Regional Labor Markets and the Determinants of Wage Inequality

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From 1972 to 1990, the United States experienced the largest increase in wage inequality of any developed country. The spread in log wages between the 90th and 10th percentiles of the male wage distribution increased by about 60 points, and inequality increased within virtually every demographic or skill category of the labor force (see Chinhui Juhn et al., 1993). Various explanations have been offered, including changes in the relative demand for skill-intensive goods, international trade, immigration of less-skilled workers, and increased labor-force participation of women. Yet attempts to quantify the relative importance of these factors have not met with much success. This leaves skill-biased "technical change" as the residual claimant that rationalizes the data.

This paper uses regional differences in the evolution of wage inequality to provide new evidence on the determinants of relative wages. Using a model of factor demand in geographic markets, I isolate contributions of (i) changing skill ratios in the labor force; (ii) increased participation of women; (iii) technical change; and (iv) changes in the industrial composition of labor demand. The data indicate that changing skill ratios and women's labor supply have affected the wages of low-skilled men. In the West, the data indicate that increased immigration of less-skilled Hispanic and Asian workers has adversely affected the wages of natives, causing a greater increase in inequality there than in any other region of the country.

I. Modeling Wage Inequality in Regional Markets

Inequality has increased in all regions of the United States, but the magnitude is not the same across regions. This is demonstrated in Table 1, which divides the distribution of men's wages into three "skill" intervals, corresponding to the top, middle, and bottom thirds of the distribution.[1] The medians of these intervals are at the 84th, 50th, and 16th percentiles, and the table reports changes in log wage differences between these percentiles from 1972 to 1990. The largest change in relative wages occurred in the West, where the 84–16 wage differential grew by 31 log points in 18 years. This change is about 50-percent greater than in the Northeast, and triple the corresponding change in the South.

The data in Table 1 reject the idea that rising inequality occurred at the same pace in all areas, and they suggest that distinctly local factors affect relative wages. They also suggest that the extent of labor markets is limited by geography, at least in the intermediate run. If these factors can be isolated, they may shed light on the determinants of the overall increase in wage inequality. To pursue these points, I estimate an equilibrium model of relative wage determination for geographic labor markets.

Think of men from each third of the wage distribution as forming separate skill groups ($i=1,2,3$), which are inputs to industry-j production in region m. Women's labor supply may affect the demand for men, so low- and high-skilled women ($i=4,5$) are additional factors. Ignore capital and

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[1] The data are drawn from the March Current Population Survey files for survey years 1973–1991; see Topel (1994) for details.

TABLE 1—REGIONAL CHANGES IN MALE WAGE INEQUALITY

Region	Change in log wage difference between indicated percentiles 84–16	50–16	84–50
New England	0.196	0.096	0.101
Atlantic	0.221	0.150	0.071
North Central	0.251	0.176	0.075
West North Central	0.174	0.094	0.080
Southeast	0.093	0.052	0.041
South Central	0.122	0.050	0.072
Southwest	0.216	0.101	0.115
Mountain	0.181	0.121	0.061
West	0.312	0.193	0.119

Source: March Current Population Survey, 1972–1990.

assume homotheticity, yielding demand equations of the following form:[2]

$$(1) \quad \dot{x}_i^{jm} - \dot{z}^{jm} = E_i^j \dot{w}^m + F_{i1}^j\left(\dot{x}_{f_1}^{jm} - \dot{z}^{jm}\right) + F_{i2}\left(\dot{x}_{f_2}^{jm} - \dot{z}^{jm}\right) + \phi_i^j + u_i^{j'}$$

where $\dot{z}^{jm} = \sum_l k_l^{jm} \dot{x}_i^{jm}$ is a cost-share-weighted average of the five skill groups in the model. Then (1) expresses rates of change of factor ratios. The output-constants demands for men condition on the employment of high-skilled (f_1) and low-skilled (f_2) women in industry j, which I treat as exogenous. The terms ϕ_i^j index nonneutral technical change that raises the demand for skill-group i in industry j. I assume that technical change is common across regions, so that ϕ_i^j is independent of m.

