

## Regional Wage Divergence and National Wage Inequality

In recent years, concern about rising wage and income inequality in the United States has been expressed in both the mass media and the academic literature. The media stories have stressed the uneven nature of the gains in wages and incomes during the 1980s, with reports that the gains have been concentrated at the top of the distribution and that most Americans have seen little, if any, increase in either wages or income.<sup>1</sup>

The academic literature on the subject has been focused on the possible causes of the rise: labor-supply factors—such as changes in the education, age, and gender of the work force—and labor-demand factors—such as changes in the industry and occupation mix. Although several recent studies have pointed to some possible causes for the rise in inequality, much of the rise remains unexplained.<sup>2</sup>

In this study, I seek to add to the literature by addressing the question of how much of the rise in U.S. wage inequality during the 1980s can be explained by a divergence in wages across regions. Several studies have shown that after a long period of convergence, regional wages diverged during the 1980s. These studies also indicate that the divergence was likely temporary and that wages are likely to return to convergence. If a strong link exists between the regional divergence and the rise in U.S. wage inequality, then a return to regional convergence in the 1990s could put significant downward pressure on wage inequality.

I find that the regional shocks that occurred during the 1980s produced a pattern of wage divergence that correlated closely with the pattern of national wage inequality. In a mathematical decomposition of national wage inequality, however, I find that the divergence of regional wages

accounted for only 2.1 percent to 5 percent of the rise in national wage inequality. The regional effect is similar in magnitude to factors relating to the industrial structure but is relatively small in comparison with factors relating to education, occupation, gender, and age. Given this result, the regional convergence that will likely take place in the 1990s is unlikely to have a significant impact on overall wage inequality in the United States.

### National wage inequality

In a review of the literature on wage inequality, Loveman and Tilly (1988) find that most researchers agree that the inequality of labor earnings has increased since the late 1970s. The causes of the increase, however, are not well understood. According to Loveman and Tilly, factors such as changes in gender composition, age distribution, and industrial and occupational mix explain only a small part of the rise in earnings inequality.

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<sup>1</sup> For example, see Smith (1992) and Stein (1992).

<sup>2</sup> While studies have found a rise in both income and wage inequality, the two measures are quite different. Income is affected by investment income and transfers. Household income is affected by family size and structure. In this study, I look solely at pretax wages, and, thus, my focus is on the structure of labor income. Labor income does not reflect the total income or the overall welfare of individuals.

In more a more recent study, Grubb and Wilson (1992) find that factors relating to education and occupation played important roles in a rise in wage inequality in the 1980s, while worker age and industry had relatively small impacts. Grubb and Wilson find, however, that much of the rise in inequality in the 1980s was unexplained. They conclude that the spread of wages across education groups is likely to continue to increase in the future, causing further upward pressure on wage inequality. The authors caution that further analysis is needed to find a more complete explanation for the rise in wage inequality.

Bound and Johnson (1992) highlight three major wage structure developments in the 1980s: an increase in wage differentials by education, a decrease in the gender wage gap, and—for workers without a college degree—an increase in the average wage of older workers relative to younger workers. Bound and Johnson conclude that the principal reason for the increase in wage differential by education and the decrease in the gender differential was a skilled-labor-biased technological change. The authors found little to explain the relative-wage decrease of young workers with low educational attainment. The authors indicate that wage differentials by education are likely to continue to increase, putting further upward pressure on wage inequality.

## Regional wage divergence

One possible factor in rising national wage inequality that has received relatively little attention is a divergence in wages across regions. Browne (1989) notes that “after three decades of

gentle convergence, regional per capita incomes diverged sharply in the 1980s.” She finds that changes in relative wages were the primary source of changes in regional per capita income.

If regional shocks, such as the recessions in the oil and farm belts, caused wages in low-wage areas of the country to decline relative to the wealthier areas, then this change could cause national wage inequality to increase. And if these shocks were temporary, then a return to regional convergence in the 1990s could put downward pressure on wage inequality.

