Geographic concentration of trade-sensitive employment

Manufacturing industries that are greatly involved in international trade are more geographically concentrated than those that are not, with export-sensitive industries generally located in different regions than import-sensitive industries; trade-related displacements are also geographically concentrated

Robert C. Shelburne
and
Robert W. Bednarzik

U.S. manufacturing activity, both in general and for specific industries, has a tendency to concentrate in certain geographic areas. The phenomenon was described as early as 1900 and 1905 in the Census of Manufactures.[1] An implication of such clustering is that reemployment is likely to be more difficult when a worker loses a job in an industry that is geographically concentrated.

This article provides some estimates of geographic clustering by industrial sector and shows how certain industry characteristics are related to geographic concentration. It also discusses some uses for the estimates in understanding labor market adjustment problems in industries that are intensively involved in international trade.

Methodology and data

We estimated geographic concentration of employment by industry using a Gini coefficient, a useful summary measure of the degree of concentration of a variable.[2] If employment in a sector is located in each State in the exact proportion to total State employment, then there is no tendency toward concentration in that sector, and the Gini coefficient is given a value of zero. If, however, all of the employment in an industry is located within one State, then the Gini would approach its upper limit of 1. The employment pattern in most industries falls somewhere in between these two extremes; thus, the Gini will be somewhere between 0 and 1. (See the appendix for how the Gini index we used was actually derived.)

The Gini coefficients were estimated using State employment data from the Employment and Wages (ES-202) program of the Bureau of Labor Statistics' Office of Employment and Unemployment Statistics. For the classification of industrial sectors, the Standard Industrial Classification (SIC), 1987 revision, was used. Calculations were made at the three-digit SIC level for 416 sectors and at the four-digit SIC level for 1,012 sectors. These represent the most comprehensive estimates available.[3]

Factors affecting concentration

To reveal how the basic pattern of geographic concentration is influenced by commodity characteristics, the two-digit SIC sectors are grouped into four major industrial divisions: agriculture (SIC's 01 to 09), mining (SIC's 10 to 14), manufacturing (SIC's 20 to 39), and services and construction (SIC's 15 to 17 and 40 to 99). The mean Gini coefficient for each grouping, using three- and four-digit SIC subgroupings, is presented in the following tabulation:

Robert C. Shelburne and Robert W. Bednarzik are senior economists in the Bureau of International Labor Affairs, U.S. Department of Labor.

	Mean Gini index	
	Three-digit	*Four-digit*
Agriculture	.582	.707
Mining	.797	.813
Manufacturing	.522	.607
Services and construction	.307	.351

The general pattern among the groups is similar, regardless of the level of aggregation; however, at the four-digit level, all of the groups exhibit more geographic concentration (that is, values closer to 1). As expected, mining is the most concentrated group: geological deposits are highly localized, and mining industries must be situated according to the pattern of those deposits. Agriculture has slightly more flexibility in regard to location, but weather, soils, and other environmental factors certainly constrain the placement of most crops to fairly limited areas. What is more interesting, however, is the degree to which manufacturing is concentrated. Although there are certainly manufacturing industries that are constrained to specific locations in order to have low-cost access to inputs that are dependent on environmental or geological factors, most manufacturers have a great deal of flexibility as regards location. Yet the degree of concentration in manufacturing is only slightly less than that found in agriculture or mining. The service and construction group is significantly less concentrated than the rest of U.S. industry. The appellation by which this group is generally known—the nontraded sector—explains to a large degree its lack of concentration. Usually, nontraded products must be provided at the location of consumption, and consumption is highly diffused throughout the economy. Nevertheless, as the expansion of services in the balance of payments demonstrates, changes in communication technology are allowing services to be transported more easily, and this trend could lead to increases in concentration of the industry in the future. Several service sectors, such as securities and commodities brokers (SIC 62), have Gini coefficients higher than the average for manufacturing. (See the appendix for average Gini indexes for all two-digit SIC industries.)

Michael Porter has suggested that geographic clustering is associated with global competitiveness;[4] therefore, we examined the relationship between competitiveness in international trade and geographic concentration. We used four measures to assess the extent of an industry's international trade activity:

$M/(M+S)$	(import penetration)
X/S	(export penetration)
$X-M$	(trade competitiveness)
$X+M$	(tradeability index)

where

M = U.S. imports
X = U.S. exports
S = U.S. product shipments
$M+S$ = new supply

Because Porter observed geographic concentrations of industries that were successful at exporting, we begin with an analysis of U.S. exports. Based on the value of U.S. exports and domestic product shipments in 1987, we placed 50 four-digit SIC manufacturing industries with the highest export penetration rates into an export-intensive group.[5] Similarly, we put the 50 four-digit manufacturing industries with the highest import penetration rates into an import-intensive group.

We then calculated the average Gini coefficient for the export-intensive group and found it to be .671. A similar calculation for the import-intensive group yielded an almost identical .679. If trade competitiveness is now defined as the difference between export penetration and import penetration, its correlation with the Gini coefficient is slightly negative. These findings suggest that there is no correspondence between trade competitiveness and geographic concentration.

