of the within establishment variance at the bottom of the table shows that the within-establishment increase resulted largely from increased variance of the residual in the equation – that is, to greater variance among workers with similar characteristics within establishments rather than to changes in the within-establishment composition of workers¹⁵.

The surprisingly small (and negative) effect of the variance of the index of individual characteristics on the change in dispersion of earnings within and between establishments merits

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Workers in establishments with multi employers within the same state are allocated to establishments using distance to work versus residence, together with summing conditions. See Abowd et al (2002) for the allocation algorithm. To check that our results are not sensitive to this allocation, we report results using SEIN rather than SEIN UNIT as the organizational unit in Table 3 A. The between employer variance goes down to .276 versus .292, and the share of the increase in the variance due to between employer variation is 61 percent rather than 65 percent when using state-employer instead of establishment. Otherwise the patterns are very similar.

attention in light of large increases in the estimated coefficient on education, which adds to the variance of earnings. To understand what lies behind the small estimated composite effect, we decomposed the variance of March CPS earnings yearly from 1977 to 2011 and calculated the contribution of worker attributes to the overall increase in variance.

Figure 2 gives the results of this decomposition. The line for years of schooling shows that schooling increased the variance of log earnings as the return on years of schooling increased. But the line for gender shows a large decline in the variance of log earnings associated with gender.¹⁶ From 1977 to 2011 the schooling measure added 0.07 points to the variance while the gender measure reduced the variance by 0.06 points. Over the 1992-2007 period the more modest upward trend in variance due to schooling is partially offset by declines in variance due to gender, age, and the co-variances as well.

Section 3: The widening percentile distribution of earnings

Studies that focus on the entire distribution of earnings document that percentage changes in earnings in the period on which we focus were larger in the higher percentiles of the distribution and were especially large for top earners – the upper 10% or 1%, depending on the study (Lemieux 2008; Alvaredo, Atkinson, Pikkety and Saez, 2013).

To see how establishment differentials affect changes in earnings by percentile in the earnings distribution, we calculated LEHD percentile earnings distributions for individuals in 1992 and 2007. We assigned to each person the establishment effects of their workplace and

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In this calculation we included the covariance of gender with age. We made similar calculations for the matched LEHD data and obtained similar results. In that data set, adding establishment effects reduces the estimated educational wage differentials by about 20 percent, reflecting a positive sorting of high educated workers towards high paying establishments.

calculated the mean of establishment effect¹⁷ for all individuals at a given percentile. If the distribution of earnings in 1992 had 1,000 workers at the 10th percentile, the establishment effect for the 10th percentile would be the average of the establishment effects for the 1,000 workers. Similarly, if the distribution of earnings in 2007 had 1,500 workers at the 10th percentile (due to the increased work force), the establishment effect for the 10th percentile would be the average of the establishment effects for those workers. Given these estimates, we then calculated the increase in the average establishment effects by percentile between 1992 and 2007. If changes in establishment earnings were important in altering the distribution of individual earnings, the pattern of change in the establishment earnings by percentile should closely resemble the pattern changes in the earnings of workers in the percentiles.

Figure 3 shows that this is the case. The dotted line for the changes in the average establishment effect for workers by percentile increases with the percentiles of the distribution. To see how this meshes with the changes in earnings of individuals at each percentile, we calculated the average log earnings of individuals by percentile in 1992 and 2007 and computed the difference between these percentile averages. To better contrast changes for individuals and changes for establishment effects, we then subtracted the average change in log earnings for all individuals from each percentile's change. We did this because by construction the changes in establishment differentials average to zero with negative as well as positive effects. Subtracting the change in the mean for individual earnings preserves relative changes while putting individual changes in similar units as the establishment changes.

The solid line in figure 3 shows these changes. The pattern of changes for individual earnings and for establishment effects closely mirror each other. Establishment effects have

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The regression includes years of schooling, experience and experience squared, a race dummy, all interacted with gender in addition to an establishment fixed effect.

larger increases than individual earnings at the lower end of the distribution and smaller increases than individual earnings at the top percentiles. These differences reflect the fact that the earnings distribution is ordered by individuals, whose changes will be influenced by their circumstances as well as by establishment effects – individuals low in the distribution will have negative shocks and those high in the distribution will have positive shocks. But the deviations are modest. Changes in earnings at the establishment where people work dominate the pattern of higher increases in earnings at higher percentiles of the distribution.

