Occupational Differences in Labor Market Integration: The United States in 1890

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When labor markets are subject to large demand or supply shocks, as was the case in the late nineteenth-century United States, geographic wage differentials may not be an accurate index of market integration. This article uses a conceptually more appealing measure—the elasticity of local labor supply—to compare the integration of urban labor markets for a variety of occupations in 1890. According to this measure, markets for unskilled labor and skilled metal-working trades appear relatively well integrated in comparison to those for the skilled building trades.

Improvements in the efficiency of labor markets are an important feature of economic growth. Most efforts to trace those improvements have focused on geographic wage differentials.[1] But if demand conditions are changing at the same time that migration is occurring, as appears to have been the case in the late nineteenth-century United States, inferences about market efficiency based solely on the behavior of wages may be misleading.[2]

From the perspective of employers at a particular location, the efficiency of the labor market is reflected in the elasticity of the labor supply curve they face. In an imperfectly integrated market, wages will

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[1] Recent examples include Winifred B. Rothenberg, "The Emergence of Farm Labor Markets and the Transformation of the Rural Economy: Massachusetts, 1750–1855," this JOURNAL, 48 (Sept. 1988), pp. 371–87; and Joshua L. Rosenbloom, "One Market or Many? Labor Market Integration in the Late Nineteenth-Century United States," this JOURNAL, 50 (Mar. 1990), pp. 85–107. Geographic integration is, of course, only one aspect of labor market efficiency. An overall analysis of labor market efficiency would also need to consider the allocation of labor between different sectors and between firms within sectors. However, Harry J. Holzer, in "Employment, Unemployment and Demand Shifts in Local Labor Markets" (NBER Working Paper No. 2858, 1989), found that for contemporary data, frictions involved in the geographic reallocation of labor are a more important source of inefficiency than are those related to supply adjustments at any particular location.

[2] As far as I know, the only attempts to date to analyze nineteenth-century wage differentials and migration as simultaneously determined endogenous variables are those by G. C. Bjork, "Regional Adjustment to Economic Growth: the United States, 1880–1950," *Oxford Economic Papers*, 20 (1968), pp. 81–97; and Thomas J. Orsagh and Peter J. Mooney, "A Model for the Dispersion of the Migrant Labor Force and Some Results for the United States, 1880–1920," *Review of Economics and Statistics*, 12 (Aug. 1970), pp. 306–12.

vary in response to differences in local labor supply and demand. As integration increases, outside sources of labor will become more responsive to geographic wage differentials, and the labor supply at any particular place will become more elastic. In this article I compare local labor supply elasticities for a range of skilled and unskilled workers in construction and the metal-working trades, estimated from cross-sectional data on a sample of 40 U.S. cities in 1890.[3] Because complete integration is unlikely to be observed, it is not possible to draw conclusions about the absolute level of geographic integration—but it is possible to compare the extent of integration in the markets for these different kinds of labor. A marked pattern of occupational differences emerges from this comparison, indicating that the markets for skilled building trades workers were less integrated than those for either skilled metalworkers or unskilled labor.[4]

DATA ON INTERCITY VARIATION IN WAGES, PRICES, AND EMPLOYMENT

To estimate labor supply and demand equations, it is necessary to combine data on wages, employment, and living costs with measures of the exogenous factors affecting local supply and demand. These data must be assembled from a variety of sources. Wages and retail prices are drawn from the published reports of studies undertaken by the U.S. Commissioner of Labor in the early twentieth century; measures of employment and exogenous supply and demand shocks are derived from the published returns of the 1880 and 1890 censuses of population and manufacturing.[5]

Average hourly wages were collected by industry and occupation for a variety of skilled and unskilled workers. Here I focus on workers in 11

[3] The use of cross-sectional data reflects an implicit assumption that the different markets are not completely integrated, because in a truly unified market there would be only one wage, and any observed variation would reflect compensating variations, differences in labor quality, or measurement errors. At the same time, it is necessary that the locations not be completely unintegrated. In this case, different cities will obtain labor from different sources, and the resulting estimates of supply elasticities will confound the different elasticities faced by employers at different places. The hypothesis of complete integration cannot be tested within a model of local wage determination, but it seems reasonable to characterize the sample of U.S. cities examined here as less than perfectly integrated. It *is* possible to test for differences in labor supply elasticities across subsets of the sample, and this possibility is considered in subsequent pages.