More interesting, both the top 50 export-intensive and the top 50 import-intensive groups have Gini coefficients above the average for all manufacturing. In fact, there is a significant positive correlation between the Gini coefficient and both the import intensity and the export intensity variables. If we now define a tradeability variable as the sum of import penetration and export penetration, we find that the average Gini coefficient for the top 100 four-digit SIC manufacturing industries, based on tradeability, is .653, and that for the bottom 100 four-digit SIC manufacturing industries is .531. (Weighted by 1990 employment in each four-digit SIC category, the figures are .619 for the top 100 and .404 for the bottom 100.) Clearly, those industries with a high penetration of exports, imports, or both are significantly more geographically concentrated than those industries which are not involved with trade. So just as the traded sectors are more highly concentrated geographically than the nontraded sectors, the trade-intensive manufacturing sectors are more highly concentrated geographically than manufacturing sectors that are not as extensively involved with trade. In general, then, there appears to be something about tradeability that is associated with geographic concentration.

Although we do not know why industries intensively involved with trade cluster, we offer a few conjectures. As noted, Porter suggested that industries which are highly competitive internationally (industries successful at exporting) have a tendency to cluster geographically. However, our

findings show that import-sensitive industries cluster as well. This suggests that there are certain industry characteristics which cause industries to cluster geographically within a nation and which also appear to be operating at a global level. International trade appears to result when firms cluster in only a few areas (countries), assuming that demand is fairly evenly distributed geographically. Thus, the correlation between domestic concentration of production and a high level of tradeability merely mimics a more global phenomenon.

Because the employment-weighted averages for both the top 100 and the bottom 100 four-digit SIC manufacturing industries have Gini coefficients that are lower than the corresponding nonweighted averages, it is apparent that the sectors with larger employment have lower Gini coefficients. Larger employment may be due to a larger number of establishments, a larger average establishment size, or both. To control for these effects, we performed a multiple regression with the Gini coefficient as the dependent variable and the total number of establishments, average establishment size, import intensity, and export intensity as the independent variables. The results are presented in the following tabulation, with all the estimated coefficients significant at the 99-percent level:

	Estimated value of parameter	*t-statistic*
Number of firms	−0.00003	8.09
Mean size of firm	.00044	7.81
Exports-shipment ratio	.13809	2.71
Imports-new supply ratio	.16455	3.55

Thus, the larger the number of establishments there are in a four-digit SIC industry, the smaller is the degree of concentration, a result that is to be expected in view of the law of large numbers. In contrast, the larger the average number of employees per establishment, the greater is the degree of concentration. This may be due in part to the fact that the variance in establishment size increases with average size, thus contributing to concentration; however, there is still a definite tendency for the number of establishments to concentrate with average size. If Gini coefficients are calculated using the number of establishments instead of total employment and are then regressed on the same set of variables, average establishment size remains significant. Hence, the number of establishments, their average size, and their involvement in trade are significantly related to the degree of geographic concentration in an industry.

The issue of geographic concentration may turn out to be important in regard to how the production structure of a nation is altered by trade agreements. Paul Krugman has found that the manufacturing industry in the European Community, viewed as one region, is less geographically concentrated than the same industry is in the United States.[6] Numerous industry studies, such as that of the automobile industry by Philip Jones and John North, reach a similar conclusion.[7] If Krugman is correct, the comparison seems to suggest that economic integration leads to increased geographic concentration of industries. In addition, David Greenaway and Robert Hine provide some evidence that the increased integration of the world economy during the 1980's resulted in production patterns within the member countries of the Organisation for Economic Co-operation and Development becoming more regionally specialized.[8] The question therefore arises as to whether further trade liberalization will increase the geographic concentration of industries.[9] Currently, there are ongoing negotiations in the General Agreement on Tariffs and Trade (GATT) to liberalize the global economy further, as well as several efforts, such as the proposed North American Free Trade Agreement (NAFTA) and the 1992 Single Market program in the European Community, to promote regional trading blocs. More open trading arrangements will lead to increased economic integration and, perhaps, increased geographic concentration of industry. This in turn is likely to increase the amount of interindustry trade, which may then create labor adjustment problems for job losers.[10]

Adjusting to trade liberalization

The Gini coefficient for geographic concentration not only may be associated with the tradeability of an industry, but also may provide information about potential trade adjustment problems resulting from trade agreements. For example, Marie Howland and George E. Peterson found that the strength of the local economy was important in minimizing the financial losses of displaced workers employed in declining industries.[11] Specifically, a growing local economy reduced the financial losses of displaced white-collar workers, but not those of blue-collar workers. Also, a depressed local economy led to large financial losses among all displaced workers, even those who were young and well educated. We argue that a downturn in an industry that is highly concentrated could severely weaken the local economy, which in turn would weaken the reemployment prospects of displaced workers.

Identifying trade-sensitive industries. A recent study identified import- and export-sensitive manufacturing industries at the four-digit SIC level, based on the level and growth of their trading activity between 1982 and 1987.[12] The study con-

cluded that a number of import-sensitive manufacturing industries, especially low-wage apparel and leather and high-wage machinery, could be adversely affected by a more open international trading environment. In contrast, it also found that the export-sensitive food, chemicals, and electrical equipment industries could benefit from such an environment. Analysis of worker characteristics revealed that those most vulnerable to import competition—women, youth, blacks, Hispanics, and the less educated—would also have the greatest difficulty relocating.