Top earners

Finally, given widespread attention to the increased relative rewards to workers at the top of the earnings distribution, we examined the extent to which the advantage at the top increased because earnings at the establishments at which they work increased relative to earnings at other establishments. We divided the LEHD sample into top earners – defined as those in the upper 5% of the distribution of the nine states – and the remaining 95%. We computed the 1992-2007 increase in the log earnings difference between the top 5% and the 95% and the impact that increase had on earnings inequality for all workers. We then estimated the change in earnings at the establishments where the top 5% worked relative to the establishments where the 95% worked and the impact that had on the difference between the 5% and the 95%.

Table 4 shows that the increased advantage of the 5% accounts for 40% of the increase in the variance of log earnings measures of inequality and that the divergence of establishment earnings underlies much of the increased advantage of top earners. Line 1 records the variance of log earnings and change in variance for all workers in 1992 and 2007. Lines 2 and 3 estimate the log mean earnings and changes in log means for the top 5% and the remaining 95%. Line 4

gives the differences in the means. The earnings advantage of the top 5% over the 95% increased by 0.208 log earnings points. Line 5 uses the variance formula in the table note to calculate the impact of the earnings gap to the total variance in each year and the impact of the increase in the gap to the increased variance for all workers. It is from this calculation that we obtain the 40% figure cited above as the effect of the changed gap on the total increase in variance between 1992 and 2007.¹⁸

The remainder of the table assesses the role of changes in establishment differentials on the 0.208 increased advantage of the top 5%. Lines 6 and 7 estimate the establishment effects for the 5% and for the 95%. The estimates follow the procedure in the figure 3 calculations just described: they average the establishment effects from the LEHD earnings regression for all persons in the relevant groups.¹⁹ Note that per the figure 3 discussion, the establishment effects are scaled around zero, which places them on a different metric than the mean earnings in lines 2-4. But the changes over time are comparable. Line 8 shows that the change in the establishment effects for the top 5% vs the 95% was 0.174. This is 84% of the change between the mean earnings of two groups in line 4. Given that 40% of the increased variance of log earnings is associated with the pulling away of the top 5% versus others, the implication is that 33% ($0.84 \times 40\%$) of the increased variance of log earnings is attributable to increased gap between the average earnings in the establishments where the top 5% work and the average earnings in the establishments where others work.

In sum, changes in the distribution of earnings among establishments substantially

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The 60% of the rest of the increase in variance is due largely to increased variance in log earnings among the 95% is associated with the widening of establishment effects in their establishments.

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They come from the same regression of log earnings of individuals on years of schooling, experience and experience squared, a race dummy, interacted with gender and the key vector of establishment dummies that yields the establishment effect.

affected changes in earnings along the entire earnings distribution and the increased advantage of top earners compared to other workers. The question that naturally arises next is “what forces have moved establishments further apart from each other in earnings space?”

Section 4. Pathways for the widening earnings structure among establishments

To answer this question and determine what establishment-level factors are associated with the establishment average earnings we regressed log average yearly earnings in establishments on measures of establishment attributes using the following equation:

$$(6) \quad \ln w_p = G_p a + I_p b + c \ln E_p + d MU_p + e \ln Ef_p + f \ln NP + \varphi_p$$

where w_p is the average annual earnings in an establishment in year t from the LBD. The vector φ_p measures establishment mean earnings net of the other variables in the regression. It differs from the establishment effects examined in sections 1-3, mainly because it does not contain controls for individual characteristics such as education, as the LBD has no data on individuals.

G is vector of 537 dummy variables for the geographic area in which an establishment locates: for urban areas, it is the metropolitan area (PMSA), and for rural establishments outside of PMSA

adding employment size variables as well. The 2007 calculations show that neither geography nor size of the employing business contributes much to the variance in that year. What matters is industry: its contribution rises from 20 to 49 percent when we expand the number of dummy variables going from one to two digit industries, then increases modestly with additional industrial detail. Establishment effects also matter: they represent 42 percent of the variance with detailed industry codes and employment and covariances.²⁰ In 2007, the 4-digit industries with the highest pay were Securities and Commodity Contracts Intermediation and Brokerage, Securities and Commodity Exchanges, Software Publishers, Pipeline transportation of crude oil and natural gas, Other Financial Investment activities, and Electric Power generation, transmission, and distribution. The 4-digit industries with lowest pay included Apparel Manufacturing, Food and Beverage Stores, Food Services and Drinking Places, Accommodation, and Book, Periodical and Music Stores.