[4] This result is consistent with work by Gerald Friedman, "Skill Differentials, Unions, and American Labor Markets" (mimeo, Department of Economics, University of Massachusetts, 1989), which found that building trades unions were more effective than others in controlling entry into local labor markets.

[5] U.S. Department of Commerce and Labor, *Nineteenth Annual Report of the Commissioner of Labor, 1904*, "Wages and Hours of Labor" (Washington, DC, 1905); U.S. Department of Commerce and Labor, *Eighteenth Annual Report of the Commissioner of Labor, 1903*, "Cost of Living and Retail Prices of Food" (Washington, DC, 1904); U.S. Department of the Interior, Census Office, *Eleventh Census, 1890*, "Report on Population of the United States," part 2 (Washington, DC, 1897); U.S. Department of the Interior, Census Office, *Eleventh Census, 1890*, "Report on Manufacturing Industries in the United States," Part 2: Statistics of Cities (Washington, DC, 1895); and U.S. Department of the Interior, Census Office, *Twelfth Census, 1900*, "Abstract" (Washington, DC, 1901).

occupations in the building trades—laborers, bricklayers, carpenters, painters, and plumbers—and in foundry and machine shops—laborers, blacksmiths, boilermakers, pattern makers, iron molders, and machinists. The data were obtained by special agents of the labor department from information contained in payroll and other business records.[6]

Concurrently, data on retail food prices were collected from the books of 814 merchants throughout the country. Food accounted for about 44 percent of expenditures in working-class budgets and appears to be a fairly good proxy for overall living costs.[7] For 26 of the cities it was possible to supplement the retail food price data with prices from the Aldrich Report for other commodities representing an additional 42 percent of working-class budgets.[8] The construction of cost-of-living estimates from these data is described in an appendix available from the author.

Table 1 reports for each city and region the cost-of-living estimates and average nominal and real wages, by occupation group. Consistent with other studies, there was considerable variation in the cost of living, both within and between regions.[9] And, though nominal wage differentials between eastern and midwestern cities were not especially large, regional differences in living costs produced a much greater variation in real wages. For the South, where nominal wages were lower, and the two western cities, where they were higher, adjustment for cost-of-living differences did reduce real wage differentials.

Employment data directly comparable to the wage data do not exist. Instead, it was necessary to use data on average industrial employment reported in the 1890 Census of Manufactures, which are available by city for industries closely corresponding to those included in the wage study.[10] These figures include workers in a variety of occupations, but

[6] The industrial and occupational coverage of the study was dictated largely by the need to consider comparable occupations throughout the country.

[7] Inspection of price indices in Michael R. Haines, "A State and Local Consumer Price Index for the United States in 1890," *Historical Methods*, 22 (Summer 1989), pp. 97–105, suggests that variations in the cost of food were highly correlated with variations in a broader basket of goods.

[8] U.S. Congress, Senate, *Retail Prices and Wages*, Senate Report No. 986, 52nd Cong., 1st sess. (Washington, DC, 1892).

[9] Philip R. P. Coelho and James F. Shepherd, "Regional Differences in Real Wages: the United States, 1851–1880," *Explorations in Economic History*, 13 (Apr. 1976), pp. 203–30; and Rosenbloom, "One Market or Many?"

[10] The census industries used were (with the occupations to which they were matched in parentheses) blacksmithing and wheelwrighting (blacksmiths); foundry and machine shop products (pattern makers, iron molders, machinists, and boilermakers); carpentering (carpenters); masonry, brick, and stone (bricklayers); painting and paperhanging (painters); plumbing and gas fitting (plumbers). The sum of employment in all the building trades was used as a proxy for employment of building trades laborers, and employment of foundry and machine shop laborers was measured as the sum of employment in foundry and machine shop products and architectural ironwork. The manufacturing census data are preferred to occupation statistics from the population census because workers reporting a particular occupation may well have been employed in industries other than those included in the wage data, and because at least in more recent times the labor market appears to be segmented along industrial as well as occupational lines.