The following tabulation reports average Gini measures of geographic concentration for selected manufacturing industry groups, both those that are trade sensitive and those that are not:

	Average Gini
Import sensitive	.658
Export sensitive	.680
Not sensitive to trade	.602

Separating out any industry found in both the import- and export-sensitive groups yields the following:

	Average Gini
Import sensitive only	.629
Export sensitive only	.674
Import and export sensitive	.696

Table 1. **Distribution of employment in trade-sensitive manufacturing industries, by region, 1990**

[Percent]

Region[1]	All manufacturing	Industries sensitive to—		
		Imports only	Exports only	Both imports and exports
Employment (thousands)	19,143.3	1,391.9	2,117.6	412.9
Percent	100.0	100.0	100.0	100.0
New England	6.4	8.2	8.7	11.7
Mid-Atlantic	14.3	19.7	10.9	18.4
South Atlantic	16.4	16.1	10.5	11.4
Lakes	22.1	16.8	15.3	33.2
Deep South	7.5	9.9	3.7	4.4
Heartland	7.4	7.6	7.0	8.3
Oil States	8.2	6.5	12.1	4.6
Mountain	3.4	3.3	5.5	1.4
Pacific	14.4	12.0	26.5	6.7

[1] Regions:
New England—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.
Mid-Atlantic—New York, New Jersey, Pennsylvania.
South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida.
Lakes—Ohio, Indiana, Illinois, Michigan, Wisconsin.
Deep South—Kentucky, Tennessee, Alabama, Mississippi.
Heartland—Iowa, Minnesota, Missouri, North Dakota, South Dakota, Nebraska, Kansas.
Oil States—Arkansas, Louisiana, Oklahoma, Texas.
Mountain—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada.
Pacific—Washington, Oregon, California, Alaska, Hawaii.

NOTE: The regions listed are the standard Census Bureau regions with the following name changes: East North Central—Lakes; East South Central—Deep South; West North Central—Heartland; West South Central—Oil States.

SOURCE: Special tabulation from BLS Employment and Wage (ES–202) program.

Although these results are similar to earlier ones in that there is a high degree of geographic concentration among industries more actively engaging in trade, export-sensitive industries show a slightly higher degree of concentration than do import-sensitive industries. This is even more noticeable in the case of those trade-sensitive industries that are import sensitive only or export sensitive only: the gap between the Gini coefficients widens. While the difference is not large, it does provide an indication that the gains from trade liberalization may be more concentrated than the losses. However, as noted earlier, the concentration of import-sensitive industries relative to that of all manufacturing and that of the service sector is quite high, which could lead to reemployment difficulties for those displaced.

Regional view. Because employment in trade-sensitive manufacturing industries exhibits geographic concentration, it would be useful for policymakers to know where it may be concentrated. Of course, the existence of a concentration of total employment and manufacturing employment in a certain region will increase the likelihood that there is also a concentration of trade-sensitive employment in that region. Table 1 shows that in 1990 total manufacturing employment was concentrated in the Lakes region of the Nation and also in the South Atlantic region, followed by the Pacific and Mid-Atlantic regions. The Lakes region had more than 20 percent of U.S. manufacturing employment, the other three regions near 15 percent each. Although this distribution helps account for the regional distribution of employment in trade-sensitive industries, that distribution is even more concentrated.

In addition to finding that tradeability is associated with geographic concentration, we found that the locations of the concentrations are related to the type of trade activity involved. For example, there is a heavy geographic concentration of industries that are both import and export sensitive in the Lakes region. Export-sensitive industries were concentrated in the west, especially the Pacific region, while import-sensitive industries were concentrated in the east, particularly the Mid-Atlantic and New England regions. The Deep South also had a disproportionate share of import-sensitive industries.

Those regions with a high percentage of employment in import-sensitive industries also recorded a high percentage of employment in nondurable goods manufacturing, and those regions with a high percentage of employment in export-sensitive industries recorded a high percentage of employment in durable goods manufacturing. For example, almost half of employment in the apparel industry (SIC 23) and three-fourths of that in the

Table 2. **Distribution of average annual employment in manufacturing, by two-digit SIC industry level, 1990[1]**

Region[2]	All manufacturing	Food and kindred products (SIC 20)	Textile mill products (SIC 22)	Apparel and other textile products (SIC 23)	Lumber and wood products (SIC 24)	Furniture and fixtures (SIC 25)	Paper and allied products (SIC 26)	Printing and publishing (SIC 27)	Chemicals and allied products (SIC 28)
Employment:									
Number	19,143,306	1,665,766	700,030	1,039,591	736,897	509,958	699,713	1,569,511	1,091,617
Percent	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
New England	6.4	2.8	5.0	3.0	3.6	2.7	8.3	6.6	4.2
Mid-Atlantic	14.3	12.4	8.9	20.8	7.1	9.7	15.4	19.4	22.2
South Atlantic	16.4	14.9	67.3	24.7	19.2	27.7	16.8	14.8	20.6
Lakes	22.1	18.0	2.2	6.3	13.5	20.3	22.6	20.2	19.8
Deep South	7.5	7.2	11.2	17.5	11.9	13.4	8.9	4.9	6.6
Heartland	7.4	12.9	.6	3.6	6.0	5.6	8.7	9.7	5.2
Oil States	8.2	11.0	1.7	8.3	9.1	5.9	7.9	6.9	11.1
Mountain	3.4	4.5	.3	1.6	5.9	2.2	1.3	4.4	2.2
Pacific	14.4	16.3	2.8	14.2	23.7	12.5	10.1	13.2	8.1