The decomposition of the change in variance from 1992 to 2007 shows that industry and establishment also dominate changes over time. Two digit industry dummies provide considerable information about changes in establishment earnings, but there remains considerable variance in the changes among establishments in the same two digit industry. Indeed, even with detailed four digit industry dummies, the estimated ϕ_p vector shows substantial widening in the distribution of earnings among establishments.

Establishment Earnings and labor productivity

Was the increased dispersion of earnings among establishments accompanied by

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increased dispersion of other measures of establishment performance or was the widening of the distribution unique to earnings?

It would be strange if earnings were the only establishment-level factor that diverged among establishments. Divergence of earnings due to the labor market factors would presumably lead establishments with increasing wages to substitute other factors for labor – capital or innovative technology – and raise labor productivity relative to establishments with decreasing earnings, producing a wider dispersion of labor productivity. In terms of exit or entry of establishments, those with low productivity would presumably survive better in a world where they can hire workers at wages far below average than if wages are concentrated near the average,²¹ further widening the distribution of productivity. From the productivity side, establishments in markets with inherent heterogeneity in workplace productivity (see, e.g., Melitz 2003; Klette and Kortum 2004; Bender et al 2008; Faggio et al 2007; Comin et al 2009) due to differences in the introduction of new technology or other supply shocks or that face differential changes in product demand are likely to see productivity increases spilling over to wages through “rent-sharing” behavior. Efficiency wage models focused on the motivational impact of wages also suggest that wages and productivity are likely to increase or decrease together. Whatever the causal mechanism, we expect rising dispersion in earnings to be associated with rising dispersion of labor productivity.

To examine the relation between changes in productivity and changes in establishment earnings, we estimated the variance of log revenues per worker among establishments and compared changes in that variance to changes in the variance of log earnings. To estimate

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establishment revenues per worker, we obtained data from the US Census Bureau's Economic Census files, which are based on quinquennial censuses of establishments in every year with an ending of 2 or 7.²² Revenues per worker are not an ideal indicator of productivity but have the virtue of focusing on the flow of funds that is likely to bound labor payrolls.

Table 6 displays the variance of log revenues per worker (upper panel) and the corresponding variance of log earnings among establishments (lower panel) from the LBD for the one digit private sector industries every five years from 1977 to 2007. The variances of log revenues per worker are much larger than the variances of log yearly earnings -- 2-3 times larger for all sectors. More important for our issue, the variances of log revenues per worker increased roughly twice as much as the variances of log earnings (0.311 versus 0.156). For whatever reason, establishments moved further apart in revenue per worker than they did in earnings in the period under study.

Rent-sharing and other non-competitive models of wage determination offer one possible explanation for the two series diverging in the same period. These models posit that exogenous changes in revenues/profits change wages in the same direction (see, e.g., Arai 2003; Martins 2009; Dobbelaere and Mairesse 2010; and Card et al 2013). Following this logic we examine the link between wages and revenues using the following model:

$$(7) \quad \ln w_{pir} = a + b \ln R_{pir} + c \ln AW_{ir} + d s_I + v_{pir}$$

characteristics measured at detailed industry level.²³

Table 7 presents the results from estimating equation (7) on a panel of establishments for five year intervals from 1977 to 2007 using different statistical models. The key coefficient in the regression is the b parameter that links revenues per worker to earnings. Given the fact that variance of revenues per worker increased at about twice the variance of earnings, an estimated b of around 0.7 would attribute most of the increased variance of log earnings to the increased variance of revenues per worker.²⁴ None of our estimated models give such a large rent sharing parameter. The OLS model in column 1 has a rent sharing parameter of 0.386. Addition of establishment fixed effects in column 2 (so that the analysis links within establishment earnings to within-establishment revenues per worker) drops the rent-sharing parameter to 0.324. The instrumental variable estimate in column 3, which deals with the endogeneity of revenues per worker by the Card, Devicienti, and Maida (2010) method of taking revenues outside of the region of the observed establishment as the instrument, gives an estimate of 0.163. The identifying restriction in this analysis is that, conditional on average earnings in the industry and region, higher revenues per worker in the industry outside the region affects earnings solely through establishment revenues. With an impact on earnings of 0.163 the increased revenue per worker adds about 5-6% to the variance of earnings among establishments²⁵ and thus falls far short of explaining the increased variance of establishment effects and increased inequality of

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The skills measure is the average predicted xb from the section 1 equations using

individual earnings.

