

A NOTE ON REGIONAL NONAGRICULTURAL EMPLOYMENT

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Introduction

In recent years, the popular press has given the impression that massive shifts in nonagricultural employment have occurred, predominantly from the industrial North to the Sunbelt. This note investigates the impact of these shifts upon regional employment patterns at various industry levels and specifically examines the hypothesis that industry employment has become more evenly distributed among regions.

Table 1 provides data on the major changes that took place between 1960 and 1980 for various industry divisions (construction; manufacturing; transportation and public utilities; wholesale and retail trade; finance, insurance and real estate; service and miscellaneous; and government) in the nine geographic census regions of the United States. Total U.S. employment for the 20-year period increased by 69.1 percent but the growth is unevenly distributed among the geographic areas. The Mountain region, with an increase of 132 percent, enjoyed the largest gain, followed by the West South Central region with 110 percent. The Middle Atlantic region lagged behind with a growth rate of only 25.5 percent. This diverse growth pattern is also evident in the comparison of specific industries. For instance, in manufacturing, the Mountain region's gain is 115 percent, while the Middle Atlantic's loss is approximately 14 percent. Similar variations may be observed in other industrial sectors.

Has the rapid growth of industries in regions of the South and West, coupled with diminishing activity in the Northeast and North Central regions had a homogenizing effect on employ-

ment opportunities in the major industrial sectors? The hypothesis that nonagricultural employment patterns have become less differentiated as a result of the uneven growth rates between 1960 and 1980 is examined empirically in the note.

Methodology

Analysis of variance techniques were applied to data from the *Statistical Abstract of the United States*, selected at five-year intervals between 1960 and 1980. Typically, measurements or observations used in analysis of variances are gathered from experimental results such as in agricultural, biological, or marketing research. However, economic data which arise from nonexperimental activities may also be analyzed by means of analysis of variance methodology (Iverson and Norpoth, 1976, p. 6). Two hypotheses are tested by means of a one-way classification model:

- (1) For each industry sector, the nine geographic regions are tested for equality of means. The hypothesis of equality of means implies that employment opportunities are homogeneous in all regions for that particular industrial division. If the hypothesis is rejected, the implication is that at least one region differs substantially from the others.
- (2) The second null hypothesis tested is that no changes occurred in the industry sector means during the period 1960-80. If this hypothesis can be rejected, the implication is that sectoral employment patterns for the country as a whole have changed.

The data used in the computations are shown in Table 2. Since the magnitude of employment in each region for each sector differs considerably, it was necessary to express the data in terms of a total per hundred observations. The computations necessary for the first hypothesis are undertaken by rows for each geographic region within industrial sectors, while the computations for the second

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Table 1
Relative Nonagricultural Employment Change: 1960-1980 by Geographic Region and by Industry^a
(Numbers in Thousands)

Region	Total	Construction	Manufacturing	Transportation and Public Utilities	Wholesale and Retail Trade	Finance, Insurance & Real Estate	Service and Miscellaneous	Government
Industry 1960								
United States	52898	2772	16337	3902	11642	2485	7302	8458
New England	3697	163	1445	202	709	186	524	469
Middle Atlantic	11914	524	4128	911	2325	728	1792	1508
East North Central	11486	529	4460	796	2311	480	1420	1493
West North Central	4155	238	996	375	1012	206	615	716
South Atlantic	7183	456	2030	504	1511	329	1011	1347
East South Central	2739	145	840	182	568	109	394	503
West South Central	4243	275	820	386	1047	194	745	777
Mountain	1865	140	262	166	435	81	372	415
Pacific	6298	389	1695	473	1392	309	888	1154
Industry 1980								
United States	89456	4399	20300	5143	20386	5168	17901	16249
New England	5474	184	1523	238	1167	329	1203	830
Middle Atlantic	14954	508	3562	887	3134	1018	3278	2567
East North Central	16738	650	4715	858	3765	870	3122	2758
West North Central	6850	306	1379	436	1709	373	1361	1286
South Atlantic	14510	853	3042	810	3229	774	2731	3071
East South Central	5041	250	1364	267	1074	221	823	1042
West South Central	8912	664	1662	602	2214	499	1601	1670
Mountain	4327	291	564	277	1055	242	964	934
Pacific	13005	602	2560	742	3040	824	2793	2444
Percentage Change								
United States	69.1	58.7	24.3	31.8	75.1	108.0	145.2	92.1
New England	48.1	12.9	5.4	17.8	64.6	76.9	129.6	77.0
Middle Atlantic	25.5	-3.1	-13.7	-2.6	34.8	40.2	82.9	70.2
East North Central	45.7	22.9	5.7	7.8	62.9	81.3	119.9	84.7
West North Central	64.9	28.6	38.5	16.3	68.9	81.1	121.3	79.6
South Atlantic	103.3	87.1	49.9	60.7	113.7	135.3	170.1	128.0
East South Central	84.0	72.4	62.4	46.7	89.1	102.8	108.9	107.2
West South Central	110.0	141.5	102.7	56.0	111.5	157.2	114.9	114.9
Mountain	132.0	107.9	115.3	66.9	142.5	198.8	159.1	125.1
Pacific	106.5	54.8	51.0	56.9	118.4	166.7	214.5	111.8

^a National totals differ from the sum of the state figures because some states have more recent benchmarks and because the stratification of industries differs among states.