Region[2]	Petroleum and coal products (SIC 29)	Rubber and miscellaneous plastics products (SIC 30)	Leather and leather products (SIC 31)	Stone, clay, glass, and concrete products (SIC 32)	Primary metal industries (SIC 33)	Fabricated metal products (SIC 34)	Industrial machinery and computer equipment (SIC 35)	Electronic and other electrical equipment (SIC 36)	Transportation equipment (SIC 37)	Measuring and controlling equipment (SIC 38)	Miscellaneous manufactures (SIC 39)
Employment:											
Number	158,540	892,165	133,885	557,815	758,384	1,422,503	2,096,640	1,679,291	2,000,307	1,002,227	377,864
Percent	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
New England	1.3	6.1	17.1	3.6	4.2	7.0	8.0	8.8	6.8	12.0	14.6
Mid-Atlantic	15.2	12.4	18.4	17.1	17.3	13.3	13.2	13.9	6.2	20.9	21.1
South Atlantic	4.3	14.4	8.9	18.8	10.6	9.5	10.4	13.5	10.3	10.4	8.5
Lakes	17.1	31.7	15.5	19.8	38.0	32.9	29.5	20.4	29.9	12.8	18.0
Deep South	5.3	8.4	8.9	7.1	8.4	7.0	5.3	6.5	5.7	2.1	6.9
Heartland	4.3	6.9	14.0	6.5	4.2	7.6	9.3	6.1	7.8	6.8	6.4
Oil States	30.1	7.8	9.8	10.1	6.2	9.2	8.4	8.6	7.6	5.1	6.6
Mountain	2.8	2.1	2.0	4.6	2.5	2.2	3.5	4.8	3.7	4.8	5.4
Pacific	19.5	10.1	5.5	12.4	8.7	11.2	12.2	17.4	22.1	24.9	12.5

[1] For reasons of nondisclosure of the data, the tobacco products industry (SIC 21) is left out of the table. Employment totals and totals for the region, however, include data for the industry.

[2] See table 1 for list of States in each region.

SOURCE: Special tabulation from Bureau of Labor Statistics Employment and Wage (ES–202) program.

textile industry (SIC 22) are located in the Atlantic regions, where more than a third of import-sensitive industries are located. (See table 2.) Similarly, a considerable share of employment in measuring and controlling equipment (SIC 38), lumber and wood products (SIC 24), and transportation equipment (SIC 37) (especially aircraft) is located in the export-oriented Pacific region. The largest share of trade-sensitive employment is found in the Lakes region, where 30 or more percent of employment in the following industries are located: primary metals (SIC 33), fabricated metals (SIC 34), transportation equipment (SIC 37), machinery (SIC 35), and rubber and plastic products (SIC 30).

Workers in import-sensitive industries are more vulnerable than those in other industries to job loss from a more open international trading environment. Trade Adjustment Assistance is the primary U.S. employment program serving workers displaced because of trade. It would be useful to know the geographic distribution of both recipients of such assistance and displaced workers in general. For example, examining the geographic distribution of Trade Adjustment Assistance certifications relative to the geographic distribution of displaced workers will give some indication of the extent to which job losers are served by the program. Also, if the program is serving its target population, one would expect to find a concentration of Trade Adjustment Assistance recipients in regions with a large share of import-sensitive industries. For example, table 3 shows the number and distribution of factory workers receiving Trade Adjustment Assistance and the number and distribution of displaced factory workers, by region, from 1987 to 1992. The regional distribution of factory workers receiving such assistance parallels fairly closely (Pearson correlation coefficient of .877) the regional distribution of employment in import-sensitive manufacturing industries given in table 1. In particular, the regions with the highest and lowest distributions are the same in

both cases. This result both suggests that the Trade Adjustment Assistance program is well targeted and, if certification is viewed as another measure of import sensitivity, supports our finding that employment in import-sensitive industries is geographically concentrated.

Not surprisingly, factory worker displacements are distributed geographically in the same relative proportions as the distribution of total manufacturing employment, a clear exception being the disproportionate share of displaced manufacturing workers in New England. Examining the two percent distribution columns in table 3 reveals that disproportionate trade-related displacements occurred in the Mid-Atlantic, Lakes, Deep South, and Oil States regions. Each of these had a higher share of Trade Adjustment Assistance certifications than of displacements. Moreover, all of them except the Lakes region had a higher share of certifications than of total manufacturing employment. These findings indicate that trade-related job losses were indeed geographically concentrated during the period in question. Importantly, from a labor market adjustment standpoint, the duration of unemployment was longer in regions where trade displacements were concentrated. Also, according to the January 1992 BLS Displaced Worker Survey, the percentage of displaced manufacturing workers reemployed at the time of the survey was lower in regions with a high concentration of trade-related displacements.[13]

Table 3. **Factory workers receiving Trade Adjustment Assistance and displaced factory workers, by region, 1987–92**

Region[1]	Factory workers receiving Trade Adjustment Assistance		Displaced factory workers[2]	
	Number[3]	Percent distribution	Number	Percent distribution
Total	314,916	100.0	1,955,000	100.0
New England	25,262	8.0	168,000	8.6
Mid-Atlantic	66,967	21.3	299,000	15.3
South Atlantic	49,075	15.6	352,000	18.0
Lakes	60,961	19.4	354,000	18.1
Deep South	39,133	12.4	123,000	6.3
Heartland	19,314	6.1	137,000	7.0
Oil States	29,645	9.4	125,000	6.4
Mountain	9,308	3.0	79,000	4.0
Pacific	15,251	4.8	318,000	16.3

[1] See table 1 for list of States in each region.