There are caveats to the finding that rent-sharing does not appear to be a major driver of the increased dispersion of establishment level earnings. Our measure of revenue per worker is a serviceable but not ideal measure of productivity nor of the super-normal profits that firms may share with workers. Our measure of establishment pay may be contaminated by changes in the composition of workers. The importance of rent-sharing may differ by the industry in which an establishment operates and the industrial organization of the sector or by the firm to which an establishment belongs. Given that approximately 43% of American workers are covered by “shared capitalist” forms of compensation, such as profit-sharing and gain-sharing systems, use of bonuses, stock options and employee share ownership (Kruse, Blasi and Park 2010, table 1.1), more research on rent-sharing is clearly warranted.²⁶ Still, our results suggest that factors beyond demand-driven rent-sharing would seem to be needed to account fully for the divergence of establishments in earnings space.

5. Conclusion

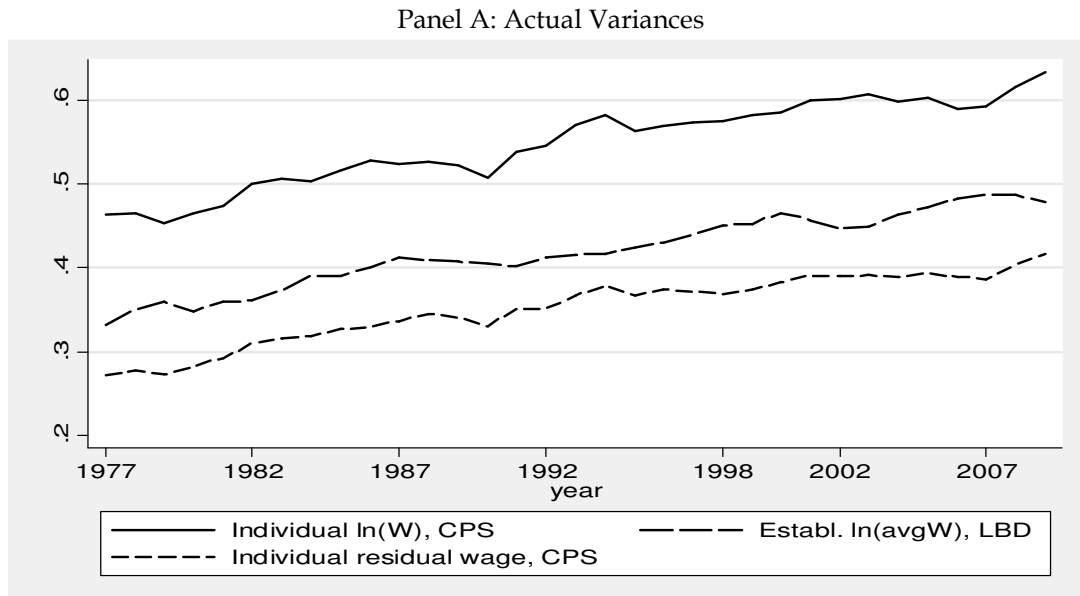
The distribution of earnings across establishments widened markedly during the 1970s-2000s period of increasing inequality of individual earnings. Using several data sets and modeling procedures we find that the widening of the establishment earnings distribution underlies much of the increase in inequality. The widening establishment distribution accounted for most of the increased variance of log earnings among workers, explaining 79 percent of the

²⁶ Studies that link changes in dispersion of wages to modes of compensation give conflicting results for the contribution of compensation systems to the increased dispersion of pay among individuals. Lemieux et al (20

increase in dispersion among workers who continued from one year to the next in the same establishments. It also accounted for most of the pattern of larger increases in earnings among workers higher in the earnings distribution and for most of the increased gap between earners in the upper 5% and others. The distribution of log revenues per worker also widened over the period though our demand-driven rent-sharing model did not add much to the change in variance of earnings.

The finding that the establishments where people work has been a major factor in the much-heralded increase in inequality does not provide a simple explanation for the increase in inequality but rather directs attention at the economics that have pulled establishments apart in earnings space, which preceding work has downplayed. This in turn suggests the value of renewed analysis of establishment pay setting and hiring policies on the demand side; on establishment-level mobility on the supply side; and on factors beyond establishment demand shocks, such as productivity shocks associated with the introduction of innovative products or processes, in producing the divergence of establishment earnings. The huge role of establishment factors in the trend rise in inequality found in this study is a signpost to pay attention to the places where people work as well as to their skills in studies of inequality.