TABLE 1
AVERAGE HOURLY WAGES AND THE COST OF LIVING, 1890

City	Wages (cents per hour)						Cost of Living (U.S. = 100)
	Laborers		Skilled Building Trades		Skilled Foundry and Machine Shop		
	N	R	N	R	N	R	
East							
Albany	15.7	15.6	26.9	26.7	26.7	26.5	100.6
Baltimore	13.9	14.0	32.6	32.8	23.5	23.6	99.4
Boston	16.8	15.9	35.2	33.3	27.8	26.3	105.6
Brooklyn	14.3	12.4	43.8	38.0	26.7	23.2	115.2
Buffalo	14.6	15.4	27.9	29.4	23.8	25.1	94.9
Hartford			40.9	39.1	30.2	28.8	104.7
Jersey City			32.0	29.9			101.0
Lynn			35.3	30.9			114.4
Newark			31.9	31.6	25.5	25.2	101.0
New Haven			30.9	30.0	26.9	25.7	104.7
New York	16.0	14.0	43.4	38.0	28.6	25.0	114.2
Paterson			27.0	23.8			113.6
Philadelphia	15.6	13.8	34.4	30.5	26.0	23.0	112.8
Pittsburgh	14.9	15.7	35.7	37.6	26.3	27.7	94.9
Providence	12.8	12.3	28.1	27.0	25.6	24.6	103.9
Reading			21.1	19.4			108.7
Rochester	15.2	15.1	25.4	25.3	23.2	23.1	100.6
Scranton			18.7	18.0			103.7
Syracuse			20.9	20.8			100.6
Washington	20.8	19.3	41.5	38.6			107.4
Average	15.5	14.9	31.7	30.0	26.2	25.2	105.4
Midwest							
Chicago	16.1	17.0	40.6	43.0	28.6	30.3	94.3
Cincinnati			35.8	37.4	23.8	24.9	95.7
Cleveland	13.6	14.4	30.3	32.0	23.6	24.9	94.5
Detroit	14.3	16.7	28.7	33.5	23.0	26.8	85.7
Grand Rapids			33.3	40.5			82.2
Indianapolis	14.5	14.6	34.9	35.1	23.6	23.7	99.5
Kansas City, MO			36.3	38.1			95.0
Milwaukee	13.5	14.1	29.5	30.7	24.7	25.6	96.3
Minneapolis			27.8	31.6			88.1
St. Louis	16.8	19.0	37.5	42.3	27.7	31.3	88.6
St. Paul	17.0	19.3	33.6	38.1	28.3	32.1	88.1
Average	15.1	16.4	33.5	36.6	25.4	27.5	91.6
South							
Atlanta	11.1	11.4	19.4	19.8	28.0	28.6	97.8
Charleston			20.8	22.1	25.4	27.0	94.1
Louisville	14.2	15.8	33.3	36.9	25.9	28.7	90.2
Memphis	14.8	15.1	36.7	37.5	30.0	30.7	97.8
Nashville	10.5	10.7			28.3	28.8	98.0
New Orleans	15.8	16.3	30.9	32.0	30.5	31.6	96.6
Richmond			24.6	25.8	21.7	22.7	95.6
Average	13.3	13.9	27.6	29.0	27.1	28.3	95.7
West							
Denver			43.8	40.6			107.9
San Francisco	19.2	15.8	44.9	36.9	34.4	30.8	116.2
Average	19.2	15.8	44.4	38.8	34.4	30.8	114.8

Notes: Wage rates for each occupation group are an unweighted average of those reported for each occupation in the group. N equals nominal wages; R equals real wages.
Sources: U.S. Department of Commerce and Labor, *Eighteenth and Nineteenth Annual Reports of the Commissioner of Labor* (Washington, DC, 1904–1905).

as long as the proportion of workers in each one is relatively stable across cities, total industry employment can be used as a proxy for intercity differences in employment in the occupations included in the wage study.

A MODEL OF LOCAL WAGE RATE DETERMINATION

The process of urban growth reflects the combined location decisions of employers and workers. Although economic theory posits that both employers and workers are influenced in part by intercity differences in wage rates, other factors also appear likely to affect their choices. Throughout the nineteenth century, favorable access to transportation and low-cost raw materials encouraged a movement of manufacturing establishments into relatively labor-scarce regions of the Midwest.[11] Superimposed onto this broad regional redistribution, however, were pronounced variations in the fortunes of particular urban places. While locational advantages help account for these differences, geographers and urban historians have suggested that persistent differences in rates of growth were reinforced by feedback effects, through which rapid growth at a particular location stimulated local demand and encouraged the further expansion of economic activity.[12]