[2] Persons with 3 or more years of tenure who lost or left a job between January 1987 and January 1992 because of plant closings, slack work, or the abolishment of their positions or shifts.

[3] Administrative cumulative count of worker certifications under the Trade Adjustment Assistance program from Jan. 1, 1987, to Dec. 7, 1992.

SOURCES: Special tabulation, Office of Trade Adjustment Assistance, Employment and Training Administration; BLS January 1992 Displaced Worker Supplement to Current Population Survey.

An examination of the distribution of Trade Adjustment Assistance certifications by two-digit SIC manufacturing industries for each region provides some insight into the disproportionate regional distribution of trade-related displacements. The situation in the Mid-Atlantic and Lakes regions, for example, is due in large part to their generally greater shares of employment in industries sensitive to imports that are located there. The situation in the Deep South and Oil States regions is not as straightforward, because those regions do not have a large share of import-sensitive industries, although the share in the Deep South is disproportionate, with a large number of workers in the apparel industry (SIC 23). There was a large concentration of job losses in that industry during the 1987–92 period, and nearly 60 percent of the Trade Adjustment Assistance certifications in the region were in the apparel industry. In fact, based on the number of certifications over the period, the apparel industry in nearly every region was hit hard by imports: 30 percent of all Trade Adjustment Assistance certifications in the manufacturing industry from 1987 to 1992 were in the apparel industry. This figure was followed by 15 percent in the transportation equipment industry (SIC 37). Trade-related displacements, denoted by the number and share of Trade Adjustment Assistance certifications, in these two industries in the Oil States region accounted for that region's disproportionate trade-related displacement. (See table 4.) Other noteworthy concentrations of certifications—an indication of where trade-related job losses occurred—were leather (SIC 31) in the Heartland region, lumber and wood products (SIC 24) in the Pacific region, machinery (SIC 35) in the Mountain and Pacific regions, transportation equipment in the Lakes and Heartland regions, and apparel in the two Atlantic regions.

North American Free Trade Agreement (NAFTA). The prospect of the signing of the North American Free Trade Agreement has focused attention on Mexico's trade pattern with the United States. Currently, Mexico ranks third behind Canada and Japan in trade volume with the United States. U.S. imports from Mexico increased at an annual rate of 12 percent from 1986 to 1991, while U.S. exports to Mexico increased by 22 percent per year over the same period.

Much attention has been directed toward the employment effects of the proposed agreement with Mexico.[14] Which industries will gain jobs? Which will lose jobs? Will there be adequate support for the job losers? Will some regions benefit or be hurt more than others? Because of the large difference in income and wages between the two countries, some have expressed concerns about the possibility of a surge in U.S. imports from

Table 4. **Percent distribution of Trade Adjustment Assistance certifications by two-digit SIC manufacturing industry, by region, cumulative from January 1, 1992, to December 7, 1992**

SIC	Industry	Total	New England	Mid-Atlantic	South Atlantic	Lakes	Deep South	Heartland	Oil States	Mountain	Pacific
	All manufacturing										
	Number	314,916	25,262	66,967	49,075	60,961	39,133	19,314	29,645	9,308	15,251
	Percent	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
20	Food and kindred products	.8	.3	.5	.4	.2	—	—	—	—	11.7
21	Tobacco products	—	—	—	—	—	—	—	—	—	—
22	Textile mill products	2.9	7.3	2.7	8.8	.6	1.6	—	.1	—	.6
23	Apparel and other textile products	30.0	16.8	34.4	50.4	4.7	57.1	15.4	37.5	14.8	12.2
24	Lumber and wood products, except furniture	1.0	.5	—	—	.2	.1	—	1.0	1.8	15.8
25	Furniture and fixtures	2.1	1.0	3.0	2.7	.8	1.5	.5	1.7	—	8.1
26	Paper and allied products	.6	2.2	1.1	—	.3	—	—	—	—	2.9
27	Printing and publishing	.4	.7	.3	.6	.7	—	.3	—	—	.3
28	Chemicals and allied products	1.5	.2	2.9	.2	.8	.2	1.8	.9	9.6	4.2
29	Petroleum and coal products	.2	—	—	.2	.2	.1	—	1.0	—	—
30	Rubber and miscellaneous plastics products	3.8	4.9	4.3	6.3	4.8	2.5	.8	1.8	1.2	—
31	Leather and leather products	7.2	16.0	7.4	7.6	3.2	5.8	25.6	2.1	.8	1.3
32	Stone, clay, glass, and concrete products	1.4	1.7	1.3	2.6	1.6	.6	.2	1.5	—	1.1
33	Primary metal industries	2.7	2.1	4.1	.8	5.3	1.6	.7	.9	3.3	2.6
34	Fabricated metal products, except machinery and transportation equipment	4.6	8.3	3.6	2.4	11.4	.4	2.4	3.0	1.0	1.3
35	Industrial machinery and computer equipment	8.5	11.8	10.8	.7	14.5	1.0	7.8	2.0	23.2	18.4
36	Electronic and electrical equipment, except computer equipment	12.8	16.9	12.4	8.3	12.2	14.0	14.9	14.2	28.8	7.1
37	Transportation equipment	15.2	.8	5.3	6.4	35.2	10.6	24.8	28.9	10.5	7.2
38	Measuring and controlling equipment	2.3	4.2	2.2	.3	3.3	1.4	2.9	3.1	3.0	2.6
39	Miscellaneous manufactures	1.9	4.3	3.6	1.3	.5	1.5	2.0	.3	2.0	2.7

