The Distribution of Annual and Long-Run US Earnings, 1981–2004

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Numerous authors have presented evidence of increased dispersion in the distribution of annual earnings in the United States from the late 1970s through 2004 or later. However, the dispersion of long-run earnings measured over many years has received relatively little attention because of the limited availability of appropriate data. This article uses the Social Security Administration's Continuous Work History Sample, which documents the earnings histories of 3.3 million workers, to examine changes in both the annual and the long-run distributions of earnings during 1981–2004 for men and women. For men, the results indicate an increase in long-run earnings inequality of roughly the same magnitude as the trend seen in annual earnings dispersion, but there has been very little increase in the dispersion of long-run earnings among women. If calculations are restricted to a sample of women who work every year of the observation period, a trend of increased earnings dispersion emerges, but much less so than that observed for men.

Introduction

A large body of research shows that a substantial increase in the dispersion of annual earnings of American workers began around 1980 (for example, Katz and Autor 1999; Eckstein and Nagypál 2004; Goldin and Katz 2007). In a widely cited article, Levy and Murnane (1992) note two key years that marked the onset of change in prior earnings trends: 1973, which saw the end of large annual increases in real earnings for many workers; and 1979, when a large sustained increase in annual earnings inequality began. At least among prime-aged men, real earnings have declined or stagnated for low-wage earners, have increased modestly in the middle of the distribution, and have risen substantially for high earners. The trend is consistent with the view that more highly skilled and educated workers have been paid higher premiums for their labor over time, while the productivity and earnings of lower-skilled workers have not similarly benefited from improvements in technology. Moreover, this change is something of a global phenomenon, as evidenced by increases in earnings dispersion documented in many other developed economies (for example, Gottschalk and Smeeding 1997; Atkinson 2008). Details vary among countries regarding the amount of increased dispersion, the parts of the distribution where change is most pronounced, and the timing of those changes, yet there are similarities in the increased relative earnings for high-skill workers. The increase in earnings dispersion in the United States is among the largest of the developed countries, if not the very largest.[1]

Much of the research on the earnings distribution and earnings trends focuses on pretax earnings for a period of a year or less. However, the distribution of earnings over a lifetime—or at least over many

Selected Abbreviations

CPS	Current Population Survey
CV	coefficient of variation
CWHS	Continuous Work History Sample
OASDI	Old-Age, Survivors, and Disability Insurance
SE	self-employment

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Selected Abbreviations—*Continued*

SSA	Social Security Administration
VLN	variance of the logarithm of earnings
WS	wage and salary

years—is often of greater interest than the distribution of earnings during shorter intervals. Economic well-being is determined more by earnings over an extended period than by earnings during a relatively short interval that may reflect a temporary deviation from a longer-term average. Workers can often shift resources from higher- to lower-income periods to maintain their preferred consumption level over time. Change in the distribution of longer-period (multiyear) pretax earnings of US workers during the past three decades is the primary focus of this article.

In contrast with the attention given to the distribution of annual earnings, there is relatively little empirical research on the dispersion of lifetime earnings, most likely because of the more demanding data requirements. With individual earnings histories often spanning four decades or longer, it is unusual to have longitudinal microdata that can fully document lifetime earnings for a single birth cohort, let alone for multiple cohorts that would allow a trend to be identified. That obstacle has not deterred researchers from making inferences about lifetime earnings by using one or both of two strategies. The first takes a descriptive approach to the data and directly calculates long-run earnings with the age range or time interval circumscribed by the data set's sampling rules and observation period. In that way, a good-sized panel data set that samples a number of cohorts for a dozen or more years can yield information on completed multiyear periods for multiple birth cohorts. Using this approach in a US-based study, Haider (2001) finds an increase in long-run earnings dispersion for male household heads by comparing 10-year totals for real earnings in 1969–1978 and 1982–1991. Total 10-year real earnings for men aged 30–44 at the start of each reference period are compared using data from the Panel Study of Income Dynamics. Large declines in 10-year total real earnings are noted for men in the lower tail of the distribution (23 percent and 11 percent declines at the 10th and 25th percentiles, respectively) compared with increased real earnings in the upper tail (6 percent at the 90th percentile), with consequent increases in several inequality measures. Haider notes that the increases in earnings dispersion are somewhat smaller when the sample is restricted to workers with positive earnings in every year of the reference period.[2] Björklund (1993) provides another example of this approach using data for Sweden for 1951–1989, although that paper presents results for a broader definition of income that includes pensions, capital income, and realized capital gains in addition to earnings. He concludes that lifetime income inequality is nearly as large as annual income inequality during ages 30–64. The large dispersion in income prior to age 30 largely accounts for the finding that lifetime inequality is 35–40 percent lower than that given by annual measures.

The second approach to measuring long-run earnings inequality requires the analyst to specify a statistical earnings-generating process that can be used to derive the properties of earnings histories that are only partially observed. Once the missing portions of the earnings histories have been estimated, calculating discounted totals and the moments of their distribution is straightforward. The methodology is described by Creedy (1977), who examines the lifetime earnings for various British occupational groups in the 1970s. Blomquist's (1981) study of Swedish lifetime income, which focuses on earnings and the value of leisure, is another important early contribution to this literature. A recent example of this work is Aaronson's (2002) investigation of the increase in the dispersion of US men's earnings in the first decade of work after the completion of schooling using synthetic cohort data constructed from 1968–2000 Current Population Survey (CPS) data. During 1967–1990, men's real earnings in the first decade of their careers fell except for the most educated group, and the coefficient of variation increased by one-third. Gittleman and Joyce's (1996) finding of increased US dispersion of earnings for 4-year intervals during the 1980s, especially among less educated workers, is yet another example.[3]

This article investigates how the distribution of long-run pretax earnings for US workers has evolved as annual earnings dispersion has risen during the past three decades. The analysis is conducted using longitudinal earnings data from the Social Security Administration's (SSA's) Continuous Work History Sample (CWHS), a collection of files containing the earnings histories of 3.3 million workers. The article begins by presenting a set of dispersion measures for annual earnings calculated for the period 1981–2004. These measures allow us to corroborate the trends in annual earnings inequality documented primarily in CPS data. Once the extent of annual earnings dispersion has been established, we then investigate the distribution of total real earnings for two consecutive 12-year periods, 1981–1992 and 1993–2004, and assess the extent to which the distribution of 12-year real earnings changed. Much of the previous research on changes in the distribution and variability of earnings for time periods that exceed 1 year restricts the analysis to workers who have few, if any, zero-earnings years. Our results for long-run earnings cover virtually all workers who display a multiyear pattern of earnings that indicates at least moderate long-run attachment to the labor force, and exclude only those people with very low lifetime earnings. We find evidence of increased long-run earnings dispersion during 1981–2004, although the increase is not as large as has occurred for annual earnings over the 24-year period. Results are presented for both men and women.

Data

This article uses data drawn from the 2004 CWHS 1-percent active file.[4] The data contain the earnings and benefit records for approximately 1 percent of the population that has been issued Social Security numbers since the program's inception in 1935. The large sample size, representation of many birth cohorts, and accuracy of recorded earnings relative to the self-reported amounts provided in most surveys make the CWHS an attractive data source for the study of worker earnings.[5] Although the CWHS was created for statistical and research purposes, the file content is drawn from administrative records that are maintained primarily for the purpose of administering the agency's programs and not with social science research in mind. Thus, the advantages of the data set come with a number of limitations, which we address where possible, usually by restricting the analysis to those data elements and time periods for which the information can be judged reliable for our purposes. Two shortcomings of the CWHS merit mention here: periodic changes in the recordkeeping rules about which earnings amounts are recorded in the data set; and changes over the years in the proportion of jobs covered by the Old-Age, Survivors, and Disability Insurance (OASDI) program. We briefly discuss these issues and our means of addressing them.