Eberts (1989) finds that a divergence in regional wages in the 1980s likely was caused by region-specific factors, such as the oil and farm crisis, and was not merely the uneven regional impact of changing national patterns. For example, if there was a regional concentration of highly educated workers, then the national rise in wages resulting from educational attainment could have resulted in regional wage divergence. Eberts shows that the rise in regional wage inequality generally was not caused by differences in regional shares of demographic and industry factors.

Carlino (1992) uses a time-series approach to determine whether the regional earnings divergence in the 1980s was caused by permanent or temporary shocks. He concludes that the divergence was most likely caused by temporary shocks, such as the energy and agricultural shocks, and that the divergence does not represent a reversal of the long-term trend in regional convergence. Given the results of Eberts’ and Carlino’s studies, the regional wage divergence in the 1980s was likely temporary and independent of national demographic and industry factors. These results indicate that if regional divergence in the 1980s had a strong impact on national wage inequality, then a return to regional wage convergence in the 1990s could put significant downward pressure on wage inequality.

## Describing U.S. wage inequality and regional shocks

As shown in Figure 1, wage inequality in the United States increased throughout much of the 1980s.<sup>3</sup> The measure of wage inequality shown in Figure 1 is the population-weighted Theil statistic. (For more information about the calculation and

<sup>3</sup> In this study, wages are measured as annual wages and salaries of people 16 years of age or older who worked year-round, full-time (YRFT), or, more precisely, people who worked fifty weeks or more during the year and thirty-five or more hours during the week. The data are taken from the March Current Population Surveys (CPS) of the U.S. Bureau of the Census. During the study period, YRFT workers represented 54 percent to 60 percent of all sampled workers, and the sample size of YRFT workers ranged from 41,750 in 1977 to 50,434 in 1989. Although average hourly wages received during the year for all workers are preferred, this information is not available on the CPS tapes.

Figure 1  
Theil Measure of Wage Inequality



NOTE: This measure is defined in equation 2 in the box.

SOURCE OF PRIMARY DATA: U.S. Department of Commerce, Bureau of the Census, Current Population Survey, March tapes.

properties of this measure of inequality, see the box titled "Using the Population-Weighted Theil Measure of Inequality.") As shown in Figure 1, wage inequality increased from 1978 to 1987 and then declined. The rise in wage inequality shown here is consistent with other measures of wage inequality.<sup>4</sup>

The rise in wage inequality in the early 1980s is at least partly explained by the two recessions that occurred between 1980 and 1982. Previous work has shown that wage inequality typically increases during cyclical downturns and decreases during expansions.<sup>5</sup> The increase in inequality during the long expansion from 1983 to 1987 is more difficult to explain. The rise in wage inequality, however, matches closely with the economic decline in the farm and oil states and the corresponding rise in the defense states.

As shown in Figure 2, employment in the farm and oil states generally grew faster than the national average during the 1970s.<sup>6</sup> But during the 1980s, these regions weakened sharply. High debt levels, combined with rising interest rates and falling farm exports, pushed the farm economy into a recession that persisted until 1987.<sup>7</sup> The energy states also entered a recession following a peak in oil prices in early 1981. Following some improvement in 1984 and 1985, the energy states suffered a sharp blow in 1986, when oil prices

crashed and real estate markets tumbled.

In contrast with the oil and farm areas of the country, the defense dependent regions grew at a healthy pace during the 1980s (Figure 3).<sup>8</sup> Between 1980 and 1987, national defense outlays, in constant dollars, increased at an annual rate of 5.3 percent, and total defense employment increased at an annual rate of 4.2 percent. The military buildup was centered in private-sector companies that produce military equipment. Private-sector defense employment grew 7.8 percent annually, while public-sector military personnel grew only 1.4 percent annually.<sup>9</sup> The strong surge in defense

<sup>4</sup> Karoly (1992) shows that ten different measures of wage inequality all increased during the 1980s.

