Comparing Manufacturing Export Growth Across States: What Accounts for the Differences?

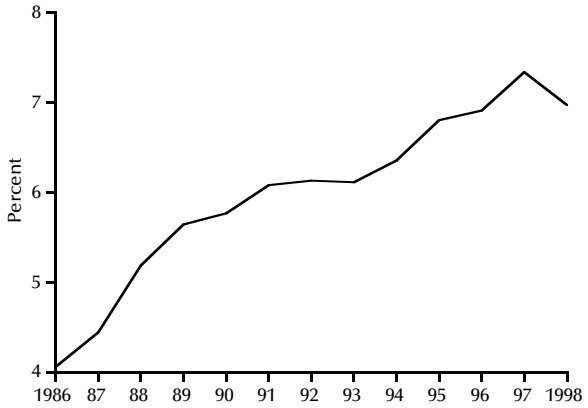
Cletus C. Coughlin and
Patricia S. Pollard

Until the reduction in manufacturing exports caused by the Asian crisis, U.S. manufacturing exports as a share of gross domestic product had trended upward since the mid-1980s. As shown in Figure 1, this share increased from 4.1 percent in 1986 to 7.3 percent in 1997, before decreasing to 7.0 percent in 1998. This feature of the internationalization of the U.S. economy has spread unevenly across regions and states. As shown in Table 1, from 1988 through 1998 the annual rate of change of manufacturing exports ranged from a low of –10.9 percent in Alaska to a high of 28.2 percent in New Mexico.[1] In this paper we examine the differences in the growth of manufacturing exports across states. Using a technique called shift-share analysis, we isolate the effects that account for the difference between a state's manufacturing export growth and U.S. manufacturing export growth between 1988 and 1998.

Applying the shift-share method generates a measure of each state's *net relative change* over the period. States in which manufacturing exports grew more (less) rapidly than the national average between 1988 and 1998 have a positive (negative) net relative change. In classic shift-share models a state's net relative change is separated into an industry mix effect and a competitive effect. The industry mix effect is the change due to differences in the initial industry makeup of the state relative to the nation. A positive (negative) industry mix effect indicates that a state's exports were relatively more concentrated in industries whose exports expanded faster (slower) than the overall national average. Meanwhile, the competitive effect in these models is the change in exports due to differences between the export growth of a state's industries and export growth at the national level, assuming the state's industry mix was the same as the nation's.

Figure 1

Manufacturing Exports as a Share of GDP
1986-98



Source: U.S. Department of Commerce, Bureau of Economic Analysis and Bureau of the Census; U. S. Department of Labor, Bureau of Labor Statistics

Recent work by Gazel and Schwer (1998) extended the classic shift-share model to incorporate the destination of a state's exports. This is potentially important because the geographic distribution of exports differs a great deal across states, a fact stressed by Erickson and Hayward (1991) and Cronovich and Gazel (1998) in general studies and by Coughlin and Pollard (2000) in a recent study of the impact of the Asian crisis on individual states. These studies highlight the importance of developments in foreign markets as a source of differential export performance across states. In the present context, a positive (negative) destination effect indicates that a state's manufacturing exports were initially relatively more concentrated in export markets that subsequently expanded faster (slower) than the overall national average.

In the following section we provide details on the data used in our study and the differences in export behavior across states. We also highlight the differences in the overall growth of manufacturing exports across states as well as the differences in the industrial compositions and geographic destinations of these exports. In the sub-

Cletus C. Coughlin is a vice president and associate director of research and Patricia S. Pollard is an economist and research officer at the Federal Reserve Bank of St. Louis. Heidi L. Beyer provided research assistance.

[1] Alaska was the only state with a decline in manufacturing exports. Between 1988 and 1998 these exports declined $1.4 billion, primarily as a result of a decline in exports of food products to Japan.

sequent section we discuss shift-share analysis and the two models we calculate—a classic shift-share model and Gazel and Schwer's (1998) model. Next, we examine our results to assess the importance of the industry mix, competitive, and destination effects. A summary of the key findings completes the paper.