NOTE: See table 1 for list of States in each region. Dash indicates less than .05 percent or no observations.

SOURCE: Special tabulation, Office of Trade Adjustment Assistance, Employment and Training Administration.

Mexico that are priced below U.S.-produced goods, as well as a potent exodus of U.S. firms to Mexico to take advantage of the lower wage base there.

With regard to the concentration issue, there are two major concerns. First, as noted before, the proposed agreement itself could lead to greater geographic concentrations of industry in each country as the two economies integrate. Second, if the industries that are adversely affected by the agreement are geographically concentrated, the adjustment process for the job losers could be more difficult than if those industries are not geographically concentrated.

Employing and expanding upon the methodology used by Bednarzik in an earlier *Monthly Labor Review* article to identify trade-sensitive industries,[15] we developed a preliminary list of U.S. manufacturing industries (at the four-digit SIC level) with a history of conducting trade with Mexico from 1982 to 1987. We established four criteria—two based on the level of trade and two based on the growth of trade—to determine which U.S. industries had a history of importing from or exporting to Mexico. A broad measure of import penetration considers the trend and level of U.S. imports from Mexico, by industry, as a percentage of new supply (domestic production plus imports), and a narrow measure considers imports from Mexico as a percentage of all U.S. imports. Exports are examined in a similar fashion.[16] The following tabulation gives the average Gini coefficient for those industries deemed import sensitive or export sensitive with respect to U.S. trade with Mexico from 1982 to 1987:

	Total manufacturing	*Import sensitive*	*Export sensitive*
Number of jobs	19,111,000	539,900	720,400
Average Gini index	.607	.619	.600
Weighted Gini index	.543	.593	.511

Comparing the average and weighted Gini coefficients of import-sensitive versus export-sensitive

manufacturing industries pertaining to U.S. trade with Mexico reveals that the import-sensitive industries are slightly more concentrated. They are also slightly more concentrated than manufacturing generally. Workers in geographically concentrated import-sensitive industries could face a prolonged search for a comparable job if they become unemployed.

Conclusions and implications

There has been a tendency for similar economic activities to cluster together geographically; this article shows how that tendency is related to industry characteristics. Geographic clustering is most prevalent in the mining sector, less so, but still significant, in the agriculture and manufacturing industries, and not very evident in the services sector. Manufacturing industries that are intensively involved in international trade, either as importers or as exporters, are significantly more geographically concentrated than manufacturing industries with less involvement in trade. Geographic concentration is also positively related to average establishment size and negatively related to the overall number of establishments in an industry.

Among the labor market implications of the geographic concentration of trade-sensitive industries is the prospect that a downturn in an industry that is highly concentrated geographically could weaken the local economy and the ability of displaced workers to find alternative employment. Conversely, trade agreements that open markets favoring specific product lines are likely to benefit the regions that manufacture those products. Average Gini coefficients show that both export- and import-sensitive industries are geographically concentrated, export-sensitive industries slightly more so. That import-sensitive industries are concentrated geographically is supported by the regional distribution of Trade Adjustment Assistance certifications. Unfortunately, from a labor market adjustment standpoint, job gains are not likely to be in the same region as job losses. Concentrations of export-sensitive industries are in the Pacific region, while import-sensitive industries are concentrated in the Atlantic regions. Industries that are both import and export sensitive are in the Lakes region. Historical trading patterns show that U.S. industries trading with Mexico also tend to be concentrated geographically, although not to the extent of trade-sensitive industries generally. □

Footnotes

ACKNOWLEDGMENT: The authors thank Michael B. Buso, Office of Employment and Unemployment Statistics, and Barbara P. Athey, Office of Technology and Survey Processing, both of the Bureau of Labor Statistics, for the preparation of data appearing in this article.

[1] Joseph Lewis, "The Localization of Industries," *Manufactures: 1905* (Washington, Bureau of the Census, 1907).

[2] See Robert C. Shelburne and Robert W. Bednarzik, *The Geographical Concentration of Employment and Its Implications for Trade and Adjustment* (Washington, Bureau of International Labor Affairs, 1992), originally presented at the Southwestern Economics Association in San Antonio in March 1992. In this paper, we included average Ginis for all two-, three-, and four-digit SIC industries. Geographic Gini indexes are used by Paul Krugman, in *Geography and Trade* (Cambridge, MA, MIT Press, 1991).