Prior to 1978, the CWHS recorded earnings only for Social Security-taxable earnings; that is, only earnings in Social Security–covered employment are available, and the annual amounts recorded are capped at each year's maximum earnings subject to OASDI payroll taxes.[6] This censoring of higher earnings amounts is problematic in studying the earnings distribution and for this reason we do not examine earnings prior to 1978. Wage and salary (WS) data for noncovered earnings—that is, both earnings in jobs not covered by OASDI and earnings in covered jobs that exceed the annual maximum taxable amount—are available beginning in 1978. The pre-1978 censoring of earnings, along with data quality problems for earnings amounts in 1978–1980, cause us to restrict the article's analysis to WS earnings during 1981–2004.[7,8] Furthermore, self-employment (SE) earnings records are, to varying degrees, limited prior to 1994.[9] From 1981 to 1990, the CWHS recorded SE earnings only up to the OASDI-taxable maximum. The taxable maximum earnings amounts for OASDI and Medicare (Hospital Insurance, or HI) were equal until 1991, at which point annual Medicare-taxable WS and SE earnings amounts were recorded separately from their OASDI counterparts. During 1991–1993, the Medicare-taxable maximum was about 2.34 times the OASDI maximum; since 1994, all Medicare-covered earnings have been subject to payroll taxes. Taken together, these and other recordkeeping rules for Medicare-taxable earnings imply that the CWHS data for SE earnings are substantially censored in varying degrees prior to 1994, posing considerable problems for researchers.[10]

Second, since 1950, the percentage of US employment that is covered by the Social Security program has increased greatly. Social Security coverage rates among civilian workers rose from 61 percent in 1951 to 82 percent in 1955, 86 percent in 1960, and 90 percent in the late 1970s. Coverage rates for civilian workers have been about 96 percent for the past decade. The increasing coverage rate clouds the interpretation of earnings histories that include years prior to 1978, a problem that is larger for earlier birth cohorts who have more working years during 1951–1977. Thus, for pre-1978 instances in which recorded annual earnings are zero, we cannot distinguish between nonparticipation in the labor force and work in noncovered employment.[11]

Furthermore, some WS amounts during the 1980s and early 1990s are understated because employee-elected deferred compensation is omitted or undercounted, with the largest understatements affecting earners in the upper tail of the annual distributions.[12] Because this article's earnings data include elective deferrals for 1994–2004, the findings overstate any increase in earnings dispersion attributable to high earners during 1981–2004, but the effect should be small. For all of these reasons, the results presented below pertain to the distribution of pretax WS earnings, which accounted for approximately 93 percent of annual total earnings (the sum of WS and SE earnings) recorded in the CWHS data during 1994–2004.

Nominal annual earnings are converted to real values denominated in 2000 dollars using the gross domestic product (GDP) implicit price deflator for Personal Consumption Expenditures (PCE).[13] The construction of the earnings variable is more fully described in the Appendix.

The Distribution of Annual Wage and Salary Earnings, 1981–2004

We begin by examining the distribution of annual WS earnings during 1981–2004. Trends in annual earnings have most frequently been documented using data from the Annual Social and Economic Supplement (formerly known as the March Supplement) to the CPS. Calculations are most often made for WS earnings of full-time, full-year workers and require the survey's information on both wage rates and hours of work. Hours of work are not available in the CWHS data, so the choice of which workers to include in the analysis must be made solely on the basis of annual earnings amounts. We examine earnings for a somewhat broader group than full-time, full-year workers and include anyone with "substantial" earnings during the year. Among a number of arbitrary earnings criteria that could be used, the rule adopted here is to require that real earnings be at least $5,000.[14] This criterion results in the inclusion of part-time or part-year workers in the annual earnings distribution, which is likely to increase the relative frequency of earners in the lower portions of the distribution. Applying this selection rule yields average annual sample sizes of 577,644 men and 472,487 women.

We present calculations for nine complementary earnings dispersion measures:[15]

- *Gini coefficient*. In an economy with n earners, the Gini coefficient (G) is equal to the arithmetic mean of the absolute values of differences between all pairs of earnings values. Or:

$$G = \frac{1}{2n^2\bar{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|$$

where $\bar{y}$ is the calculated mean value of earnings.

The Gini coefficient is probably the most widely used inequality measure and yields a single number bounded by 0 (equal earnings) and 1 (one person has all the earnings) that summarizes the shape of the distribution throughout its entire range. It is sometimes criticized for giving too much weight to earnings values near the mean of the distribution and insufficient emphasis to the earnings values near the tails, which may be of greater concern to policy makers.

- *Variance of the logarithm (VLN) of earnings*. This measure is calculated as

$$VLN = \frac{1}{n} \sum_{i=1}^{n} (\ln y_i - \overline{\ln y})^2$$

where $\overline{\ln y}$ is the mean value of $\ln y_i$. The variance is a basic statistical measure of a variable's dispersion and is a natural choice for studying dispersion in earnings distributions. The logarithmic transformation of earnings amounts dampens the importance of higher earnings values relative to lower ones.

- *Coefficient of variation* (*CV*). This measure is given by the standard deviation of earnings divided by its mean.

$$CV = \frac{\sqrt{\sum_{i=1}^{n} (y_i - \bar{y})^2 / n}}{\bar{y}}$$

Relative to the Gini coefficient and VLN, this measure gives more weight to earnings values in the upper tail of the distribution.

- *Percentile ratios*. If n earnings amounts are ordered from smallest to largest, dividing those values into 100 nonoverlapping, equi-sized groups allows one to identify the percentile values that represent the boundaries between adjacent subsets. The 10^{th} percentile (p10) is the data value that is the boundary between the lowest 10 percent of values and the remaining 90 percent of higher values. Specific percentile ratios allow one to measure the behavior of relative incomes at various positions in the distribution. This article uses six percentile ratios: p90/p10, p90/p50, p80/p10, p80/p50, p50/p10, and p75/p25.

For men (Table 1 and Chart 1), the Gini coefficient and VLN measures show similar percentage increases over the 24-year reference period (23 percent and 30 percent, respectively); the CV shows a considerably larger increase (251 percent). Consistent with the findings of previous studies, the Gini coefficient increases by 11 percent during 1981–1988, increases at a slower rate during 1989–1991, then increases by another 12 percentage points by 2000. The 2004 value

Table 1.
Measures of dispersion of annual wage and salary earnings for men, 1981–2004

Year	Gini coefficient	VLN	CV	Percentile ratios					
				p90/p10	p90/p50	p80/p10	p80/p50	p50/p10	p75/p25
1981	0.381	0.529	0.950	6.517	2.078	5.253	1.675	3.137	2.716
1982	0.387	0.537	0.983	6.593	2.109	5.292	1.693	3.127	2.730
1983	0.389	0.546	1.017	6.642	2.096	5.363	1.692	3.169	2.769
1984	0.394	0.555	1.059	6.752	2.132	5.430	1.715	3.167	2.809
1985	0.397	0.562	1.095	6.829	2.154	5.460	1.722	3.171	2.810
1986	0.405	0.578	1.164	6.975	2.179	5.558	1.736	3.202	2.830
1987	0.412	0.584	1.384	6.981	2.167	5.549	1.723	3.221	2.812
1988	0.421	0.593	1.508	7.025	2.189	5.582	1.739	3.209	2.845
1989	0.420	0.593	1.419	7.065	2.212	5.574	1.745	3.194	2.839
1990	0.423	0.594	1.473	7.037	2.222	5.549	1.752	3.167	2.840
1991	0.426	0.603	1.457	7.328	2.325	5.580	1.770	3.152	2.885
1992	0.436	0.618	1.669	7.441	2.349	5.652	1.784	3.168	2.915
1993	0.438	0.621	1.565	7.520	2.387	5.661	1.797	3.150	2.921
1994	0.442	0.624	1.645	7.524	2.425	5.631	1.815	3.103	2.898
1995	0.443	0.625	1.731	7.544	2.442	5.612	1.817	3.089	2.877
1996	0.449	0.632	2.432	7.622	2.459	5.638	1.819	3.099	2.869
1997	0.456	0.644	2.670	7.759	2.475	5.699	1.818	3.135	2.876
1998	0.460	0.655	3.092	7.873	2.491	5.730	1.813	3.161	2.862
1999	0.467	0.665	3.444	8.010	2.510	5.801	1.818	3.191	2.866
2000	0.472	0.673	3.475	8.134	2.539	5.851	1.826	3.204	2.857
2001	0.468	0.675	3.306	8.226	2.548	5.917	1.833	3.229	2.880
2002	0.462	0.676	2.687	8.307	2.550	5.997	1.841	3.257	2.907
2003	0.465	0.681	2.704	8.393	2.565	6.050	1.849	3.272	2.920
2004	0.470	0.690	3.331	8.493	2.582	6.117	1.860	3.289	2.946

SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

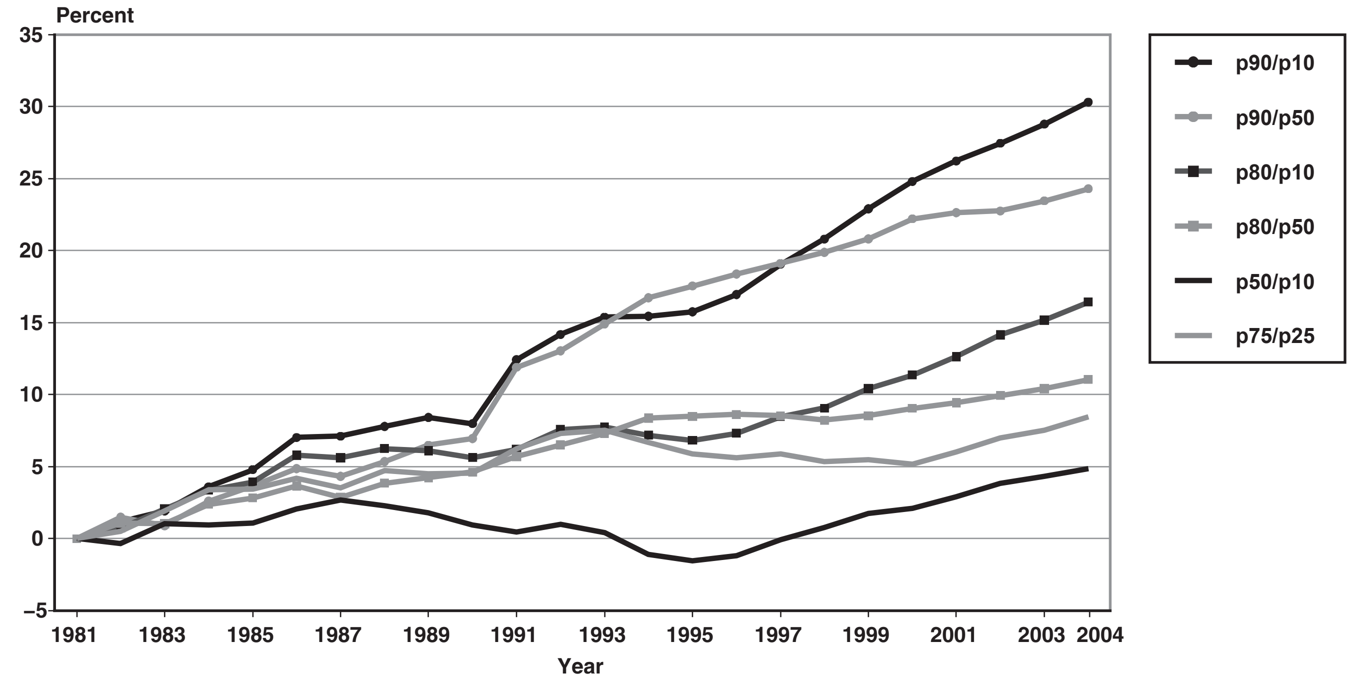
NOTE: All dispersion measures are restricted to wage and salary earnings of workers who earned at least $5,000 (in 2000 dollars) during a calendar year. Sample sizes for each year range from 487,099 in 1982 to 646,930 in 2001, with an average annual sample size of 577,644.

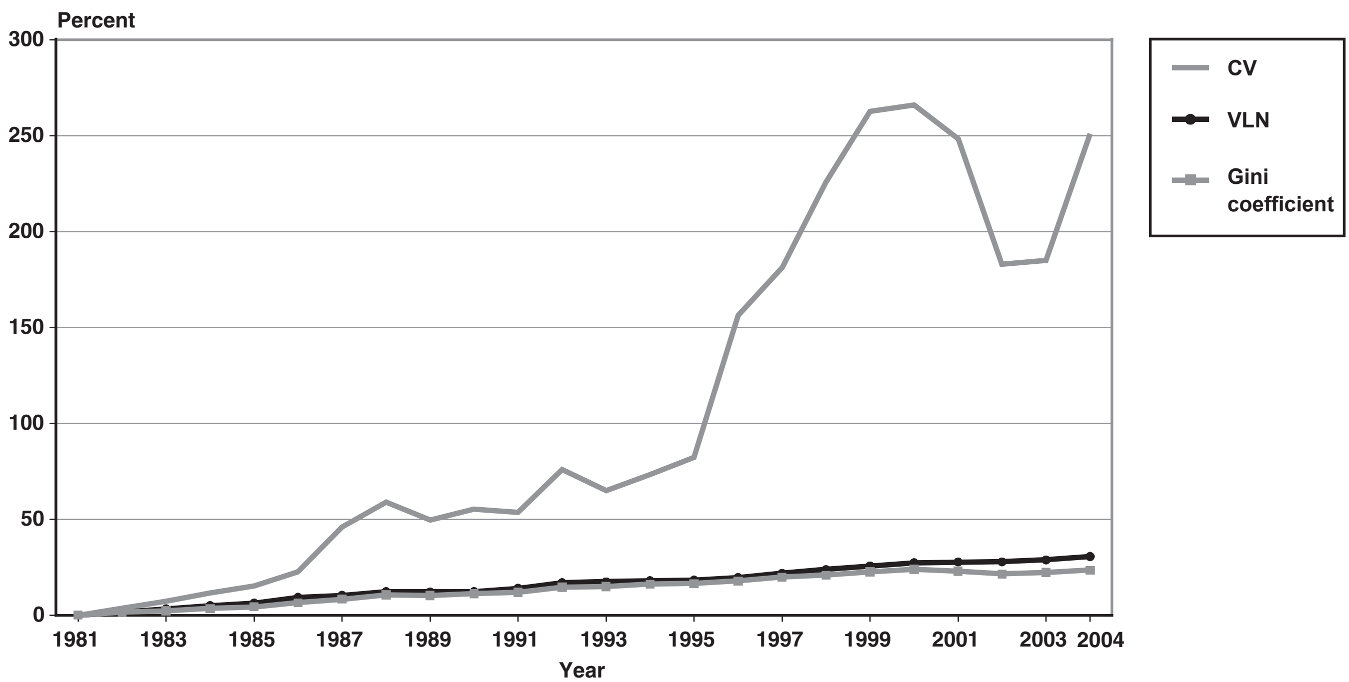
of the Gini coefficient is a little lower than in 2000, with a dip in 2001–2002. The behavior of VLN during 1981–2004 is similar to that of the Gini coefficient. The CV measure also shows a very large increase in earnings dispersion, particularly during 1996–2000, reflecting large increases in earnings near the top of the earnings distribution.

The percentile ratios for men clearly attribute much of the increased earnings dispersion to the greater relative earnings growth at the top of the earnings distribution. The p90/p10 ratio increases 30 percent and the p90/p50 ratio rises 24 percent, compared with a much smaller 5-percent increase in the p50/p10 ratio. Moving away from the distribution's upper and lower tails, the p75/p25 ratio increases by 8 percent, or about one-third of the growth in the p90/p10 ratio.