Market equilibrium requires that the sum of industry demands equals input supply. This implies $\dot{x}_i^m = \Sigma S_i^{jm} \dot{x}_i^{jm}$, where S_i^{jm} is the share of factor-i employment accounted for by industry j. Substituting from (1) and solving for the evolution of relative wages yields

$$(2) \quad \dot{w}^m = [E^m]^{-1}\left\{\dot{x}_i^m - \sum_j S_i^{jm} \dot{z}^{jm} - \sum_j S_i^{jm} F_i^j\left(\dot{x}_f^{jm} - \dot{z}^{jm}\right) - \sum_j S_i^{jm} \dot{\phi}_i^j - u_i\right\}$$

where $E_i^m = \Sigma_j S_i^{jm} \; E_i^j$. Then $[E^m]^{-1}$ is the matrix of market-wide elasticities of complementarity (J. R. Hicks, 1932), which relate changes in market wages to changes in observed quantities and to technical change. According to (2), changes in relative wages are determined by four main factors.

First, $\dot{x} - \dot{z}$ is the change in net supply (supply minus demand) of factor i in market m. If supply grows faster than demand, relative wages of type-i men will fall. The second factor is women's labor supply. If employment of women rises, and if women are net substitutes for men ($F_{i1} < 0$ or $F_{i2} < 0$), then men's wages will fall. Third is technical change. If type-i workers in region m are concentrated in industries with i-saving technical change, then w_i^m will decline more rapidly in market m. Finally, the u_i^m are unobserved relative demand shocks for type-i workers. The first three of these variables can be measured in census-style data, as follows.

II. Data and Estimation of the Model

I work with five skill groups. Three groups of men are from each third of their wage distribution. The wage for each group is its median, so the relative wage changes to be explained are those in Table 1. For women, data limitations dictate two groups: low-skilled women are below the median of the female distribution, while high-skilled women are above it.

Given these prices, a natural choice of quantities might be the number of people from the indicated interval of the wage distribution. This will not do; by definition, the relative supply of these groups is fixed. Instead, I predict the number of individuals in each percentile, p, from their characteris-

[2]The demand for input 2, men from the middle of the wage distribution, is implied by homogeneity.

TABLE 2—ESTIMATED MARKET-WIDE COMPENSATED DEMAND ELASTICITIES FOR LOW- AND HIGH-SKILLED MEN

Skill	Skill: Low	Skill: High
Low	−0.253	0.267
	(0.039)	(0.061)
High	0.061	−0.105
	(0.028)	(0.043)

Note: Estimates are employment-share-weighted averages of own- and cross-price demand elasticities. Employment shares for the West are used, but other regions produce trivially different effects. Standard errors are in parentheses.

tics, **C**, and the pooled wage distribution over all years, $f(p|\mathbf{C})$. Then secular changes in observables that are associated with higher wages (e.g., rising education levels in the labor force) imply declining relative supply of less-skilled workers because $f(p|\mathbf{C})$ shifts. The question is whether regional differences in the evolution of these factors affects relative wages.

Finally, I grouped three-digit industries into 10 aggregates based on the skills (wages) of workers. I ranked industries by their employment shares of low-wage ($i=1$) men. Then, for example, industry 1, the least skilled industry, is the set of three-digit SIC industries with the largest employment shares of low-wage men that account for 10 percent of total employment, and so on.

Estimation of (2) requires measures of the bracketed terms. Measures of $\dot{x}$ and $\dot{z}$ can be constructed from the data just mentioned, while F_{i1}^j and F_{i2}^j are estimated from (1) for each industry. The assumption that the ϕ_i^j's are independent of region means that technical change can be estimated from average changes in factor ratios across regions, captured in (1) by a vector of year dummies, D_{it}^j, that are common to input i in industry j, but are independent of m. Given estimates of model (1), model (2) is estimated with $\hat{F}$ and $\hat{\phi}$ inserted in place of their theoretical values.

Space constraints preclude a detailed presentation of (1) by industry. Table 2 summarizes the price effects, showing estimated market-wide demand elasticities using industry shares as weights. Own price

TABLE 3—ESTIMATED DETERMINANTS OF RELATIVE WAGES OF LOW-SKILLED AND HIGH-SKILLED MEN, 1971–1989 (ELASTICITIES OF COMPLEMENTARITY)