[3] Unlike Krugman's results, which were based on a data set that was incomplete because of confidentiality concerns, the results presented here are based on a complete data set. The Bureau of Labor Statistics does not release data on industries when it would be possible to determine firm-specific information from them. This can occur when there are only a few firms in a given geographic area. The problem was avoided by providing the Bureau with the requisite computer programs and allowing its staff to compute the desired estimates. Firm-specific information cannot be derived from Gini coefficients.

[4] Michael Porter, *The Competitive Advantage of Nations* (New York: The Free Press, 1990). As early as 1919, Alfred Marshall, in *Industry and Trade* (London, McMillan, 1919), suggested that clustering was an attempt to reap technological spillovers from other firms. This factor is likely to be most important in industries characterized by sophisticated and rapidly changing technology. We divided the manufacturing sector into three groups—industries characterized by new products requiring significant inputs of research and development and human capital, industries that produce standardized commodities with established technology, and industries that are resource intensive—and calculated the Gini index for each group. The results failed to reveal the presence of any technological factor in geographic concentration among these industries. (Their Gini indexes were similar.)

[5] The variables for the ratio of imports to new supply and exports to shipments have been calculated by the Industry Statistics Division of the U.S. Dept. of Commerce; the most recent data available are for 1987.

[6] Krugman, *Geography and Trade*. Krugman makes this assessment using several criteria; for instance, the manufacturing production structures of the United Kingdom, West Germany, France, and Italy are more similar to each other than are the production structures of the four major U.S. regions.

[7] Philip Jones and John North, "Japanese Motor Industry Transplants: The West European Dimension," *Economic Geography*, April 1991, pp. 105–23.

[8] David Greenaway and Robert Hine, "Intra-Industry Specialization, Trade Expansion and Adjustment in the European Economic Space," *Journal of Common Market Studies*, December 1991.

[9] A theoretical discussion of this issue can be found in Paul Krugman and Anthony Venables, "Integration and the Competitiveness of Peripheral Industry," in Christopher Bliss and Jorge Braga de Macedo, *Unity with Diversity in the European*

Economy: The Community's Southern Frontier (Cambridge, U.K., Cambridge University Press, 1990), pp. 56–75.

[10] The costs of adjustment associated with the geographic-concentrating effects of the Single Market program have been an important issue within the European Community. See Harry Flam, "Products and 1992: Full Integration, Large Gains?" *Journal of Economic Perspectives*, Vol. 6, No. 4, Fall 1992, pp. 7–30.

[11] Marie Howland and George E. Peterson, "Labor Market Conditions and the Reemployment of Displaced Workers," *Industrial and Labor Relations Review*, October 1988, pp. 109–22.

[12] "Robert W. Bednarzik, "An analysis of U.S. industries sensitive to foreign trade, 1982–87," *Monthly Labor Review*, February 1993, pp. 15–31. Trade sensitivity considers the trend as well as the level of activity over a 6-year period, 1982–87. Also, it is based on 1972 SIC's. That is, it does not include any new four-digit SIC industries that may have been included in the trade-intensive group.

[13] We cannot be sure, however, whether the longer jobless duration was a result of the geographic concentration of the displacements or of the fact that the displacements were trade related. The literature is clear that the duration of unemployment is longer and postdisplacement wage losses are larger for workers displaced by trade than for comparable unemployed groups. (See, for example, Walter Corson, Paul Decker, Phillip Gleason, and Walter Nicholson, *International Trade and Worker Dislocation: Evaluation of the Trade Adjustment Assistance Program* (Princeton, NJ, Mathematica Policy Research, Inc., April 1993).

[14] For a review of many of the studies on NAFTA, see Gregory Schoepfle and Jorge Perez-Lopez, *U.S. Employment Effects of a North American Free Trade Agreement: A Survey of Issues and Estimated Employment Effects*, Economic Discussion Paper 40 (Bureau of International Labor Affairs, July 1992).

[15] Bednarzik, "U.S. industries sensitive to foreign trade."

[16] Specifically, import sensitivity was measured as the percentage of total U.S. new supply, by industry, imported from Mexico and as the percentage of total U.S. imports, by industry, imported from Mexico. The following thresholds were established for the level and the growth of import activity over the 1982–87 period: average share of shipments of 2 percent or more; average annual increase in share of shipments of 1 percent or more; average share of imports of 20 percent or more; and annual average increase in share of imports of 2 percent or more. Industries that reached or exceeded two or more of these thresholds were deemed import sensitive.

Export sensitivity was measured as the percentage of total U.S. shipments, by industry, exported to Mexico and as the percentage of total U.S. exports, by industry, exported to Mexico. The following thresholds were established for the level and the growth of export activity over the 1982–87 period: average share of shipments of 2 percent or more; average annual increase in share of shipments of 1 percent or more; average share of exports of 20 percent or more; and annual average increase in share of exports of 2 percent or more. Industries that reached or exceeded two or more of these thresholds were deemed export sensitive.