<sup>5</sup> For example, Blank (1985) finds that "the income distribution narrows in times of growth, primarily because of large elasticities of labor market income among poor heads of household for whom both wages and hours increase during economic upturns." Also, Bluestone and Harrison (1988) find that the proportion of year-round full-time workers who earned low wages has a statistically significant negative relationship with cyclical movements in gross national product.

<sup>6</sup> The farm states are defined as deriving at least 5.2 percent of their gross state product in 1977 from farming (The national average was 2.6 percent.) These states are Arkansas, Idaho, Iowa, Kansas, Minnesota, Mississippi, Montana, Nebraska, North Dakota, South Dakota, and Wisconsin. The energy states are defined as those that would suffer employment losses from a decline in energy prices, as shown in Brown and Hill (1988). The energy states are Alaska, Colorado, Louisiana, New Mexico, Oklahoma, Texas, West Virginia, and Wyoming (Kansas and North Dakota also suffered employment losses from an energy-price decline but were not included here because they were considered primarily agricultural states.)

<sup>7</sup> For a discussion of the reasons for the farm recession in the early 1980s and its subsequent recovery that began in 1987, see Drabentstolt and Barkema (1990).

<sup>8</sup> The defense states were defined as states (plus the District of Columbia) that in 1991 had at least 3 percent of their work force employed in the private defense industry. The defense states are Arizona, California, Connecticut, Maryland, Massachusetts, Virginia, and Washington.

<sup>9</sup> Figures for defense spending and employment were taken from pages 61, 229, and 230 of U.S. Congress, Office of Technology Assessment (1992).

Figure 2  
Economic Performance of Energy  
and Farm States



NOTE: The lines are equal to the year-over-year percentage growth in employment in the farm and energy states minus the year-over-year percentage of growth in U.S. employment.

SOURCE: Bureau of Labor Statistics, Establishment Survey.

Figure 3  
Relative Economic Performance  
of Defense States



NOTE: The line is equal to the year-over-year percentage growth in employment in the defense states minus the year-over-year percentage of growth in U.S. employment.

SOURCE: Bureau of Labor Statistics, Establishment Survey.

spending boosted employment and wages in areas of the country where defense companies were located.

The weak performance of the farm and energy regions reduced their relative wages, while the relative wages of the defense states rose. As shown in Figure 4, from 1981 to 1987 relative wages in the energy states declined from 102.8 percent of the national average to 97.7 percent, and relative wages in the farm states declined from 94.3 percent of the national average to 89.3 percent. In contrast, wages in the defense states grew from 105.6 percent of the national average in 1981 to 110.3 percent in 1987.

During the late 1980s, defense spending began to decline. The end of the defense buildup had a detrimental effect on employment growth and relative wages in the defense states, as shown in Figures 3 and 4. During this period, a gradual recovery was occurring in the farm and oil regions of the country, and employment growth improved in these areas. As shown in Figure 5, the dispersion of average wages across regions increased sharply between 1978 and 1987, and subsequently

fell from 1987 to 1989. The divergence in regional wages from 1978 to 1987, and the subsequent convergence, is consistent with first the increase, and then the decline, in national wage inequality in the 1980s.

### A decomposition of the rise in wage inequality

While the timing of changes in regional wage dispersion suggests a link to national wage inequality, a decomposition of national wage inequality shows that regional wage divergence had only a small direct impact on the rise in national wage inequality. Although the dispersion in average wages across the four economic regions increased sharply between 1978 and 1987, and from 1982 to 1987 (*Figure 5*), the effect of the increased dispersion on national wage inequality was small in both periods.

The Theil measure of inequality can be decomposed into two main effects: inequality caused by inequality in average wages across groups and inequality caused by wage inequality

within groups. Both of these effects can then be divided into a primary effect and the effect of changing shares. For example, inequality that results from inequality of average wages across groups could increase even if the estimated mean wage of each group remained constant. This increase would occur if the employment shares shift such that the weight given to a high- or low-wage group increases and the weight given to an average-wage group decreases. Similarly, overall inequality could increase if wage inequality was constant within each group but the employment share rose for a high-inequality region and declined for a low-inequality region.