Figure 1. Variance of log earnings: individuals and establishments, 1977-2009



Panel B: Variances Scaled at zero in 1977

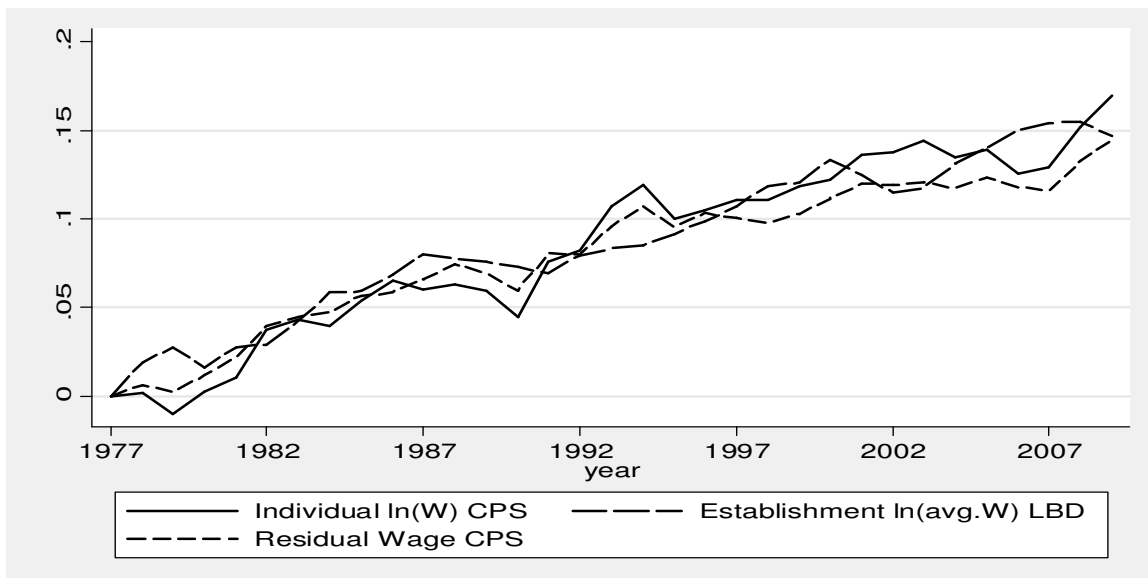


Figure 2. Variance decomposition of log earnings from CPS, 1977-2009
based on estimated impacts of individual characteristics from yearly regressions