Explanatory variables	Low-skilled men	High-skilled men
Net supply:	−0.666	−0.591
$x_i^m - \sum_j S_i^{jm} z^{jm}$	(0.105)	(0.135)
Low-skilled women:	−1.943	−1.330
$-\sum_j S_i^{jm} F_{iL}^{jm}(x_L^{jm} - z^{jm})$	(1.243)	(0.193)
High-skilled women:	−0.962	−0.083
$-\sum_j S_i^{jm} F_{iH}^{jm}(x_H^{jm} - z^{jm})$	(0.160)	(0.199)
Technical change:	−1.047	−0.992
$-\sum_j S_i^{jm} \phi_i^j$	(0.116)	(0.152)
Region effects	yes	yes
R^2, total:	0.876	0.881
R^2, net of region effects:	0.881	0.792
R^2, net of region effects and technical change:	0.800	0.499
Observations:	171	171

effects are negative, and the demand for less-skilled men is more elastic than for skilled ones. Though not reported here, the demand models also indicate that women typically substitute for men in production, $F_{ji} < 0$, though the pattern of substitution effects is counterintuitive. For example, high-skilled women, who account for almost all of the increase in women's labor supply, are better substitutes for low-skilled men than are low-skilled women. This may reflect the fact that the median of the female wage distribution is at about the 25th percentile of men's, so much of the increase in supply is among women who are paid similarly to less-skilled men. But it may also be an artifact of the industry definitions, in which growing female-intensive industries may be aggregated with contracting male-intensive ones. I leave this point for subsequent research.

Estimates of (2) for the determinants of relative wages are in Table 3. Each regressor is entered with the sign it carries on the right-hand side of (2), so theory indicates that each should reduce relative wages. This is confirmed. The models clearly reject the hypothesis—implicit in (2)—that each regressor has the same effect on relative wages.

The effects of changes in own net supply on relative wages are strongly negative. The effect for low-skilled men is fairly remarkable, since rising average schooling levels have caused the supply of low-skilled men to fall at the same time their relative wages have declined. The resolution of this paradox is that technical change, controlled for in row 4 of Table 3, has been biased against them, so labor demand has fallen faster than labor supply. The evidence in the table means that regions with less-rapid reductions in net supply of low-skilled men have experienced larger declines in their relative wages. I will show that the West is an example. Similarly, the relative supply of high-skilled men has risen more slowly than technical change has increased the demand for them, so their wages have risen. I return to this point shortly.

These effects of "net supply" combine the impact of changing input supplies, $\dot{x}$, with an index of changing industry demands, $\dot{z}$. It turns out that none of the variation in net supply is due to variation in the industry composition of demand. I had expected that differences in regional specialization and the decline of certain industries (durable goods in the Midwest, or trade-sensitive industries in general) would have important effects on wage inequality. *There is no evidence that different regional evolutions of wages are demand-driven*; the whole story is on the supply side.

The estimates also indicate that increased employment of women reduces men's wages. The effects of low-skilled women are too large to be plausible; they exceed the effects of net supply for both high- and low-skilled men. In practice, however, the only estimate of any importance is for high-skilled women. Labor supply of low-skilled women has been nearly constant, so they have no appreciable effect on trends in men's wages.

How much does the model explain? The last row of the table reports partial R^2 statistics that net out both fixed region effects and the effects of technical change. For high-skilled men, only about half of regional differences in the evolution of wages are explained by net supply and women's employment; but for low-skilled men, the four regressors explain about 80 percent of regional differences in the evolution of relative wages.

TABLE 4—ACTUAL AND PREDICTED COMPONENTS OF CHANGE IN RELATIVE WAGES OF MEN, FROM 1972–1973 TO 1989–1990

Region/skill	Actual	Predicted	Net Supply	Women: Low-skill	Women: High-skill
New England					
Low	−0.101	−0.096	0.194	0.002	−0.128
High	0.095	0.098	−0.026	0.020	−0.000
Atlantic					
Low	−0.150	−0.157	0.178	−0.006	−0.166
High	0.071	0.087	0.000	0.012	0.007
North Central					
Low	−0.176	−0.129	0.161	−0.005	−0.126
High	0.075	0.071	−0.031	0.008	−0.006
West North Central					
Low	−0.094	−0.116	0.167	−0.006	−0.124
High	0.080	0.088	−0.014	0.004	−0.006
Southeast					
Low	−0.052	−0.089	0.174	0.001	−0.103
High	0.041	0.105	−0.039	0.039	−0.006
South Central					
Low	−0.050	−0.118	0.168	−0.005	−0.119
High	0.072	0.082	−0.029	0.007	−0.006
Southwest					
Low	−0.101	−0.122	0.136	−0.003	−0.096
High	0.115	0.088	−0.023	0.007	−0.006
Mountain					
Low	−0.121	−0.155	0.136	−0.001	−0.130
High	0.061	0.090	0.021	−0.033	−0.006
West					
Low	−0.193	−0.190	0.051	−0.008	−0.073
High	0.119	0.113	0.014	−0.004	−0.005
Average					
Low	−0.115	−0.130	0.151	−0.003	−0.118
High	−0.081	0.091	−0.014	0.004	−0.006