Source: U.S. Bureau of the Census, *Statistical Abstract of the United States*. (Washington, D.C.: U.S. Government Printing Office, various years).

analysis are by columns for the specified years within each industry sector.

In the analysis of variance technique, the hypothesis is stated in terms of equality of means. The significance test, however, is conducted in terms of the variances of the respective means. This approach is an extension of the testing procedure for the equality of two means. The proper test statistic for the null hypothesis is the F-distribution. The hypothesis of equal means will be rejected when the computed F-value is greater than $F_{1-\alpha, k-1, n-k}$ for a test whose significance level is α . Here k denotes the number of means being considered and n is the total number of observations.

Testing for Homogeneity of Employment in Different Regions

With respect to the first hypothesis, which considers the question of whether or not

various industrial employment opportunities differ from region to region, the computed F values ranged from 3.69 to 22.90. The proper critical values of F are:

$$F_{.95, 8, 36} = 2.21$$

or

$$F_{.99, 8, 36} = 3.04.$$

The null hypothesis must be rejected in every case, since all computed F-ratios exceed the critical values for $\alpha = .05$ and $\alpha = .01$. Therefore, it must be concluded from the test results that employment opportunities in the various industrial sectors for the nine geographic regions of the United States are not homogeneous, despite the trends of the last two decades.

While overall regional homogeneity of employment does not appear to exist, it is possible that employment patterns in some industrial sectors do not vary between the dif-

Table 2

Nonagricultural Employment per 100 employees by Geographic Region and Industrial Division 1960-1980
(Five-Year Intervals)

Region	Contract Construction					Manufacturing					Transportation & Public Utilities				
	1960	1965	1970	1975	1980	1960	1965	1970	1975	1980	1960	1965	1970	1975	1980
New England	4.4	4.6	4.5	3.6	3.4	39.1	36.5	32.1	27.9	27.8	5.5	5.0	5.0	4.6	4.3
Middle Atlantic	4.4	4.2	4.1	3.5	3.4	34.7	32.8	29.5	25.1	23.8	7.7	7.1	6.7	6.2	5.9
East North Central	4.6	4.4	4.0	3.7	3.9	38.8	38.0	34.6	30.4	28.1	6.9	6.1	5.8	5.4	5.1
West North Central	5.7	5.4	4.7	4.4	4.5	24.0	23.4	22.9	20.5	20.1	9.0	7.7	7.1	6.5	6.4
South Atlantic	6.3	6.7	6.1	5.7	5.9	28.3	27.4	25.6	22.0	21.0	7.0	6.3	6.3	5.8	5.6
East South Central	5.3	5.8	5.0	5.1	5.0	30.7	31.5	32.1	28.1	27.1	6.6	5.9	5.5	5.2	5.3
West South Central	6.5	6.7	6.0	6.2	7.5	19.3	19.6	20.3	18.4	18.6	9.1	7.9	7.2	6.7	6.8
Mountain	7.5	6.3	5.6	5.9	6.7	14.0	13.3	13.7	12.3	13.0	8.9	7.7	6.8	6.3	6.4
Pacific	6.2	5.5	4.5	4.1	4.6	26.9	24.1	22.0	19.7	19.7	7.5	6.8	6.7	6.1	5.7

Region	Wholesale & Retail Trade					Finance, Insurance and Real Estate				
	1960	1965	1970	1975	1980	1960	1965	1970	1975	1980
New England	19.2	19.3	20.5	21.6	21.3	5.0	5.1	5.5	5.9	6.0
Middle Atlantic	19.5	19.7	19.9	20.7	21.0	6.1	6.0	6.4	6.7	6.8
East North Central	20.1	19.7	20.6	21.9	22.5	4.2	4.3	4.4	4.7	5.2
West North Central	24.3	23.8	23.7	24.6	24.9	5.0	5.0	5.0	5.1	5.4
South Atlantic	21.0	20.6	20.8	21.6	22.2	4.6	4.7	4.8	5.4	5.3
East South Central	20.7	19.6	19.2	20.4	21.3	4.0	4.0	4.0	4.3	4.4
West South Central	24.7	23.7	23.0	23.8	24.8	4.6	4.9	5.0	5.5	5.6
Mountain	23.3	22.8	22.7	23.4	24.4	4.3	4.7	4.7	5.1	5.6
Pacific	22.1	22.1	22.2	22.8	23.4	4.9	5.4	5.4	5.7	6.3