The Theil measure of inequality increased from 0.177 to 0.225 from 1978 to 1987, from 0.199 to 0.225 from 1982 to 1987, and then decreased to 0.199 in 1989. Table 1 shows the decomposition of these changes in the Theil into the two main effects and then, within these main effects, that part that results from changing employment shares. As shown in the top half of Table 1, between 1978 and 1987 the national Theil increased by 0.0481, and the change in the dispersion of average wages across regions only accounted for 0.001 (or 2.1 percent) of the increase. Almost all this change was brought on by wage changes, not by changing employment

Figure 4  
Relative Regional Wages  
(Regional Wage Divided by U.S. Wage)



SOURCE OF PRIMARY DATA: Bureau of Labor Statistics, Establishment Survey.

Figure 5  
Dispersion of Wages Across Economic Regions



NOTE: The measure of dispersion show here is defined in equation 5 in the box.

SOURCE OF PRIMARY DATA: Bureau of Labor Statistics, Establishment Survey.

shares. Excluding the recessionary periods of the late 1970s and early 1980s, increases in the variation of average wages across economic regions still accounts only for 2.7 percent of the increase in national wage dispersion.

Most of the rise in wage inequality is left unexplained by the divergence in average wages across regions. Increased wage dispersion was mostly a result of increased wage dispersion within regions. The increase within regions gives little information about the causes of the rise in wage inequality. As shown in Table 2, wage inequality, as measured by the regional Theil statistic, rose in all four regions from 1978 to 1987 and from 1982 to 1987. During the period from 1982 to 1987, inequality in the farm and oil states increased at a significantly faster pace than in the defense states and at a moderately faster pace than in the remaining states.

While the shocks to the farm, oil, and defense regions likely played a major role in the divergence of regional wages, other factors likely also played a role. To account for other factors, I also look at the effect on national wage inequality of the wage divergence across all fifty states and the District of Columbia. As shown in the bottom half of Table 1, the overall effect does not in-

Table 1

**Decomposition of Theil<sup>1</sup> Measure of National Wage Inequality****Decomposition by Economic Regions<sup>2</sup>**

	1978–87	1982–87	1987–89
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across regions (Equals A + B)	.0010	.0007	-.0003
A. Due to change in weight given to each region	.00005	.00003	.00000
B. Due to change in wages	.00098	.00069	-.00030
2. Change in inequality within regions (Equals C + D)	.0471	.0253	-.0254
C. Due to change in weight given to each region	-.00005	-.00040	.00002
D. Due to change in regional inequality measures	.04709	.02572	-.02539

**Decomposition by States<sup>3</sup>**

	1978–87	1982–87	1987–89
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across states (Equals A + B)	.0016	.0013	-.0004
A. Due to change in weight given to each state	.00005	.00009	.00000
B. Due to change in wages	.00158	.00121	-.00040
2. Change in inequality within states (Equals C + D)	.0464	.0247	-.0252
C. Due to change in weight given to each state	.00122	.00002	-.00008
D. Due to change in state inequality measures	.04522	.02474	-.02513

<sup>1</sup> The Theil statistic increased 27.1 percent from 1978 to 1987, (from 0.177 to 0.225), 13.1 percent from 1982 to 1987 (from 0.199 to 0.225), and declined 11.5 percent from 1987 to 1989 (from 0.225 to 0.199). For more information on the calculation and decomposition of the Theil, see the box.

<sup>2</sup> The four economic regions are the energy states, the farm states, the defense states, and all other states (including the District of Columbia). For more information on the states included in each region, see footnotes 6 and 7 in the text.

<sup>3</sup> Includes the District of Columbia.

Table 2  
Average Wages and Wage Inequality<sup>1</sup> Within Regions

Regions	1978			1982			1987		
	Wages	Theil	Weight	Wages	Theil	Weight	Wages	Theil	Weight
Energy	14,287	.198	11.9	20,200	.215	13.2	24,785	.250	12.0
Farm	13,424	.191	9.9	18,962	.208	9.4	22,655	.242	9.3
Defense	15,625	.176	22.4	22,020	.205	23.4	27,993	.221	24.1
Other	14,475	.169	55.7	19,724	.189	54.0	24,807	.215	54.5

<sup>1</sup> Data are for year-round, full-time workers. The Theil measure of inequality is described in the box.