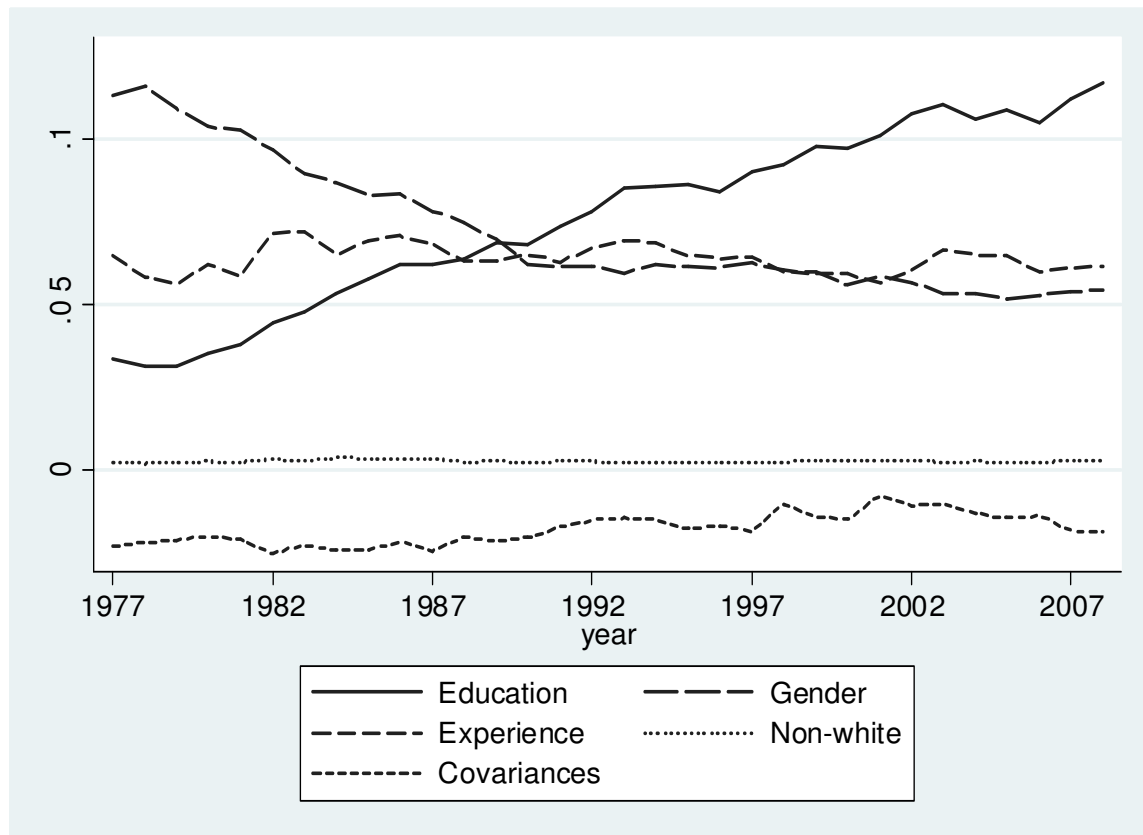


Figure 3. Change in average log earnings,
by percentile of the earnings distribution among individuals 1992-2007

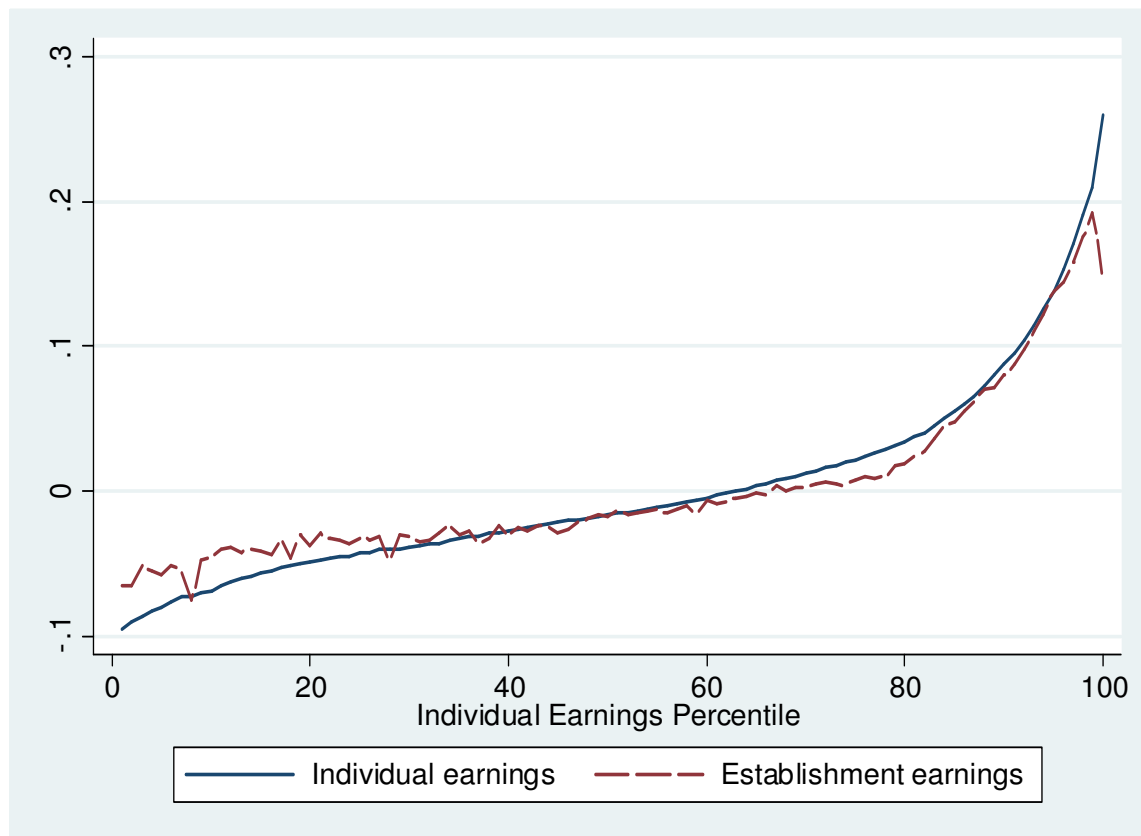


Table 1. Level and Changes in Variance in Log earnings
Between and Within Establishments, 9 LEHD states 1992-2007

	1992	2007	Growth
Variance across individuals, total	0.480	0.563	0.083
Between establishments	0.219	0.275	0.056
Within establishments	0.260	0.287	0.027
# of individuals (millions)	19.0	26.0	
# of establishments (millions)	1.33	1.81	

Note: Employment weighted means for the 9 LEHD states. See data section for details. Annual earnings, full year employees, main job. Results for quarterly earnings for all individuals observed at the employer in the 2nd quarter, as well as figures including 22 states for shorter periods of time, show similar patterns and are available from the authors on request.