In a competitive market, profit-maximizing employers at each location will seek to hire labor until its marginal product is just equal to the wage rate divided by the product price. Rewriting the marginal productivity condition, the demand for labor may be expressed as a decreasing function of the local wage rate. The position of the labor demand schedule will be shifted by anything that affects the productivity of labor. One such factor is the relative abundance of the other inputs into the production process. Others, which appear particularly important in the nineteenth-century context, are site-specific factors arising either because of the initial advantages conferred by differential access to transportation and raw materials or through advantages attained as the result of past growth. Taking these various forces into account, the demand for labor (L^d) in occupation i and city j can be written as

$$L_{ij}^{d} = F(W_{ij}/P_{ij}, X_{ij}, Z_j) \tag{1}$$

[11] Douglass C. North, "Locational Theory and Regional Economic Growth," *Journal of Political Economy*, 43 (June 1955), pp. 243–58. Jeffrey G. Williamson, in *Late Nineteenth-Century American Development: A General Equilibrium History* (Cambridge, 1974), pp. 21–51, offers an alternative but related characterization of midwestern growth.

[12] On the rate and variability of urban growth, see Carl H. Madden, "On Some Indications of Stability in the Growth of Cities in the United States," *Economic Development and Cultural Change*, 4 (Apr. 1956), pp. 236–52, and Carl H. Madden, "Some Spatial Aspects of Urban Growth in the United States," *Economic Development and Cultural Change*, 4 (July 1956), pp. 371–87. The determinants of differential urban growth rates are discussed in Allan Pred, *The Spatial Dynamics of U.S. Urban-Industrial Growth, 1880–1914: Interpretive and Theoretical Essays* (Cambridge, MA, 1966); and David R. Meyer, "Midwestern Industrialization and the American Manufacturing Belt in the Nineteenth Century," this JOURNAL, 49 (Dec. 1989), pp. 921–38.

where W_{ij} is the wage rate of occupation i in city j; P_{ij} is the price of output produced by occupation i in city j; X_{ij} is a vector of other inputs used in conjunction with occupation i in city j; and Z_j is a vector of site-specific factors affecting labor productivity in city j.

Two problems arise in connection with this formulation. First, the Z_j variables are not directly observable. However, the presence of site-specific advantages is likely to be reflected in the past growth experience of the place. Furthermore, rapid growth may itself have been a factor encouraging continued growth, through its effects on urban externalities. Two measures of past growth may be derived from census data: the growth in population from 1880 to 1890 (*POPGRW*) and the growth in the value of manufacturing production over the same period (*MANGRW*).

The second problem is that the X_{ij} variables are not exogenous, because the demand for labor is determined simultaneously with the demand for other inputs. One solution would be to replace X_{ij} with a vector of the market-determined prices of the other inputs. However, reliable data on spatial variation in these prices are scarce. As a result I had to use a measure of the physical quantity of the other inputs: expenditures on raw materials (*OTHINPUT*).[13] Although this raises the problem of endogeneity, the dominant role of site-specific advantages in determining urban growth rates suggests that access to cheap sources of labor or other mobile inputs was of limited importance in this period. To the extent that endogeneity is a problem, however, the substitution of other inputs for labor in high-wage locations would introduce a negative bias into the estimates of this "demand-shift" effect, so the test for the sign of this variable should be especially revealing.

As manufacturing shifted into the Midwest, wages were pushed up, attracting additional labor. However, the response of workers to the incentive of higher wages was mediated by the mechanisms through which they learned of and acted on this information. In particular, the cost of gathering information about earnings differentials, the social and psychic costs of moving, and the direct expenses of transportation all may have influenced migrants' choices of destination. In the nineteenth century, as today, most labor market information was transmitted through informal networks of friends and relatives. As a result, once an immigrant community had become established, information costs for subsequent migrants lessened. The presence of immigrant communities

[13] The census also reports the value of the capital stock and total revenues. The capital stock data appear to be unreliable, as there were no common standards for valuing equipment or adjusting for depreciation. Total revenue offers a more plausible alternative to the raw materials variable used here. Presumably, the lower elasticity of substitution characterizing the relationship of materials to fixed capital would make materials a better proxy than total revenue for all nonlabor inputs into the production function. In practice, expenditures on raw materials and total revenue are highly correlated and yield nearly identical results in the estimates reported hereafter.

may also have reduced the social and psychic costs of moving to an unfamiliar location. Differences in transportation costs appear less likely to have influenced migration decisions, as passenger fares were low relative to real wage differentials.[14]

In addition to these exogenous influences on migration, the size of the locally available pool of labor may have varied with industrial composition across cities. Workers with the requisite skills to enter the occupations represented in the wage study were employed by industries other than those surveyed in that study. Employers of unskilled labor were ubiquitous, but skilled workers also found employment in a variety of industries.[15]