For women, all nine statistical measures indicate less dispersion in earnings at the outset of the observation period than is observed for men. However, from that starting point, the measures generally indicate greater increases in annual earnings dispersion for women than were exhibited by men over the 24-year period, with the two exceptions being the CV and p90/p50 ratio (Table 2 and Chart 2). The CV values increase 86 percent over the 24 years, compared with the 251 percent increase for men. Comparing the behavior of the six percentile ratios for the entire period shows that the increase in women's earnings dispersion is not as predominantly located in the uppermost part of the distribution. Rather, growth in real earnings has occurred more extensively throughout the distribution. Although the p90/p10 ratio increases by 45 percent, the p50/p10 ratio increases 20 percent while the p90/p50 ratio rises by 21 percent. These differences in the nature of the increased dispersion of men's and women's annual earnings have also been documented recently by the Congressional Budget Office (2009) using CPS data.

Chart 1.
Earnings dispersion among men: Percentage change from 1981, by dispersion measure





SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

Table 2.
Measures of dispersion of annual wage and salary earnings for women, 1981–2004

Year	Gini coefficient	VLN	CV	Percentile ratios					
				p90/p10	p90/p50	p80/p10	p80/p50	p50/p10	p75/p25
1981	0.313	0.331	0.635	4.738	2.002	3.790	1.601	2.367	2.309
1982	0.318	0.344	0.641	4.855	2.021	3.882	1.616	2.402	2.352
1983	0.322	0.354	0.651	4.971	2.040	3.958	1.625	2.436	2.381
1984	0.330	0.370	0.677	5.135	2.074	4.073	1.645	2.476	2.441
1985	0.334	0.381	0.681	5.257	2.106	4.147	1.661	2.496	2.480
1986	0.342	0.398	0.710	5.433	2.130	4.276	1.676	2.551	2.527
1987	0.342	0.402	0.736	5.488	2.123	4.335	1.677	2.585	2.547
1988	0.347	0.409	0.799	5.546	2.142	4.367	1.687	2.589	2.565
1989	0.349	0.414	0.803	5.602	2.164	4.386	1.694	2.589	2.570
1990	0.352	0.420	0.796	5.664	2.191	4.413	1.707	2.585	2.583
1991	0.358	0.431	0.796	5.772	2.222	4.477	1.724	2.597	2.615
1992	0.363	0.440	1.028	5.865	2.241	4.529	1.730	2.618	2.628
1993	0.366	0.447	0.919	5.939	2.265	4.566	1.741	2.622	2.642
1994	0.367	0.447	0.849	5.918	2.267	4.538	1.738	2.610	2.637
1995	0.370	0.454	0.917	5.986	2.286	4.581	1.750	2.618	2.649
1996	0.374	0.461	0.954	6.047	2.296	4.618	1.753	2.634	2.655
1997	0.379	0.472	1.010	6.155	2.308	4.699	1.762	2.666	2.674
1998	0.383	0.483	1.053	6.265	2.318	4.762	1.762	2.702	2.682
1999	0.387	0.491	1.053	6.321	2.327	4.803	1.769	2.716	2.692
2000	0.392	0.501	1.214	6.421	2.339	4.858	1.770	2.745	2.698
2001	0.393	0.508	1.108	6.547	2.352	4.937	1.774	2.783	2.713
2002	0.393	0.515	1.083	6.673	2.369	5.025	1.784	2.817	2.742
2003	0.396	0.523	1.104	6.783	2.390	5.086	1.792	2.839	2.765
2004	0.399	0.530	1.181	6.853	2.413	5.120	1.803	2.840	2.779

SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

NOTE: All dispersion measures are restricted to wage and salary earnings of workers who earned at least $5,000 (in 2000 dollars) during a calendar year. Sample sizes for each year range from 343,667 in 1981 to 568,420 in 2001, with an average annual sample size of 472,487.

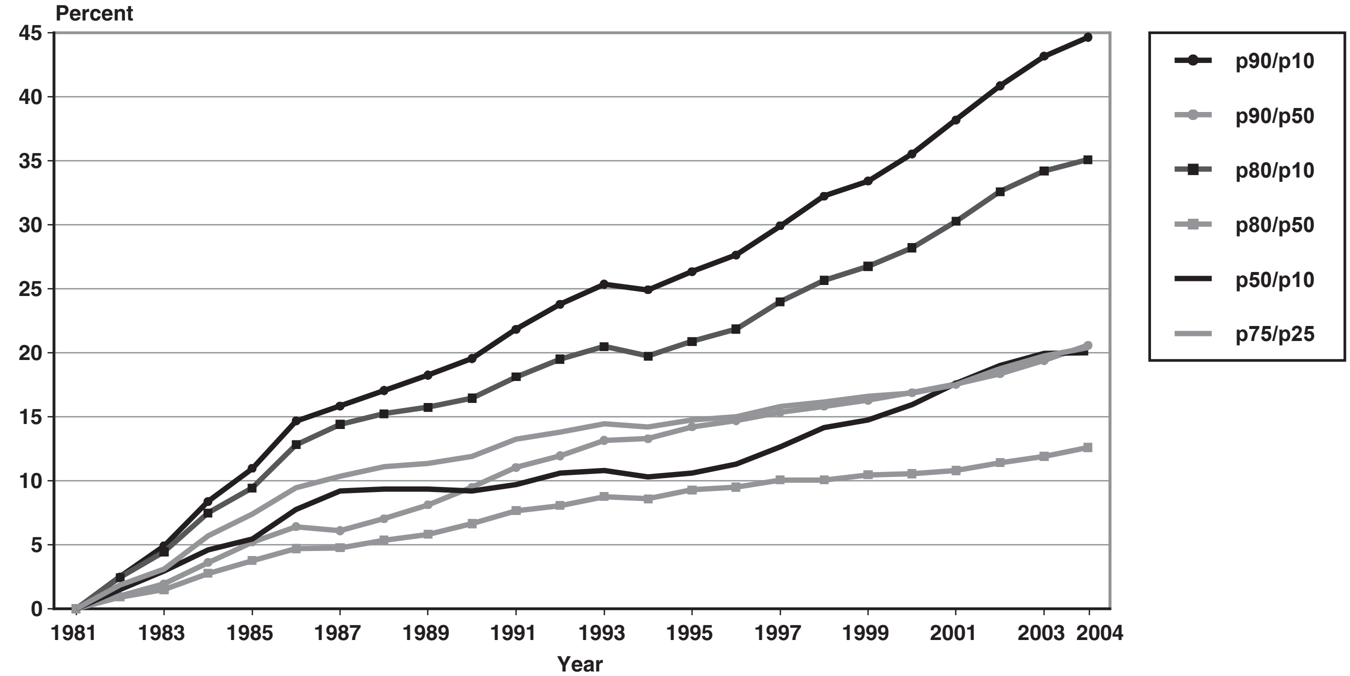
In sum, the annual distributions of WS earnings as recorded in the CWHS data confirm the increased dispersion of earnings for both men and women since 1981. For men, much of the increase is due to large increases in the earnings of workers in the upper tail of the annual earnings distribution; the increased dispersion for women has occurred throughout the earnings distribution.