Table 2. Growth in variance components within and between establishments. Stayers and all employees, LEHD data 1992-2007

	Period of Change		
	1992-1997	1997- 2002	2002- 2007
Stayers			
Change in Var(log earnings)	0.013	0.011	0.037
Change in Between variance	0.013	0.008	0.027
Change in within variance	0.001	0.003	0.009
All employees			
Var(log earnings)	0.023	0.020	0.040
Between	0.015	0.012	0.029
Within	0		

Table 3. Variance Decomposition of LEHD Earnings with Individual Characteristics

	1992	1997	2002	2007	92-07 Change	Share of Change
All:						
Var(lnw)	0.457	0.478	0.500	0.545	0.088	1.00
Ind.char.: Var (s)	0.108	0.101	0.101	0.101	-0.007	-0.08
Worker-worker: ρ	0.344	0.340	0.345	0.357	0.013	
Worker-estab.: ρ_{ϕ}	0.233	0.242	0.258	0.297	0.065	
Var between	0.235	0.246	0.259	0.292	0.057	

Table 4: Effect of Increase in Top 5% Earners/Other Earners Gap to Inequality and of Increased Establishment Differentials on Top 5% /other earners gap

Contribution of Earnings Gap between upper to Variance	1992	2007	Change
1. Variance of log earnings, all workers	0.480	0.563	0.083
2. Mean, log earnings, upper 5%	7.843	8.142	0.299
3. Mean, log earnings lower 95%	6.261	6.352	0.191
4. Difference in Means ((2)-(3))	1.582	1.790	0.208
5. Contribution of Difference in Means to Variance	0.119	0.152	0.033 (40% of row 1)
Impact of Establishment effects			
6. Establishment effects, 95 th percentile	0.465	0.630	0.165
7. Establishment effects			

Table 5 Variance and Growth in Variance Decompositions
Establishment level earnings

Different industry detail. Dependent variable: log earnings (establishment wage). LBD data.

Level 2007	Geo	Indus	Establ.	2*Cov(I;G)	Empl
1 dgt Ind (sic)	0.05	0.20	0.75	0.00	
2 dgt Ind	0.04	0.49	0.52	0.01	
3 dgt Ind	0.04	0.49	0.46	0.01	
4 dgt Ind	0.04	0.52	0.43	0.01	
4 dgt + Empl	0.03	0.52	0.42	0.01	-0.01
Change 77-07	Geo	Indus	Establ.	2*Cov(I;G)	Empl
1 dgt					

Table 6. Variance of Revenues Per Worker and Earnings Per Worker, 1977-2007

	1977	1982	1987	1992	1997	2002	2007	Change, 77-07
Var log revenues per worker								
All sectors	0.954	0.965	0.949	1.020	1.113	1.126	1.265	0.311
Mng. Util. Transp.	0.421	0.463	0.670	0.821	0.860	0.827	0.967	0.546
Manufacturing	0.593	0.633	0.638	0.656	0.686	0.646	0.742	0.149
Trade	1.135	1.129	1.115	1.1				

Table 7 Establishment wage regressions
 Dependent variable: log earnings (establishment wage)

	OLS	Fixed estab eff.
Log earnings (Sales/Employees)	0.386 (0.000)	0.324 (0.000)
Individuals' predicted wage in industry: Log earnings (Predicted industry wage)	0.553 (0.001)	0.051 (0.002)
Alternative wage: Log earnings (Industryxregion average)	0.343 (0.001)	0.113 (0.001)
1 digit Industry controls	Y	-
Fixed establishment effects	-	Y
	7188373	7188373

Note: The model is estimated on a panel of establishments from 1977 to 2007, quinquennial observations from the Economic Census. The models include controls for observation year and establishment age. Predicted industry wage is calculated from a log earnings equation including years of education, experience, experience squared, interacted with gender, averaged at the industry level using yearly CPS data. Instrumental variable (IV) specifications use industry revenue per worker, averaged over all regions except own region, as instrument for revenue per worker.