The preceding discussion suggests that in addition to mirroring real wages, local labor supply will reflect a city's differential access to potential migrants and variations in its employment base. Incorporating these exogenous influences, the supply of labor in occupation i and city j may be written as

$$L_{ij}^{s} = G(W_{ij}/P_j^*, U_{ij}, V_j) \tag{2}$$

where P_j^* is the cost of living in city j, U_{ij} is a vector of variables measuring the size of the locally available pool of labor for occupation i, and V_j is a vector of variables intended to capture the effects of information and of psychic and social costs on potential immigrants to city j.

Completely satisfactory data to implement equation 2 are not available, but several plausible measures can be constructed from census data. The effects of industrial composition on the locally available labor supply are proxied by the number of gainfully occupied persons giving occupation i as their primary employment in the 1890 population census (*LFORCE*).[16] Although differential information or psychic costs of

[14] Theoretical determinants of migration are discussed in Philip Nelson, "Migration, Real Income and Information," *Journal of Regional Sciences*, 1 (Spring 1959), pp. 43–73; and Flora Gill, "Economics and the Black Exodus: An Analysis of Negro Emigration from the Southern United States" (Ph.D. diss., Stanford University, 1974). On the historical importance of friends and relatives, see Charlotte Erickson, *American Industry and the European Immigrant, 1860–1885* (Cambridge, MA, 1957); and James A. Dunlevy and Henry A. Gemery, "Economic Opportunity and the Responses of 'Old' and 'New' Migrants to the United States," this JOURNAL, 38 (Dec. 1978), pp. 901–18. These scholars found that migrant stock was an important determinant of immigrant destinations in the 1890s. For additional references, see Joshua L. Rosenbloom, "Padrones, Employment Agencies, and Labor Exchanges: An Examination of the Methods of Labor Market Adjustment in the Late Nineteenth Century United States" (Research Paper in Theoretical and Applied Economics No. 90-1, University of Kansas, 1990). Evidence on railroad rates is from Rosenbloom, "One Market or Many?" p. 121.

[15] Skilled metalworkers were employed in railroad repair shops and agricultural implements manufacturing as well as in foundry and machine shops. Building trades workers—especially carpenters, painters, and plumbers—were often employed in manufacturing establishments.

[16] It could be argued that *LFORCE* should be used as the measure of labor supply in the model rather than as an exogenous variable. The rationale for choosing manufacturing employment as the

migration are not directly observable, other studies have suggested that the size of the existing immigrant community may have reduced those costs. Thus the fraction of gainfully employed foreign-born persons (*FORBORN*) is included in the regression.

If demand and supply are approximated as linear functions, the model becomes

$$L_{ij}^{d} = a_0 + a_1 W_{ij} - a_1 P_{ij} + a_2 OTHINPUT_{ij} + a_3 POPGRW_{ij} + a_4 MANGRW_j + e_{1ij} \quad (3)$$

$$L_{ij}^{s} = b_0 + b_1 W_{ij} - b_1 P_j^* + b_2 LFORCE_{ij} + b_3 FORBORN_j + e_{2ij} \quad (4)$$

where the a_i's and b_i's are coefficients and e_{1ij} and e_{2ij} are random error terms. The model is closed by assuming that the labor market is in equilibrium, with labor supply equal to labor demand, and by setting both of them equal to employment. The assumption that local labor markets are in equilibrium is, of course, an approximation. However, the general absence of internal labor markets and formal labor management bargaining, with their attendant rigidities, suggests that wages should have been more responsive to contemporaneous labor market conditions than they are today.[17]

ESTIMATES OF LABOR SUPPLY ELASTICITIES

The specification of equation 3 requires information on geographic variations in the prices received by producers, which is not generally available. In the absence of these data, equation 3 was estimated by excluding P_{ij}. This is equivalent to assuming that employers operated in an (effectively) national market and thus received the same price for their output no matter where they were.[18] Because of the endogeneity of wages in equations 3 and 4, I estimated them simultaneously using instrumental variables techniques, in which the instruments include all the exogenous variables from both equations. Equation 3 was estimated by imposing the restriction that the coefficient on wages and prices be equal in magnitude but opposite in sign. Tables 2 and 3 report the

quantity variable is discussed in fn. 10. Preliminary exploration of alternative specifications suggests that *LFORCE* measures something very different from industry employment.