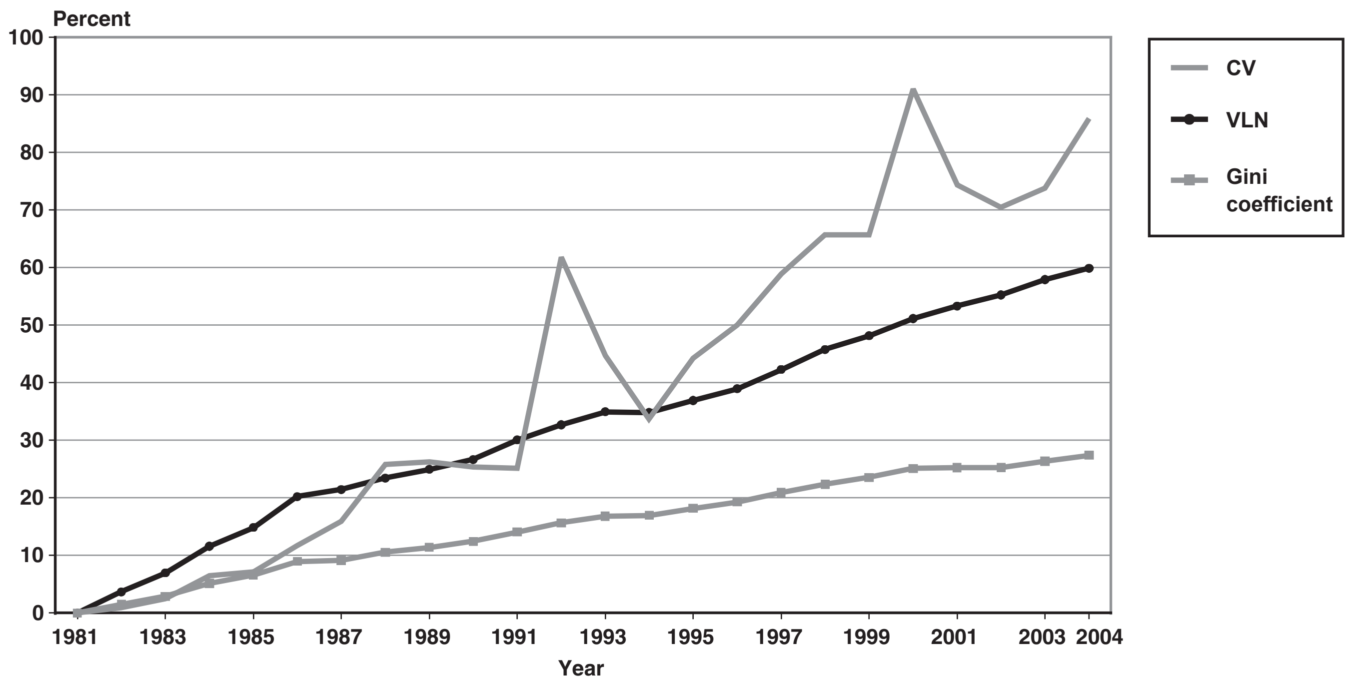
The Distribution of Long-Run Earnings, 1981–2004

Over time, economywide earnings levels tend to increase with worker productivity. Individual workers also change relative positions in the annual earnings distribution as they become more or less productive relative to other workers. Year-to-year worker mobility during a sequence of years means that the dispersion of total earnings over all years may be somewhat lower than the annual earnings dispersion measures might suggest. We now examine real earnings over two 12-year periods. We limit our focus to earnings during ages 31–62, an age range that is likely to contain the bulk of career earnings for most people with substantial lifetime labor force participation. Prior to age 30, earnings histories can be difficult to compare because of voluntary absences from the labor force to pursue education and training and frequent job changes associated with starting careers. In addition, beyond age 60, retirement begins to have noticeable effects on earnings patterns.

We subdivide the 24 years into two 12-year intervals, 1981–92 and 1993–2004. Because earnings typically increase with age for much of the work life, we want to ensure that the calculations made for each 12-year subperiod pertain to similarly aged workers. Accordingly, we calculate total real earnings for workers aged 31–50 in the first year of each reference period and compare the distributions of long-run real

Chart 2.
Earnings dispersion among women: Percentage change from 1981, by dispersion measure





SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

earnings in the two periods. Although our examination of annual earnings excludes people with real earnings of less than $5,000, those people may be included in multiyear earnings calculations because they have earnings in at least some years. The exclusion of workers with more erratic earnings histories is likely to affect the dispersion measures for multiyear periods, as evidenced in Haider (2001). In this article, the population of interest is adults who are able to work over an extended observation period and, through their earnings histories, have demonstrated more than token—and possibly substantial—labor force attachment over a number of years. We implement these considerations by applying a small set of sample restrictions for the long-run earnings calculation:

- There can be no history of disability, as indicated by participation in either Social Security's Disability Insurance program or the Supplemental Security Income program.
- The person must survive through the last year included in any multiyear earnings calculation.
- The person must be fully insured for Social Security retired-worker benefits by age 62 or, if younger during the final year of a multiyear earnings calculation, must exhibit an earnings history that is on track to attain full insurance status by age 62.
- A person must have earned at least $5,000 (real) in 1 of the 12 reference-period years.

The first two of these restrictions are intended to eliminate people who may have been unable to work throughout a 12-year reference period. The third restriction attempts to eliminate individuals with low lifetime labor force attachment from the calculations. Eligibility for retired-worker benefits at age 62 does not require very high earnings in any year, but it does require the equivalent of modest earnings in 10 different years or, at the other extreme, sufficient annual earnings to be awarded one Social Security credit in each of 40 years.[16] We also eliminate consistently low earners by requiring that at least $5,000 be earned in 1 of the 12 reference years. Finally, the sum of annual incomes received over many years is most appropriately expressed in present-value terms that make the time value of money explicit. Accordingly, 12-year real earnings totals were calculated three ways: as present values, using real discount rates of 3 percent and 5 percent; and as a simple sum where the implicit real discount rate is zero.

Table 3 displays the findings for men's undiscounted total earnings.[17] The table provides the sample mean, seven percentile values, and five dispersion measures for each of the two periods. The table also contains a set of calculations restricted to "positive earners," here defined as the subset of "all workers" who have earnings in all 12 years—respectively accounting for about 55 percent and 59 percent of all workers during 1981–1992 and 1993–2004.

Table 3 contains several key results for the distribution of men's long-run earnings. First, mean 12-year real earnings increased a seemingly modest 10.1 percent for all workers—a geometric annual growth rate of less than 0.8 percent—and by even less (7.2 percent) for positive earners. Second, all five dispersion measures show increases in long-run earnings inequality across the two periods, more so in the case of positive earners. Among all workers, those results are driven by declines in total real earnings amounts in the lower half of the distribution, as denoted by the negative percentage changes at the 5th, 10th, 25th, and 50th percentiles, and increases in the upper half of the distribution, particularly at the 90th (14.3 percent) and 95th (18.2 percent) percentiles. For positive earners, the real earnings declines are larger at and below the median, but the percentage gains for the highest percentiles are a little smaller.

The findings for women (Table 4) differ notably from those for men. Generally, the mean total real earnings amounts for the two 12-year periods are roughly half the amounts earned by men. For women, there were large gains in total real earnings throughout the distribution of long-run real earnings. Mean long-run earnings increased by 34.4 percent for all workers and by 24.2 percent for the subgroup of positive earners. There was a much smaller increase in long-run earnings dispersion for women than was exhibited by men. For all workers, long-run earnings dispersion increased very little between the two periods, and the p75/p25 ratio actually fell by 5.9 percent. Increased dispersion is more apparent among the positive earners, although very much less so than for men. All percentile earnings values in Table 4 show substantial gains in real earnings, with larger percentage gains at the higher percentile values. For both men and women, a comparison of changes in the percentile values attributable to changing the sample composition indicates that the excluded cases (more intermittent workers) are disproportionately drawn from the lower tail of the long-run earnings distribution. Restricting the calculations to workers with more steady labor force participation strengthens the conclusion of increased long-run earnings dispersion for both men and women.