APPENDIX: Deriving the Gini index

To estimate geographic concentration by industry, we employ the technique of Paul Krugman and calculate locational Gini coefficients. The Gini coefficient, which has been used extensively in analyzing income distributions, is a summary measure derived from the Lorenz distribution. For each state i, we have data for employment (E) in each sector j, which we define as E_{ij}. We define each State's share of total U.S. employment as

$$S_i = \sum_j E_{ij} / \sum_i \sum_j E_{ij}$$

and each State's share of employment in each sector as

$$S_{ij} = E_{ij} / \sum_i E_{ij}.$$

For each sector, we take the ratio $R_{ij} = S_{ij}/S_i$ and then rank the resulting values in ascending order. A continuous cumulation of S_{ij} and S_i is maintained, with the totals plotted after the figure for each State is added to the running totals. This allows us to plot a Lorenz curve, such as that shown in chart A–1, page 13, for each sector. The vertical axis represents the cumulative share of the sector (that is, the running total of S_{ij}), the horizontal axis the cumulative share of total employment (that is, the running total of S_i). A point such as B on the curve signifies that only 20 percent of employment in the given sector is located in States that account for 40 percent of total employment. Alternatively, we could say that 80 percent of employment in this sector is located in States that account for 60 percent of total employment.

If employment in a sector is located in each State exactly in proportion to total employment in that State, then the Lorenz curve will correspond to the 45-degree diagonal line. That is, the State's share of industry employment is the same as its share of national employment. The more geographically concentrated a sector is, the more curved the Lorenz curve will be. Thus, the size of the region between the diagonal line and the Lorenz curve is a measure of the amount of geographic concentration of a sector. The Gini coefficient is defined as the proportion of the area below the diagonal that is between the diagonal and the Lorenz curve. Hence, the Gini coefficient can vary from 0, when the Lorenz curve coincides with the diagonal, to 1, when all of the sector's employment is in a small area.

For the geographic regions, States have been used, although a smaller region would be more desirable. Using States presents three additional problems. First, an industry that is clustered on both sides of a State border will have a lower Gini index than if it were concentrated entirely within one of the States. Second, the fact that States are of unequal sizes will bias the Gini measure. For example, an industry concentrated in California will appear less concentrated than if it were concentrated in a similarly sized region in Wyoming. Finally, because each State represents a significant portion of total employment, the upper limit of the Gini index will approach, but never reach, 1, even when employment is all in a single State.

Table A–1 lists four-digit average Gini indexes calculated for all two-digit SIC industries.

Table A–1. **Four-digit average Gini indexes for two-digit SIC industries**

SIC	Industry	Gini	SIC	Industry	Gini
01	Agricultural crops	0.778	47	Transportation services	0.446
02	Agricultural livestock	.678	48	Communications	.313
07	Agricultural services	.403[1]	49	Electric, gas, and sanitary services	.579
08	Forestry	.776			
09	Fishing, hunting, and trapping	.762	50	Wholesale trade: durables	.235
			51	Wholesale trade: nondurables	.313
10	Metal mining	.944	52	Building and garden materials	.191
12	Coal mining	.890	53	General merchandise stores	.204
13	Oil and gas extraction	.833	54	Food stores	.267
14	Nonmetallic minerals	.691	55	Auto dealers and gas stations	.225
15	General building contractors	.274[1]	56	Apparel stores	.184
16	Heavy construction	.305	57	Furniture stores	.172
17	Special trade contractors	.204	58	Eating and drinking places	.074[1]
			59	Miscellaneous retail	.249
20	Food and kindred products	.623			
21	Tobacco products	.904	60	Depository institutions	.507
22	Textile mill products	.819	61	Nondepository institutions	.376
23	Apparel and other textile products	.635	62	Security and commodity brokers	.644
24	Lumber and wood products, except furniture	.570	63	Insurance carriers	.390
			64	Insurance agents	.110
25	Furniture and fixtures	.537	65	Real estate	.283[1]
26	Paper and allied products	.530	67	Holding and investment offices	.542
27	Printing and publishing	.396			
28	Chemicals and allied products	.650	70	Hotels	.374
29	Petroleum and coal products	.518	72	Personal services	.151[1]
			73	Business services	.294
30	Rubber and miscellaneous plastic products	.480	75	Auto repair and services	.227
			76	Miscellaneous repair services	.200
31	Leather and leather products	.707	78	Motion pictures	.443
32	Stone, clay, glass, and concrete products	.557	79	Amusement and recreation	.313
33	Primary metal industries	.638			
34	Fabricated metal products, except machinery and transportation equipment	.542	80	Health services	.268
			81	Legal services	.181
35	Industrial machinery and computer equipment	.613	82	Educational services	.273
			83	Social services	.204
36	Electronic and electrical equipment, except computer equipment	.607	84	Museums, gardens, and zoos	.373
			86	Membership organizations	.341
37	Transportation equipment	.700	87	Engineering and management services	.309
38	Measuring and controlling equipment	.561	88	Private households	.290
39	Miscellaneous manufactures	.599	89	Services, n.e.c.	.296
			91	Executive and legislative government	.700
40	Railroad transportation	.837	92	Justice and safety	.465
41	Local passenger transit	.427	93	Taxation and monetary policy	.254
42	Trucking and warehousing	.370	94	Human resources	.462
43	U.S. Postal Service	.091	95	Government environmental and housing	.411
44	Water transportation	.686	96	Administration of economic programs	.469
45	Air transportation	.390	97	Security and international affairs	.673
46	Pipelines, not natural gas	.736	99	Nonclassified establishments	.678

[1] Calculated at the three-digit level because not all States report data for this industry at the four-digit level.

NOTE: n.e.c. = not elsewhere classified.

Chart A-1. **Lorenz Curve**