[17] It is worth noting that the assumption that wages adjust to achieve local labor market equilibrium is also necessary to interpret the magnitudes of wage differentials as evidence for the extent of geographic integration. For anecdotal evidence on labor market adjustment, see Robert Ozanne, *A Century of Labor Management Relations at McCormick and International Harvester* (Madison, 1967), pp. 14–33.

[18] An alternative is to assume that the prices received by producers varied in the same way as retail prices did. Estimates of the model in this form are qualitatively quite similar to those reported below. As the truth probably lies somewhere between these two extremes, it may be concluded that the results are robust to different specifications of the impact of product prices on labor demand.

TABLE 2
INSTRUMENTAL VARIABLE ESTIMATES OF LABOR SUPPLY

Occupation	Constant	*W/P*[a]	*LFORCE*	*FORBORN*	R^2-Adj.	*N*
Unskilled Labor						
Building trades	2.12	1.96	1.00[b]	1.66	0.81	16
	(3.46)	(1.43)	(0.21)	(1.11)		
Foundry and machine shop	6.15	1.50	0.42[b]	2.65[b]	0.80	19
	(3.86)	(1.43)	(0.18)	(0.94)		
Combined[d]	5.56[c]	2.23[c]	0.68[b]	1.87[b]	0.74	35
	(3.25)	(1.30)	(0.15)	(0.81)		
Skilled Foundry and Machine Shop Labor						
Blacksmiths	1.26	2.16[c]	1.05[b]	0.04	0.86	23
	(1.55)	(1.22)	(0.11)	(0.64)		
Pattern makers	3.95[c]	1.28	0.81[b]	−0.24	0.88	25
	(2.14)	(1.77)	(0.10)	(0.90)		
Iron molders	2.49	0.03	0.77[b]	0.04	0.85	23
	(2.67)	(2.30)	(0.13)	(0.91)		
Machinists	4.14[b]	3.04[c]	1.17[b]	−0.96	0.85	27
	(1.82)	(1.64)	(0.15)	(0.80)		
Boilermakers	4.77[b]	1.19	0.57[b]	2.40	0.88	11
	(1.87)	(1.61)	(0.18)	(1.47)		
Combined[e]	2.57[b]	2.36[b]	0.91[b]	−0.24	0.90	109
	(1.04)	(0.90)	(0.06)	(0.37)		
Skilled Building Trades Labor						
Carpenters	−32.86[c]	−12.26[c]	2.99[b]	−0.24	0.22	31
	(18.65)	(7.13)	(1.22)	(2.12)		
Bricklayers	−1.26	−0.96	1.06[b]	0.51	0.46	26
	(2.83)	(2.24)	(0.26)	(1.32)		
Painters	−11.70[b]	−4.93[c]	1.54[b]	1.13	0.67	31
	(5.09)	(2.56)	(0.27)	(1.27)		
Plumbers	1.22	0.23	0.85[b]	−0.30	0.80	28
	(1.25)	(0.74)	(0.11)	(0.64)		
Combined[f]	−7.25[b]	−3.09[b]	1.27[b]	0.41	0.65	116
	(2.64)	(1.26)	(0.14)	(0.51)		

[a] To obtain an estimate of the effect of real wages on labor supply, the coefficients on log wages and log prices were constrained to be equal in magnitude but opposite in sign.
[b] Statistically significant at the 95 percent confidence level.
[c] Statistically significant at the 90 percent confidence level.
[d] The combined regression includes a separate intercept term for foundry and machine shop workers that is not reported here.
[e] The combined regression includes separate intercept terms for pattern makers, iron molders, machinists, and boilermakers that are not reported here.
[f] The combined regression includes separate intercept terms for bricklayers, painters, and plumbers that are not reported here.
Notes: Numbers in parentheses are standard errors. All coefficient estimates were obtained using instrumental variables techniques, in which the list of instruments included all the exogenous variables from equations 3 and 4 in the text.
Sources: U.S. Department of Commerce and Labor, *Eighteenth and Nineteenth Annual Reports of the Commissioner of Labor* (Washington, DC, 1904–1905); U.S. Department of the Interior, Census Office, *Eleventh Census, 1890*, "Report on Population of the United States," part 2 and "Report on Manufacturing Industries in the United States," part 2: Statistics of Cities (Washington, DC, 1897, 1895); U.S. Department of the Interior, Census Office, *Twelfth Census, 1900*, "Abstract" (Washington, DC, 1901).