Table 3.
Distribution of long-run wage and salary earnings for men, 1981–2004

Measure	All workers [a] 1981–1992	All workers [a] 1993–2004	All workers [a] Percent change	Positive earners [b] 1981–1992	Positive earners [b] 1993–2004	Positive earners [b] Percent change
			Earnings ($) [c]			
Percentiles:						
5th	36,691	36,229	-1.3	198,072	177,347	-10.5
10th	75,684	70,900	-6.3	252,603	230,224	-8.9
25th	207,364	196,240	-5.4	360,843	337,024	-6.6
50th	391,739	384,839	-1.8	512,668	498,883	-2.7
75th	600,510	626,850	4.4	700,566	734,242	4.8
90th	846,581	967,240	14.3	978,962	1,101,270	12.5
95th	1,120,661	1,324,066	18.2	1,318,512	1,527,074	15.8
Mean	479,915	528,577	10.1	624,199	668,995	7.2
			Dispersion measures			
Gini coefficient	0.436	0.488	11.8	0.342	0.401	17.3
VLN	1.066	1.174	10.1	0.357	0.455	27.3
CV	118.99	254.13	113.6	101.07	229.531	127.1
Percentile ratios:						
p90/p10	11.19	13.64	22	3.88	4.78	23.4
p75/p25	2.9	3.19	10.3	1.94	2.18	12.2
			Sample size [d]			
Total	238,270	360,997	…	130,119	214,390	…
Zero-earners [e]	15,053	22,258	…	0	0	…
Very low earners [f]	7,443	10,350	…	97	210	…

SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

NOTES: Zero-earners and very low earners are included in the sample size but are omitted from the distribution calculations.

. . . = not applicable.

a. Workers with enough quarters, or on track (in the last year of a period) to have enough quarters to qualify for retired-worker benefits.

b. Workers with earnings in every year of the period.

c. In 2000 dollars, not subject to discounting.

d. Includes only workers who were alive and were never disabled through the last year of the period.

e. Those with no earnings in the period.

f. Those who never earned more than $5,000 in any year of the period.

Tables 3 and 4 show long-run real earnings at selected percentiles throughout the distribution. Charts 3 and 4 plot the changes in the natural logarithm of real WS earnings at all percentiles in the distribution of 12-year real incomes for men and women who were aged 31–50 at the start of the reference period.[18] The two charts further document very different experiences for the 12-year earnings of men and women over the 24-year period. For men (Chart 3), real earnings growth is higher throughout most of the distribution during the second 12-year period (1993–2004). During both intervals, the calculated growth in real earnings increases with few exceptions as one moves higher in the distribution, with the largest growth occurring in the upper tail of the 12-year earnings distribution. The bottom percentiles fare particularly badly in the first period; real earnings decline up to the 25th percentile. The growth in earnings reaches 0.10 at the 67th percentile and accelerates noticeably for the top two percentiles. In the second period, earnings growth is negative only at the lowest four percentiles.

The women's results (Chart 4) differ notably from those for men, except for the similarly large growth in real earnings at the top of the earnings distribution. Although women's 12-year earnings are generally lower than men's, the growth of women's long-run earnings is higher during both periods. Earnings growth is greater in the earlier period, but in both

Table 4.
Distribution of long-run wage and salary earnings for women, 1981–2004

Measure	All workers [a] 1981–1992	All workers [a] 1993–2004	All workers [a] Percent change	Positive earners [b] 1981–1992	Positive earners [b] 1993–2004	Positive earners [b] Percent change
			Earnings ($) [c]			
Percentiles:						
5th	23,681	29,214	23.4	99,865	113,701	13.9
10th	38,878	50,262	29.3	129,030	146,238	13.3
25th	86,765	117,990	36.0	190,973	217,215	13.7
50th	182,601	236,272	29.4	280,128	326,540	16.6
75th	310,201	396,886	27.9	398,202	482,131	21.1
90th	450,378	591,394	31.3	532,088	676,288	27.1
95th	547,859	745,689	36.1	625,893	839,887	34.2
Mean	222,595	299,083	34.4	315,495	391,934	24.2
			Dispersion measures			
Gini coefficient	0.423	0.440	3.9	0.298	0.340	13.9
VLN	0.927	0.974	5.1	0.322	0.389	20.8
CV	87.599	108.326	23.7	64.654	87.225	34.9
Percentile ratios:						
p90/p10	11.58	11.77	1.6	4.12	4.62	12.1
p75/p25	3.58	3.36	-5.9	2.09	2.22	6.4
			Sample size [d]			
Total	204,770	334,779	…	92,601	186,735	…
Zero-earners [e]	10,639	16,098	…	0	0	…
Very low earners [f]	11,410	13,981	…	347	429	…

SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

NOTES: Zero-earners and very low earners are included in the sample size but are omitted from the distribution calculations.

. . . = not applicable.

a. Workers with enough quarters, or on track (in the last year of a period) to have enough quarters to qualify for retired-worker benefits.

b. Workers with earnings in every year of the period.

c. In 2000 dollars, not subject to discounting.

d. Includes only workers who were alive and were never disabled through the last year of the period.

e. Those with no earnings in the period.

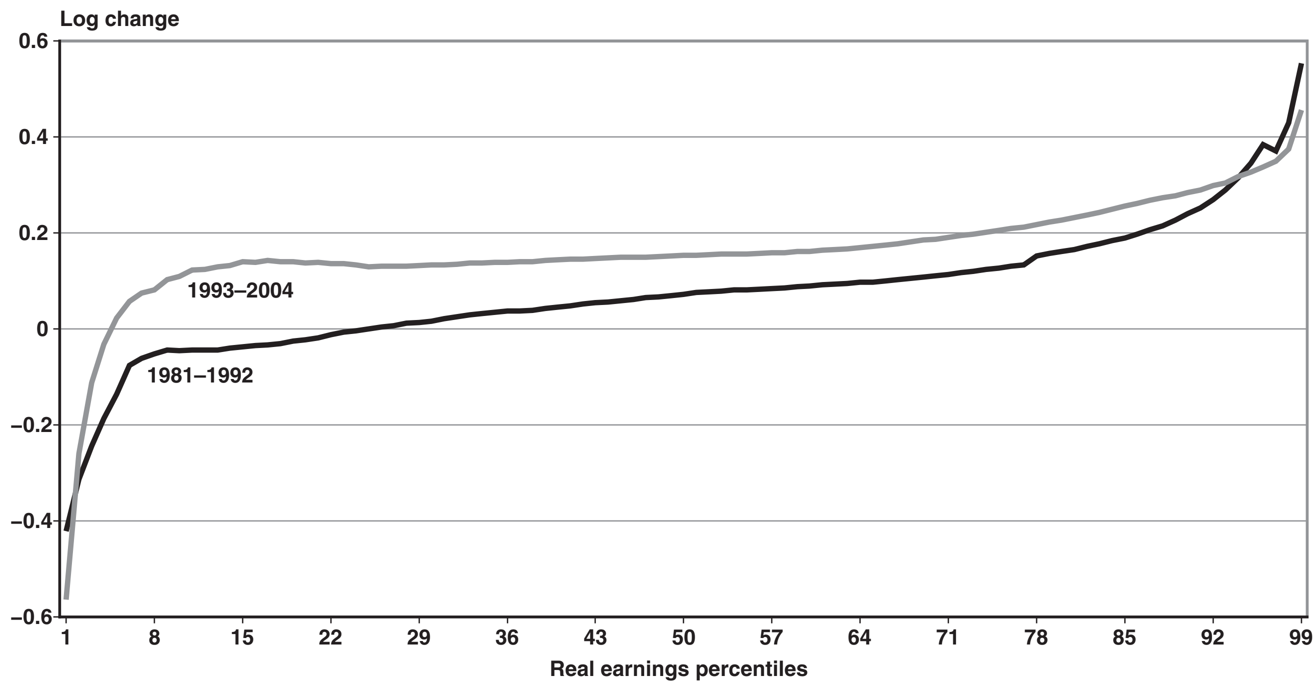
f. Those who never earned more than $5,000 in any year of the period.

periods, real earnings grow by more than 20 percent for every percentile. In both periods, the largest growth rates are exhibited by workers near, but not at, the bottom of the distribution of total WS earnings. Except for the very lowest percentiles, the growth in real earnings declines from about the 5th percentile to the 50th percentile, in marked contrast to the earnings of men, then increases gradually until approximately the 90th percentile.