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Table A-1. Correcting Establishment Earnings Dispersion Using LEHD

	1992	2007	92-07
Variance (LBD Average log earnings)	0.412	0.487	0.075
<i>Correcting LBD comparison using LEHD data:</i>			
Covariance (μ_f, σ_f)	0.009	0.019	
Variance (σ_f)	0.051	0.048	
$1/4 * V(\sigma_f) + Cov(\mu_f, \sigma_f)$	0.026	0.031	
Variance (lnw) corrected	0.386	0.456	0.070

Note: LBD earnings are average wages per worker (annual earnings divided by March 12th employment). LEHD earnings is based on annual earnings for full year employees from the 9 LEHD(92) states, from quarterly earnings from the UI files and within establishment dispersion and means are calculated within sein-unit per statexyear using EH files and then aggregated, matched and disaggregated to

Table A-2. Dispersion measures. CPS and LBD 1977-2009

	1977	1982	1987	1992	1997	2002	2007	2009	Growth
Weekly earnings									
CPS									
V(lnearnings)	0.463	.501	0.524	0.546	0.574	.601	0.592	0.633	0.170
Predicted	0.206	.207	0.199	0.209	0.214	.222	0.215	0.229	

Table A-3. Variance Decomposition of LEHD Earnings with Individual Characteristics. Within and Between Employer (SEIN)

	1992	1997	2002	2007	92-07 Change	Share of Change
All:						
Var(lnw)	0.457	0.478	0.500	0.545	0.088	1.00
Skills: Var (s)	0.110	0.104	0.103	0.102	-0.008	-0.08
Worker-worker: ρ	0.316	0.310	0.311	0.322	0.006	
Worker-estab.: ρ_{ϕ}	0.221	0.229	0.246	0.287	0.065	
Var between	0.222	0.231	0.244	0.276		

Data appendix

CPS March Data

We use the internal Census March Current Population Survey from survey years 1978-2010 to obtain observations of weekly wages from 1977-2009. All samples include workers of age 16-64 with more than 5 hours per week last year, more than 12 weeks worked last year, and whose class of work in their longest job last year was private or government wage/salary employment. Students, agricultural employment, public administration and armed forces are excluded. Weekly earnings are calculated as annual earnings divided by the weeks worked in the prior year. Gross earnings include wages, salaries, overtime, tips and commissions. Allocated earnings observations are excluded using the earnings allocation flags. Educational codes are transformed to grade levels using Jaeger (1997) and subsequent adaptations. Final weights are used in all calculations. Observations with a real wage below half the minimum wage level in 1982 were excluded.

Census Bureau's Longitudinal Business Database (LBD)

The establishment level data are from the U.S. Census Bureau's Longitudinal Business Database (LBD) covering the period 1977 – 2009. The data include all private employers for all sectors except agriculture. The data are sourced from the Census Bureau's business register which is continually updated using administrative records, Economic Census returns, and surveys such

week. Establishments with over 100,000 employees are also excluded, as from observation these are generally firm level or miscoded records, and we are not aware of a U.S. establishment that large. One issue with our wage measure is that payroll is reported annually, and employment is reported for the week of March 12. The establishment wage can be affected by significant changes in establishment employment within the year.

The LBD follows establishments over time, where considerable effort was invested by Census to recover longitudinal identifiers through linking records and matching names and addresses (Jarmin and Miranda 2002). We use these identifiers to define establishment births, deaths and continuers. A birth is an establishment that is observed in the data that did not exist five years earlier. Similarly, a death is an observation that does not survive the five years until the next economic census year. Establishments are either single-unit (SU) establishments, where the (generally smaller) firm produces in one location, or multi-unit (MU) establishments that are part of a company that operates at multiple locations. The 10%, median and 90% deciles are calculated by taking a neighborhood of establishments 1% on either side of the decile and using the mean of this sample as a pseudo-decile.

LEHD 1992-2007 and matched LEHD data

The LEHD data, produced by the LEHD program at the US Census Bureau, consists of annualized quarterly earnings from the unemployment insurance (UI) benefit programs, linked to the Quarterly Census of Employment and Wages Program. The construction of the LEHD data is carefully described in Abowd et al (2002). We use data

detailed SEIN UNIT as our unit of analysis.

Because education is imputed in the LEHD data, we have added data on education with a match between the LEHD and the US 2000 and 1990 Census long form data and the CPS when available (1986-1992). We first match the records between the Economic History files (EHF) of the LEHD and the 2000 Census. For those who do not match, we merge in data from the 1990 Census, and for those who do not match any of these, we merge in information on education from the CPS. The Census long form covers approximately 15 percent of the population in 2000, and using this procedure, we are able to create a sample covering 18 percent of the jobs in the EHF data from 1992, 97, 02 and 07. This data set is labelled “matched LEHD sample” in the analysis above.