Region	Service & Miscellaneous					Government				
	1960	1965	1970	1975	1980	1960	1965	1970	1975	1980
New England	14.2	16.0	18.2	20.3	22.0	12.6	13.5	14.2	16.1	15.2
Middle Atlantic	15.0	16.3	18.7	19.9	21.9	12.7	13.9	15.6	17.9	17.2
East North Central	12.4	13.6	15.0	17.4	18.7	13.0	13.7	15.6	16.5	16.5
West North Central	14.8	16.1	17.0	18.9	19.9	17.2	18.6	19.6	19.9	18.8
South Atlantic	14.1	14.9	15.8	18.1	18.8	18.7	19.4	20.6	21.4	21.2
East South Central	14.4	14.5	14.8	16.7	16.3	18.3	18.7	19.4	20.2	20.6
West South Central	17.5	18.4	19.0	19.9	18.0	18.3	18.8	19.5	19.5	18.7
Mountain	19.8	20.9	22.1	23.3	22.3	22.2	24.3	24.4	23.7	21.6
Pacific	14.1	16.2	18.2	20.1	21.5	18.3	19.9	21.0	21.5	18.8

Source: U.S. Bureau of the Census, *Statistical Abstract of the United States*. (Washington, D.C.: U.S. Government Printing Office, various years).

ferent regions. This possibility may be examined by using a statistical test involving linear contrasts, a procedure which systematically examines all possible pairs of group means. There are several methods that might be employed for this purpose, but the one deemed appropriate is Tukey's Multiple Range procedure (Hawkins and Weber, 1980, p. 333).

For ease of presentation of the results, the geographic regions are coded as follows:

1. New England
2. Middle Atlantic
3. East North Central
4. West North Central
5. South Atlantic
6. East South Central
7. West South Central
8. Mountain
9. Pacific

Table 3 presents the various possible subsets obtained by Tukey's Multiple Range procedure at $\alpha = .05$. Regions listed as belonging to a

common subset do not differ significantly in their means. However, regions not appearing in the same subset do have significantly different mean employment levels. For example, in the Contract Construction sector, Region 6 differs from Region 2, but it does not differ from Regions 1, 3, 4 and 9. Also, Region 5 differs from Regions 2, 1, 3 and 4, but it does not differ significantly from Regions 9 and 6. Although none of the sectors show homogeneous employment opportunities, it may be observed that two sectors, Service and Miscellaneous and Government, are much less diverse than the other sectors.

Testing for Differences in Employment Over Time

The second analysis examines the nature of employment patterns over time to determine if

employment concentration in each industrial sector has experienced a significant change during the two decades, 1960-80. More specifically, the null hypothesis is that no changes occurred in the industry sector means during the period 1960-80.

The statistical procedure adopted here is similar to the one used above. The results of the computed F values range between 1.27 and 7.98. On comparing these values with the critical values of

$$F_{.95,4,40} = 2.61,$$

or

$$F_{.99,4,40} = 3.83,$$

the null hypothesis of equal means is rejected only for the Transportation and Public Utilities and Service and Miscellaneous sectors for $\alpha = .05$, and only for the Transportation and Public Utilities sector for $\alpha = .01$. Acceptance of the null hypothesis for the majority of the sectors indicates that mean employment levels for these industries have not varied significantly in the 20-year period. This finding is contrary to the view that dramatic change has occurred in the make-up of nonagricultural employment. However, it is possible that within each geographic division, a shift in jobs

between one industry and another has occurred, yet the effect is being lost due to aggregating industries into sectors.

Concluding Remarks

On the basis of the statistical evidence presented in this note, the major conclusions are:

- (1) employment opportunities in the various industrial divisions are not yet homogeneous in all geographic regions, and
- (2) there has been no significant change in the sectoral employment make-up in the decades of the 1960s and 1970s.

These findings suggest that the employment shifts of the last two decades may have been more modest than the impression given by the popular press.

REFERENCES

- Hawkins, C. A. and J. E. Weber, *Statistical Analysis: Applications to Business and Economics*. New York: Harper & Row, 1980.
- Iversen, C. R. and H. Norpoth, *Analysis of Variance*. Sage University Paper series on Quantitative Applications in the Social Sciences, series no. 07-001. Beverly Hills and London: Sage Publications, 1976.

Table 3

Homogenous Subsets of Geographic Regions by Industry Sector^a

Contract Construction	2	1	3	4	9				
		1	3	4	9	6			
					9	6	5		
						6	5	8	
Manufacturing	8	7							
		7	4	9	5				
				9	5	2			
					5	2	6		
						2	6	1	3
Transportation and Public Utilities	1	6	3	5					
		6	3	5	9	2	8		
			3	5	9	2	8	4	
Wholesale and Retail Trade	2	6	1	3	5				
				3	5	9			
						9	8	7	
Finance, Insurance and Real Estate	6	3	8						
		3	8	5	4	7			
			8	5	4	7	1	9	
Service and Miscellaneous	6	3	5	4	9	1	2		
							2	7	
Government	1	3	2						
				4	7	6	9	5	

^a: The mean employment levels of the regions are in ascending order of magnitude. For example, within manufacturing, Region 8 has a lower mean employment level than Region 7.