SOURCE OF PRIMARY DATA: U.S. Department of Commerce, Bureau of the Census, Current Population Survey, March tapes.

crease significantly with the larger breakdown. Only 3.3 percent of the net increase in national inequality between 1978 and 1987 can be directly attributed to an increased dispersion in average wages across states. Excluding the recessionary periods of the late 1970s and early 1980s, increases in the variation of wages across states still only accounts for 5 percent of the increase in national wage dispersion. Once again, the increased wage dispersion was mostly a result of increased wage dispersion within states. The rise in wage inequality within states was widespread, with wage inequality rising in forty-four states from 1978 to 1987 and in thirty-seven states from 1982 to 1987.

The divergence of wages across states played a smaller role in national wage inequality than did several other factors, such as a rise in the variance of wages across groups classified by education, occupation, and age. The effect of gender factors was also stronger than the regional factors, but in the opposite direction. A reduction in the wage gap between men and women acted to reduce wage inequality, even while the share of women in the work force grew. The regional effect was similar only to that of the changing industrial structure of the work force.

As shown in Table 3, education and occupational factors seem to have played the largest role in the rise in wage inequality.<sup>10</sup> From 1982 to 1987, an increase in the dispersion of wages across educational groups was responsible for 22.5 percent of the net increase in the Theil; an increase

across occupational groups was responsible for 17.7 percent of the increase; an increase across age groups was responsible for 8.8 percent; and an increase across industries was responsible for 4.6 percent of the increase. A reduction in the dispersion of wages across gender groups reduced the net increase in the Theil by 15.8 percent.<sup>11</sup>

As shown in the third columns of Tables 1 and 3, wage inequality declined quite sharply from 1987 to 1989. The convergence in wages across states that occurred from 1987 to 1989 accounted for only 1.6 percent of the decline in national wage inequality during that period. The most important factor affecting the decline in wage inequality was a continuing decline in the male-female wage gap. A decline in the relative wages of managerial, professional, technical, and sales workers reduced the occupational wage spread, which also led to less overall wage inequality. The dispersion of wages across educational groups was essentially unchanged from 1987 to 1989.

<sup>10</sup> For definitions of the factor groupings, see the Appendix.

<sup>11</sup> The decompositions provided in Tables 1 and 3 simply provide clues as to which economic and demographic factors may have played a role in rising wage inequality. The decomposition ignores important interactions between factors such as occupation and education, and it is thus inappropriate to total the percent explained by all factors.

Table 3  
**Decomposition of Theil Measure of National Wage Inequality  
 By Demographic and Industry Demand Factors<sup>1</sup>**

<b>Education</b>	<b>1978-87</b>	<b>1982-87</b>	<b>1987-89</b>
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across educational groups (Equals A + B)	.0131	.0058	-.0001
A. Due to change in weight given to each group	-.00018	-.00156	-.00049
B. Due to change in wages	.01331	.00732	.00035
2. Change in inequality within groups (Equals C + D)	.0349	.0203	-.0255
C. Due to change in weight given to each group	-.00016	-.00022	-.00009
D. Due to change in group inequality measures	.03510	.02051	-.02543
 <b>Age</b>			
	<b>1978-87</b>	<b>1982-87</b>	<b>1987-89</b>
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across age groups (Equals A + B)	.0034	.0023	-.0023
A. Due to change in weight given to each group	-.00325	-.00085	-.00070
B. Due to change in wages	.00663	.00313	-.00156
2. Change in inequality within age groups (Equals C + D)	.0447	.0238	-.0234
C. Due to change in weight given to each group	-.00056	-.00021	.00075
D. Due to change in group inequality measures	.04525	.02397	-.02413

<sup>1</sup> For definitions of demographic and industry groups, see the Appendix. Data are for year-round, full-time workers.