TABLE 3
INSTRUMENTAL VARIABLE ESTIMATES OF LABOR DEMAND

Occupation	Constant	*W*	*OTHINPUT*	*MANGRW*	*POPGRW*	R^2-Adj.	*N*
Unskilled Labor							
Building trades	−7.93[a]	−0.93	0.98[a]	−0.19	0.00	0.98	16
	(2.24)	(0.84)	(0.05)	(0.26)	(0.26)		
Foundry and machine shop	−5.14	−0.22	0.88[a]	0.09	−0.27	0.98	19
	(3.14)	(1.05)	(0.08)	(0.29)	(0.55)		
Combined[c]	−3.49	0.57	0.87[a]	−0.30	0.21	0.97	35
	(4.27)	(1.55)	(0.09)	(0.33)	(0.47)		
Skilled Foundry and Machine Shop Labor							
Blacksmiths	−4.45[a]	−0.35	0.86[a]	−0.12	0.05	0.97	23
	(0.68)	(0.38)	(0.03)	(0.15)	(0.16)		
Pattern makers	−4.32[a]	0.24	0.89[a]	−0.18	−0.22	0.97	25
	(1.00)	(0.58)	(0.04)	(0.18)	(0.19)		
Iron molders	−4.88[a]	0.17	0.91[a]	−0.08	−0.22	0.97	23
	(1.24)	(0.78)	(0.04)	(0.19)	(0.21)		
Machinists	−5.87[a]	−0.62	0.91[a]	−0.12	−0.16	0.98	27
	(0.83)	(0.51)	(0.03)	(0.14)	(0.16)		
Boilermakers	−5.20[b]	−0.02	0.93[a]	−0.28	−0.29	0.96	11
	(2.50)	(0.92)	(0.11)	(0.36)	(0.68)		
Combined[d]	−4.46[a]	−0.09	0.90[a]	−0.15[a]	−0.12	0.99	109
	(0.43)	(0.27)	(0.02)	(0.07)	(0.08)		
Skilled Building Trades Labor							
Carpenters	−4.71[a]	0.44	0.89[a]	−0.03	−0.04	0.95	31
	(0.92)	(0.32)	(0.04)	(0.13)	(0.15)		
Bricklayers	−5.96[a]	−0.69	0.90[a]	−0.01	0.21	0.89	26
	(1.32)	(1.05)	(0.07)	(0.25)	(0.34)		
Painters	−4.41[a]	0.36	0.92[a]	−0.22[b]	0.04	0.97	31
	(0.97)	(0.43)	(0.04)	(0.11)	(0.15)		
Plumbers	−3.57[a]	0.98[b]	0.86[a]	−0.27[b]	−0.40[b]	0.95	28
	(1.29)	(0.50)	(0.06)	(0.14)	(0.22)		
Combined[e]	−5.05[a]	0.34	0.91[a]	−0.16[b]	0.03	0.94	116
	(0.70)	(0.29)	(0.03)	(0.08)	(0.11)		

[a] Statistically significant at the 95 percent confidence level.
[b] Statistically significant at the 90 percent confidence level.
[c] The combined regression includes a separate intercept term for foundry and machine shop workers that is not reported here.
[d] The combined regression includes separate intercept terms for pattern makers, iron molders, machinists, and boilermakers that are not reported here.
[e] The combined regression includes separate intercept terms for bricklayers, painters, and plumbers that are not reported here.
Notes and Sources: See Table 2.

parameters of labor supply and demand for each occupation separately as well as pooled into three occupation groups: unskilled labor, skilled foundry and machine shop labor, and skilled building trades labor. Because wages and prices are assumed to enter the supply equation symmetrically, Table 2 reports a single coefficient for real wages. The

dependent variable in each case is the natural logarithm of employment reported by the manufacturing census for the industry category corresponding to occupation *i*. All the other variables except *POPGRW* and *MANGRW* are also measured in logarithms, so the coefficients may be interpreted as elasticities.

The model appears to provide a plausible description of the labor market.[19] Among the exogenous variables, only the size of the labor force (*LFORCE*) and raw materials expenditures (*OTHINPUT*) variables are statistically significant.[20] The insignificance of the variables included to capture site-specific effects (*POPGRW* and *MANGRW*) may simply indicate that their effects are already captured by *OTHINPUT*. That the fraction of foreign-born (*FORBORN*) proves insignificant may be because the foreign-born, who made up a large part of the mobile labor force, tended to concentrate in the most rapidly growing cities—which were also most likely to have high wages.