In sum, although the data indicate that the dispersion in annual WS earnings increased substantially for men and less so for women, the results for longer-period earnings dispersion are more divergent. Men's long-run earnings also exhibit increased dispersion, which appears to be only slightly so for women unless the focus is on those with persistent labor force attachment.

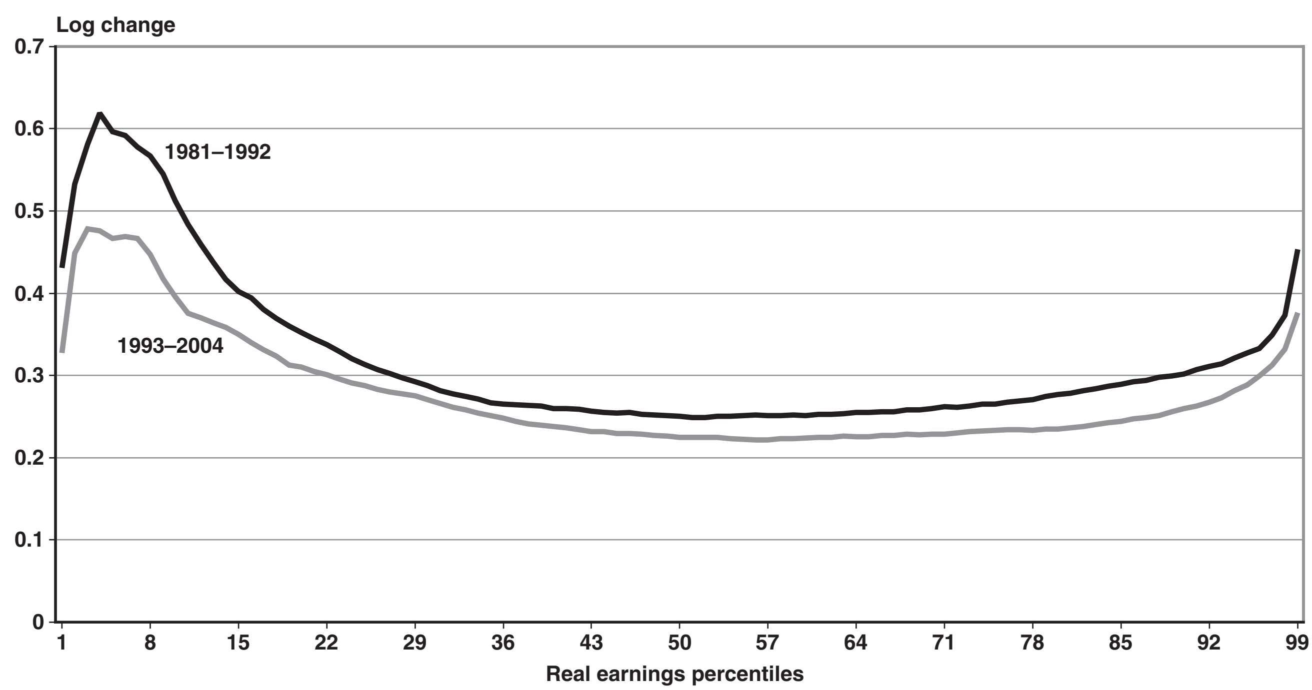
How do these findings about the dispersion of long-run earnings compare with the trends in annual earnings dispersion documented above and elsewhere in the literature? The results can be compared more directly by first calculating the mean of the annual earnings dispersion measures for the two 12-year periods and then determining the percentage change in the mean between periods. This between-period change can be compared with the percentage change in 12-year real earnings totals described in Tables 3 and 4. For men (all workers), the growth in long-run

Chart 3.
Changes in the logarithm of real wage and salary earnings for men in two 12-year periods, by percentile, 1981–2004



SOURCE: Authors' calculations based on Continuous Work History Sample, 1-percent active file.

Chart 4.
Changes in the logarithm of real wage and salary earnings for women in two 12-year periods, by percentile, 1981–2004



SOURCE: Authors' calculations based on Continuous Work History Sample, 1-percent active file.

WS earnings dispersion is about the same magnitude as one would conclude from looking at trends in annual earnings dispersion (Table 5). The percent changes in two of the long-run earnings dispersion measures (Gini coefficient and VLN) are somewhat smaller than the mean annual measures for the two periods, but the other two measures (CV and the p90/p10 ratio) show larger increases. Earnings mobility does not appear to substantially mitigate the effects of rising annual earnings inequality on longer-period earnings inequality. The women's results are quite different. The large increases in annual earnings inequality that women experienced did not translate into similarly large gains in long-run earnings inequality. The large growth in long-run earnings experienced in the lower end of the distribution, in contrast with the declines for men, resulted in small increases in the inequality of long-run earnings among women (all workers), and in considerably smaller increases in dispersion for women who are designated "positive earners" than for their male counterparts.

Final Remarks

Although the increase in annual earnings dispersion in recent decades—usually referred to as increased earnings inequality—has attained greater visibility lately, increased earnings dispersion over longer time intervals may be of greater concern. An increase in the dispersion of long-run earnings raises questions about its causes and potential consequences for economic well-being. Causal factors can include increased returns to education and skill, declining earnings opportunities for low-wage workers who are vulnerable to increased international competition, demographic shifts in labor force composition, unequal educational opportunities, and prolonged economic expansions or contractions that have disparate effects on segments of the labor force, among others. Some observers see the increased wage dispersion as providing an effective economic signal for lower-paid workers to invest in new skills that eventually lead to higher-paid work. Others see signs of increasing inequality and reductions in

Table 5.
Comparing changes in annual and long-run earnings dispersion: All workers, by sex, 1981–1992 and 1993–2004

Dispersion measure	1981–1992	1993–2004	Percent change
		Men	
		Annual earnings dispersion	
Gini coefficient	0.405	0.458	13.1
VLN	0.574	0.655	14.1
CV	1.265	2.673	111.3
p90/p10 ratio	6.932	7.950	14.7
		Long-run earnings dispersion	
Gini coefficient	0.436	0.488	11.8
VLN	1.066	1.174	10.1
CV	118.990	254.130	113.6
p90/p10 ratio	11.190	13.640	22.0
		Women	
		Annual earnings dispersion	
Gini coefficient	0.339	0.383	13.0
VLN	0.391	0.486	24.3
CV	0.746	1.037	39.0
p90/p10 ratio	5.360	6.326	18.0
		Long-run earnings dispersion	
Gini coefficient	0.423	0.440	3.9
VLN	0.927	0.974	5.1
CV	87.599	108.326	23.7
p90/p10 ratio	11.580	11.770	1.6

SOURCE: Authors' calculations based on 2004 Continuous Work History Sample, 1-percent active file.

NOTE: Annual earnings dispersion values are 12-year means. Long-run earnings dispersion values are for total real earnings over the entire period.

earnings mobility as social problems that should be remedied through public policies.

One important aspect of long-run (and perhaps even lifetime) individual earnings is their role in determining the resources available to retirees. Increases in lifetime earnings dispersion are likely to translate into greater income inequality in old age. Lifetime earnings generate much of a worker's capacity to save for retirement through personal savings and employer-sponsored defined-contribution pension plans. Aside from those forms of individually managed retirement saving, private and public pension plans often determine benefit amounts through formulas based on earnings during a certain number of years in a worker's earnings history. One example is the Social Security program, in which monthly retired-worker benefits depend on the highest 35 values of (wage-indexed) annual earnings. A progressive benefit formula ensures that replacement rates decline as lifetime earnings increase within any given birth cohort. Alternative distributions of lifetime earnings that display more or less earnings dispersion can affect the extent to which the program redistributes income both within and across cohorts, and affect program solvency as well.

Appendix: Creation of the Earnings Variable and Data Cleaning

The reported results pertain solely to WS earnings; all SE earnings are excluded. In cases where a worker has both WS and SE earnings during a year, the observation is kept, but only the WS earnings component is included.