SOURCE OF PRIMARY DATA: U.S. Department of Commerce, Bureau of the Census, Current Population Survey, March tapes.

*(Continued on the next page)*



Table 3—Continued

### Decomposition of Theil Measure of National Wage Inequality By Demographic and Industry Demand Factors

Gender	1978–87	1982–87	1987–89
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across gender (Equals A + B)	-.0077	-.0049	-.0046
A. Due to change in weight given to each group	.00147	.00040	-.00000
B. Due to change in wages	-.00921	-.00528	-.00460
2. Change in inequality within gender groups (Equals C + D)	.0558	.0309	-.0210
C. Due to change in weight given to each group	-.00211	-.00064	-.00001
D. Due to change in group inequality measures	.05792	.03156	-.02102
<b>Occupation</b>			
	<b>1978–87</b>	<b>1982–87</b>	<b>1987–89</b>
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across occupations (Equals A + B)	.0078	.0046	-.0033
A. Due to change in weight given to each group	-.00147	-.00033	.00014
B. Due to change in wages	.00926	.00428	-.00340
2. Change in inequality within occupations (Equals C + D)	.0403	.0214	-.0224
C. Due to change in weight given to each group	.00864	.00144	.00154
D. Due to change in group inequality measures	.03164	.02000	-.02393

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Table 3—Continued

### Decomposition of Theil Measure of National Wage Inequality By Demographic and Industry Demand Factors

Industry	1978–87	1982–87	1987–89
Change in Theil (Equals 1 + 2)	.0481	.0260	-.0256
1. Change in inequality of wages across industries (Equals A + B)	.0020	.0012	-.0022
A. Due to change in weight given to each group	.00064	.00029	.00022
B. Due to change in wages	.00136	.00089	-.00242
2. Change in inequality within industry groups (Equals C + D)	.0461	.0249	-.0234
C. Due to change in weight given to each group	.00539	.00188	.00124
D. Due to change in group inequality measures	.04071	.02298	-.02469

### Summary and implications

Throughout much of the 1980s, wage inequality increased in the United States. Previous research has found that a rise in earnings by educational level and increased wage dispersion across occupations were important factors in the rise in wage inequality. Researchers, however, have noted that much of the rise in wage inequality was left unexplained by the demographic and industry factors that they examined. In this study, I have furthered the analysis by examining the impact on wage inequality of a divergence in regional wages that occurred during the 1980s.

I find that regional shocks, such as the recessions in the oil and farm belts, pushed wages lower in these below-average-wage areas, and increased defense spending pushed up wages in above-average-wage areas. While these regional shocks increased overall wage inequality, I find

that regional wage divergence accounted for only 2.1 percent to 5 percent of the rise in national wage inequality. Other factors, such as increased wage dispersion across educational and occupational groups and a reduction in the male–female wage gap, played larger roles.

Although recent studies suggest that regional wages are likely to return to convergence, results of this study suggest that the convergence will likely have only a small impact on national wage inequality. The future direction of wage inequality is unclear. A growing demand for high-skilled workers (without a large increase in the supply of skilled workers) would put upward pressure on wage inequality, while a continued decline in the male–female wage gap would put downward pressure on wage inequality. To get a better idea of the future direction of national wage inequality, further work needs to be done to fully understand the factors affecting wage inequality.

## Using the Population-Weighted Theil Measure of Inequality

In this paper, I use a measure of inequality due to Theil (1967, 126–27). As shown in Horrigan (1991), this measure can be written simply as

$$(1) \quad T = \sum_i^P ps_i \ln \left( \frac{ps_i}{is_i} \right),$$

where  $ps_i$  is the population share of the  $i$ th person,  $is_i$  is the income share of the  $i$ th person, and  $P$  is the number of people in the sample. Thus, the greater is the difference between individual's income share and their population share, the greater is the Theil statistic.