My primary concern is the responsiveness of labor supply and demand to intercity variations in wages. Looking first at the supply equation, the coefficient on wages has the expected positive sign in seven of the eleven occupations considered, though in most cases the estimated values are not significantly different from zero. Interestingly, all the negative coefficients occur in the equations for the skilled building trades. The difference across occupational groups may be seen more clearly in the combined estimates. The wage coefficients estimated for the two groups of skilled labor are significantly different from zero at the 95 percent level, those for unskilled labor at the 90 percent level. Whereas those for unskilled labor and skilled foundry and machine shop labor are positive, the coefficient for skilled building trades labor is negative. Thus it appears that local labor supply was responsive to intercity wage differentials among unskilled workers and skilled foundry and machine shop workers—but not for workers in the skilled building trades.

By assuming a common labor supply elasticity, equation 4 imposes the assumption that all cities faced the same labor supply conditions. Whereas this appears to be plausible for northeastern and midwestern cities, employers in southern and western cities may have faced quite

[19] For simultaneous equation systems, R^2 may not be an appropriate measure of goodness of fit. A more reliable indication of the model's accuracy is the fit of the reduced form equations that it implies. For the wage equation, R^2 values range from about 0.2 to 0.6, suggesting that the model does indeed account for a considerable fraction of intercity wage variation.

[20] The strong positive correlation between raw materials expenditures and labor demand indicates that the potential endogeneity bias noted earlier is not, in fact, particularly severe. The availability of alternative local sources of labor appears to have been a particularly important influence on labor supply. Although *LFORCE* is highly correlated with city size (as measured by the number of gainfully employed workers in all occupations), substituting that variable for *LFORCE* would alter the estimated coefficient values considerably, eliminating all the positive wage elasticities in Table 2.

different external sources of labor supply. To more precisely assess the geographic scope of market integration the model was re-estimated, allowing the supply elasticity for northeastern and midwestern cities to take a different value from that for southern and western cities.[21] Allowing for regional differences in labor supply elasticities reduces the coefficient on wages for unskilled labor and skilled foundry and machine shop labor, but it increases responsiveness in the skilled building trades to the extent that labor supply elasticities within each of the regions becomes positive. While the supply elasticity in the northeastern and midwestern cities is still not statistically significant, this result suggests there may have been some measure of within-region integration in the building trades.[22] This interpretation is consistent with the evidence in Table 1 that North-South real wage differentials were considerably larger in the skilled building trades than in other occupations.

In the labor demand equation, six of the occupations have the expected negative wage coefficient. While several of the negative coefficients are significant, none of the positive ones is significant at standard confidence levels. Again, the equations for the skilled building trades account for most of the unexpected wage coefficients. Although labor demand for at least some occupations was sensitive to intercity differences in real wages, the overall impression given by these estimates is consistent with the view that labor demand was determined largely by nonwage factors.

CONCLUSION

The most striking feature to emerge from this examination is the clear difference in labor supply behavior between the skilled building trades and the other groups of workers considered. Whereas a model in which local labor supply was responsive (albeit imperfectly) to local wage levels appears to accurately describe the markets for unskilled labor and for skilled foundry and machine shop labor, that model seems appropriate for the skilled building trades only at a regional level. And even then, the supply response to wage differentials is not statistically significant. Possibly the lack of interregional integration in the building trades reflects the greater influence of organized labor in the construction industry. So-called national unions, whose membership was confined primarily to northern cities, may have facilitated the movement of skilled construction workers within the Northeast and Midwest but

[21] Because of the small number of southern and western cities in the sample, it was not possible to estimate separate labor supply elasticities for each of these regions.

[22] The labor supply elasticities within the Northeast and Midwest were (with standard errors in parentheses) skilled building trades, 2.32 (3.22); skilled foundry and machine shop trades, 0.02 (1.21); and unskilled labor, 0.34 (1.13). Interaction effects between real wages and a dummy for cities outside the Northeast and Midwest were skilled building trades, 4.36 (1.59); skilled foundry and machine shop trades, −1.11 (0.39); and unskilled labor, 0.95 (0.24).

blocked the entry of nonmembers from the low-wage South, thus preventing greater interregional arbitrage. It is also possible that lower southern wages reflected a systematic regional difference in skill levels that served to further inhibit the emergence of a national market for building trades workers.