The CWHS contains three variables that measure WS earnings: Federal Insurance Contributions Act (FICA) earnings (that is, Social Security taxable earnings), Medicare-taxable earnings, and total compensation. FICA earnings data are available for each calendar year 1951–2004, but the amount recorded cannot exceed the maximum taxable earnings applicable in each year, except in the case of multiple jobs (see censoring discussion that follows). Since 1978, the CWHS also contains information on total compensation for WS employment as reported on W-2 statements prepared by employers for purposes of federal income taxation. Although that amount is not top-coded, it does not contain elective deferred compensation. It is also subject to some error because of the process by which the CWHS is updated annually from the agency's Master Earnings File to incorporate the latest available year's data.[19] Medicare-taxable earnings amounts were added to the file in 1983. During 1983–1990, the Medicare and Social Security maximum taxable earnings amounts were the same, but the Medicare maximum was higher from 1991 to 1993, and was eliminated beginning in 1994.

The measure of annual earnings used throughout this article is a variable deduced from the three CWHS variables for WS earnings. For 1981–1993, we use the maximum value of the three reported earnings variables. From 1994 onward, the Medicare earnings variable is used. Once this preliminary earnings variable was created to construct the individual earnings histories used in the research, we conducted consistency checks, such as setting negative earnings values to zero and checking for outlier earnings values. Unusually large earnings amounts could potentially affect the calculated values of several of the article's earnings dispersion measures. As a check for outliers, any annual earnings amount that exceeded three times the Social Security taxable maximum was compared with values in the two prior and two following years. If none of these earnings amounts exceeded one-third the suspect value, an imputation was made by averaging the nearby positive earnings amounts. The prevalence of outliers in the earnings data was small, but not rare. When individual CWHS-recorded earnings histories were examined, instances of unusually large earnings during a single year were found for less than 1 percent of individuals; only a few cases appeared to have two outlier values. Our imputed annual earnings values are likely to have very little effect on any of the reported results. They affect a small percentage of the earnings amounts used to determine annual earnings dispersion measures and represent only one of 12 annual earnings amounts used to calculate a person's long-run real earnings.

Finally, all nominal earnings values were converted to real dollars using the GDP implicit price deflator for Personal Consumption Expenditures (PCE) with calendar year 2000 as the base period.

Notes

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[1] The precise ranking depends on the time period used in the comparison, the earnings concept that is studied, the

dispersion measure used, and the choice of which workers' earnings to include in the study.

[2] As noted by Atkinson (2008), the terms earnings "dispersion" or "differences" are often used synonymously with the term earnings "inequality," although there is a distinction. Differences in earnings may or may not be caused by what many people would think of as inequality. Earnings dispersion is a statistical property of a distribution that can be objectively measured in the absence of judgments about how "inequality" should be defined and measured.

[3] Two closely related research areas to note are studies of earnings mobility (a key link between the differences in the dispersion of earnings as measured over time periods of different lengths) and the literature on the variability of individual earnings over time. Atkinson, Bourguignon, and Morrison (1992), Burkhauser, Holtz-Eakin, and Rhody (1997), and Fields and Ok (1999) are representative of the mobility literature, while Haider (2001), Baker and Solon (2003), Shin and Solon (2008), and a series of papers by Moffitt and Gottschalk (1993, 1998, 2002) and Gottschalk and Moffitt (1994) are important recent contributions to the study of earnings variability.

[4] The CWHS has both active and inactive versions. The active file provides a longitudinal history of annual earnings for people who have any reported earnings in covered or noncovered employment, including earnings from self-employment. The inactive version contains records for individuals with no reported earnings. The structure and content of the CWHS are described in some detail by Smith (1989). Olsen and Hudson (2009) provide a recent overview of the agency's earnings records and discuss key strengths and limitations.

[5] Current law restricts access to these data to researchers at SSA and to staff at the Treasury Department and the Congressional Budget Office (Olsen and Hudson 2009).

[6] A worker's employment is said to be covered under Social Security if earnings are creditable for the retirement, survivors, and disability programs, and OASDI payroll taxes are paid accordingly.

[7] Earnings recorded for 1978–1980 are subject to an unusual number of errors because of inconsistent compliance with the agency's change from quarterly to annual wage reporting in 1978.

[8] There appears to be some residual censoring in recorded WS amounts, particularly for men, during 1981–1990. During that decade, approximately 1 percent of men have recorded annual earnings within $10 of the annual maximum taxable amount each year, and in most instances exactly that amount. That percentage abruptly declines in 1991 to about 0.02 percent and remains at that lower level through 2004. There is much less censoring among women's earnings during 1981–1990, with the percentage having recorded annual earnings within $10 of the taxable maximum ranging from 0.1 to 0.3 percent each year. The consequence for our results is that the article's annual dispersion measures that use earnings amounts from the upper tail of the distribution are understated, which will slightly overstate the increase in annual earnings inequality during the 1980s given by those measures. To the extent that workers' annual earnings are serially correlated, the 12-years aggregate earnings dispersion measures may be slightly understated as well.

[9] WS earnings data are obtained from employer Form W-2 Wage and Tax Statements and Form W-3 Transmittal of Wage and Tax Statements. SE earnings data are taken from Internal Revenue Service files derived from Schedule SE and from the line for unreported wage and tips on Form 1040, US Individual Income Tax Return (Olson and Hudson 2009).

[10] Examples of other complicating rules follow. First, a nonfarm SE worker must earn at least $400 during a year for those earnings to be covered by OASDI; thus, small amounts of SE earnings are often unrecorded. Second, before 1991, SE taxable earnings were recorded only if any WS earnings were less than the OASDI annual maximum taxable earnings amount, and then, only SE amounts that brought total covered earnings (the sum of WS and SE) up to the maximum taxable amount were recorded. Therefore, SE earners prior to 1991 cannot be identified with much precision, and recorded SE earnings amounts are sometimes censored. The censoring problem continues into the 1991–1993 period, although to a lesser degree because of the higher Medicare maximum taxable earnings amounts.

[11] The problem also occurs in cases where the primary job is not covered, but secondary jobs may be. What appears to be a low-earnings year may reflect only partial earnings.

[12] See Pattison and Waldron (2008) for an assessment of the growing importance of elective deferrals in total compensation based on data from SSA's Master Earnings File.

[13] Because we examine earnings histories that span three decades, this deflator is preferable to the Consumer Price Index, which measures price increases for a fixed consumption pattern.

[14] The $5,000 figure approximates half-time work (1,000 hours) at the federal hourly minimum wage during 1996–2004. During 1981–2004, the minimum wage increased from $3.35 to $5.15. Although our annual cutoff for sample inclusion could be more precisely tied to the prevailing minimum wage each year, its real value would change annually, as would those implied by other similar rules (for example, the earnings required for one or more Social Security credits). The inclusion of smaller earnings values in the yearly samples of earnings would nearly always increase the values of the dispersion statistics, but appear to have little effect on the trends in those statistics over time, a point recently confirmed by Kopczuk, Saez, and Song (2010).

[15] These measures are widely used in the income distribution literature and have been discussed by many authors including Sen (1973) and Cowell (forthcoming).

[16] Social Security insured-status rules have evolved over many decades. Since 1990 it has been necessary to accumulate 40 Social Security credits to qualify for retired-worker benefits. A credit is awarded for earning a specified amount that is adjusted annually for average wage growth in the economy, with a maximum of four credits that can be earned each calendar year. The 2010 figure is $1,120 per credit.

[17] Results for the two discounted versions were very similar to the undiscounted case and are consequently not shown. Haider (2001) uses a similar table design.

[18] The change in the natural logarithm of earnings gives the proportional change in real earnings over the period. The plotted values in Charts 3 and 4 represent the difference in the natural logarithms of real earnings in the 12th and 1st years of the period observed at each percentile value.

[19] Most errors in the total compensation variable result from employer reporting errors. Subsequent corrections are made in the Master Earnings File but not in the CWHS. In contrast, corrections for initial errors in the FICA- and Medicare-taxable earnings amounts are made in the CWHS.

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