As brought out by Haslag, Russell, and Slottje (1989), no single inequality measure has been proved superior to the others. As described in Shorrocks (1980), however, the population-weighted Theil is one of a limited number of additively decomposable inequality measures that satisfy three important properties:

- A transfer of earnings from a richer to a poorer individual reduces the value of the measure;
- If there are  $r$  groups with  $n$  individuals and each group has an identical distribution, then aggregating the groups would result in an inequality measure that would be equal to the measure for each of the individual groups; and

- If the wages of each person were multiplied by some positive constant, the degree of inequality would remain the same.

Shorrocks finds that among the limited number of additively decomposable inequality measures that fit these criteria, the population-weighted Theil is the most satisfactory because its decomposition is unambiguous.

In calculating the Theil with CPS data, several problems must be addressed. The first is that each observation is not weighted equally. I address this problem by adjusting the Theil measure to account for unequal weights. As shown in Horrigan (1991), the adjusted Theil is calculated as

$$(2) \quad T = \ln \mu - \frac{\sum_i^P W_i \ln(Z_i)}{N},$$

where

$$(3) \quad \mu = \frac{\sum_i^P W_i * Z_i}{N}, \text{ and}$$

$$(4) \quad N = \sum_i^P W_i.$$

$W_i$  is equal to the CPS sampling weight for individual  $i$ , and  $Z_i$  is the wage and salary earnings of individual  $i$ .

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### Using the Population-Weighted Theil Measure of Inequality—Continued

The second problem in using the CPS data is that wages that exceed a set level are not given in the sample. Although the truncated part is usually only between 0.5 percent and 1.5 percent of the sample, it nonetheless can represent an important downward bias in the Theil. To account for these high-wage earners, a Pareto distribution was estimated by state, excluding the lowest-paid 60 percent of the work force.<sup>1</sup> An average top-coded wage for each state was calculated by using the estimated distribution of the top-coded individuals, and each top-coded person was then assigned the average wage.

Once a wage was estimated for each of the top-coded individuals and a national Theil statistic was calculated using the CPS weights, then the Theil was decomposed first into the contribution of wage differences between subgroups:

$$(5) \quad B = \frac{1}{N} \sum_g^G N_g \log \frac{\mu}{\mu_g},$$

where  $N$  and  $\mu$  are defined in equations 3 and 4. The contribution due to inequality within each subgroup  $g = 1, \dots, G$  is then defined as

$$(6) \quad C_g = \frac{N_g}{N} T_g,$$

where  $T_g$  is the Theil for each group. The aggregate Theil measure is then equal to

$$(7) \quad T = B + \sum_{g=1}^G C_g.$$

<sup>1</sup> Past research on the distributions of wages and income has found that the Pareto distribution fits well at the upper end of the distribution. For example, see Singh and Maddala (1976) and Cramer (1971).

## Appendix

### Group Definitions

#### 1. Age

- A. 16–19
- B. 20–29
- C. 30–39
- D. 40–64
- E. 65+

#### 2. Education, Years Completed

- A. 0–8 Elementary School or Less
- B. 9–11 Some High School
- C. 12 High School Graduate
- D. 13–15 Some College
- E. 16 College Graduate
- F. 17+ Post-College Graduate

#### 3. Gender

- A. Female
- B. Male

#### 4. Industry

- A. Agriculture, Forestry, and Fisheries
- B. Mining
- C. Construction
- D. Durable Goods Manufacturing
- E. Nondurable Goods Manufacturing
- F. Transportation, Communication, and Public Utilities

#### G. Trade

- H. Finance, Insurance, and Real Estate
- I. Business and Repair Services
- J. Personal Services
- K. Entertainment and Recreational Services
- L. Professional Services
- M. Public Administration

#### 5. Occupation

- A. Executive, Administrative, and Managerial
- B. Professional
- C. Technicians and Related Support
- D. Sales Occupations
- E. Administrative Support
- F. Private Household
- G. Protective Service
- H. Farming, Forestry, and Fishing
- I. Precision Production, Craft, and Repair
- J. Machine Operators, Assemblers, and Inspectors
- K. Transportation and Material Moving
- L. Handlers, Equipment Cleaners, Helpers, and Laborers

## References

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