Note: Predicted components are derived by multiplying the changes in explanatory variables by the regression coefficients reported in Table 3.

A. *Long-Run Changes*

The sources of this explanatory power are particularly interesting, especially for low-skilled men. Table 4 records actual and predicted long-run changes in relative wages for each region between 1972 and 1990, along with a decomposition of the model's predictions. It turns out that industry-common changes in factor ratios, which I attribute to technical change, had region-neutral effects on wages. For low-skilled men, biased technical change reduced the wages of men at the 16th percentile by about 17 percent, relative to the median, with virtually no regional variation. For high-skilled men the effect was to raise wages by about 11 percent. To save space in the table, I omit the effects of technical change.

The model attributes regional differences in rising inequality to changes in the supply of skills. Table 4 shows that participation of low-skilled women had a negligible impact on the wages of both skill groups, with little regional variation; the rising supply of skilled women reduced the wages of unskilled men by an average of 12 percent. The range of this effect is from 17 percent in the Atlantic region, where women's participation increased most, to only 7 percent in the West. Since the average reduction in wages of low-skilled men was also 12 percent, a literal interpretation is that their wages would not have fallen if women's labor supply had remained fixed at 1972 levels.

I do not want to oversell this finding. The pattern of substitution effects that lead up to it (high-skilled women substitute for low-skilled men) may indicate that the model is misspecified. But the effects are strong, so the possibility that women's labor supply has adversely affected less-skilled men surely warrants further investigation.

B. *Net Supply, Immigration, and Wages*

The relative supplies of skilled and unskilled men have strong effects on long-run changes in inequality. Rising schooling levels in all regions reduced the relative supply of unskilled men and increased the relative supply of skilled men. These changes partially offset the impact of technical change on demand for these groups, but there was wide variation across regions, especially for unskilled men. The decline in their supply was largest in New England, *raising* wages there by 19 log points. The smallest improvement in labor-force "quality" came in the West, so supply factors raised relative wages of unskilled men by only 5 points, compared to 15 points in the country as a whole. This was swamped by the decline in demand caused by technical change, so the relative wage of low-skilled men fell by 19 points in the West.

Several previous studies have found small effects of immigration on the wages of natives, even among unskilled workers, (George Borjas, 1987; Joseph Altonji and David Card, 1989; Robert J. LaLonde and Topel, 1989). But the evidence here indicates that immigration may have had large effects on wage inequality that were concentrated in the West.

Across all regions, the supply of low-skilled ($i=1$) men fell by 29 log points, but it fell by only 10 points in the West. Why was the improvement in labor-force quality only a third as large in the West? The answer is linked to an increase in immigration of less-skilled Asian and Hispanic workers. The Current Population Survey data do not record immigration status, but they do record broad ethnic categories. Since immigration flows in the 1980's came mainly from Latin America and Asia, I calculated the change in net supply of unskilled workers in each region on a sample that excludes Hispanics and Asians. Were it not for the increasing share of Hispanics and Asians, the relative supply of unskilled workers would have fallen by 26 log points in the West. This is virtually the same as in other regions, and it implies that these "immigrants" account for the greater increase in wage inequality observed in the West. In other words, immigration of unskilled Asian and Hispanic workers reduced the wages of unskilled natives in the West by about 10 percent.

III. Conclusion

The model and evidence paint the following picture. Technical change has favored skilled workers, which raises overall inequality. At the same time, successive cohorts of workers have greater levels of schooling, which reduces the supply of low-skilled workers and reduces inequality. The former effects have dominated, on average. Yet changes in supply vary across regions, so changes in inequality do too. Regions with the greatest increase in wage inequality are those with the smallest improvements of labor-force quality. Especially in the West, the evidence is that immigration has played an important role in affecting the supply and welfare of low-skilled men.

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