EXPORT DATA DETAILS

The data on state manufacturing exports used in this study were prepared by the Massachusetts Institute for Social and Economic Research (MISER) at the University of Massachusetts. These data are export shipments by state of origin of movement at the two-digit Standard Industrial Classification (SIC) industry level. The MISER export data are regarded as the best available data source for state exports; however, these data have some well-known weaknesses that have been discussed in Cronovich and Gazel (1999) and Coughlin and Mandelbaum (1991). One potentially important problem is that the identified export state may not be the state of manufacture, but rather the state of a broker (or wholesaler) or the state where a number of shipments were consolidated. This problem is more pronounced for exports of agricultural commodities than the focus of our study, manufactured goods.

State exports exhibit much variety in both their absolute size and relative importance for economic activity in their respective states. Exports during 1998 ranged from $98.9 billion in California to $0.2 billion in Hawaii. As shown in Table 1, California and Texas led the nation during 1998 with 15.8 percent and 13.1 percent of the nation's manufacturing exports, respectively. Meanwhile, primarily because of their small economic size, seven states—Alaska, the District of Columbia, Hawaii, Montana, North Dakota, South Dakota, and Wyoming—had shares of the nation's manufacturing exports that were 0.1 percent or lower.[2]

Adjusting for the size of a state's economy, using 1998 gross state product data, produces a different picture of the importance of a state's exports. As shown in Table 2, the relative importance of exports as a share of gross state product varied substantially across states. Vermont (one of the smaller states in terms of total exports) and Washington had export shares exceeding 20 percent.[3] Michigan and Texas were also leading states, with export shares exceeding 10 percent. At the other extreme, the states showing the lowest relative manufacturing export involvement—the District of Columbia and Hawaii—had export shares of less than 1 percent.

A final point illustrated in Table 2 is the increasing importance of manufacturing exports for state economies. Between 1988 and 1998, only 6 of the 51 states experienced a decline in their ratios of manufacturing exports to gross state product—Alaska, Delaware, the District of Columbia, Louisiana, Michigan, and Montana. In seven states the share of manufacturing exports increased by more than 3 percentage points. The increase was largest in Vermont—more than 13 percentage points.

In the present paper, we focus on the growth of manufacturing exports and connect this growth to differences among states in the competitive, industry mix, and destination effects. For completeness we examined whether expressing the changes in exports in real terms, as opposed to nominal terms, altered our results in any meaningful way. The short answer is no.[4] One reason is that state manufacturing export growth rates in real and nominal terms are virtually identical. Between 1988 and 1998 the real and nominal compound annual growth rates are within 1 percentage point of each other for 47 of the 51 states. Not surprisingly, the simple correlation between these two growth rate measures is quite high (0.99). Thus, all our calculations use nominal values.

An Industry View of Manufacturing Export Growth

U.S. manufacturing exports grew at different rates across industries. Table 3 shows these different rates using two-digit SIC codes. Lumber and

[2] We treat the District of Columbia as the 51st state.

[3] A note of caution is in order. Because the measure of manufacturing exports is based on shipments, the value of exports for a state is not equivalent to value added. Thus, we are not suggesting that more than 23 percent of Vermont's gross state product was due to manufacturing exports. We are using this measure only as suggestive evidence that the importance of manufacturing exports varies across states.

[4] To calculate the real percentage change in exports, exports in 1998 were deflated by their change in price between 1988 and 1998; however, export price data are available using the Standard International Trade Classification (SITC) system rather than by SIC code. Thus, we started with an export price index that groups the data based on the SITC system and matched these industries with the appropriate SIC codes. When multiple SITC codes fit one SIC category, a weighted average of the price indices for those categories was constructed to produce the price index on an SIC basis. For additional details, see Pollard and Coughlin (1999).

Table 1

State Manufacturing Exports

State	Annual growth rate 1988-98 (percent)	Share of national manufacturing exports 1998 (percent)
Alabama	10.6	1.04
Alaska	–10.9	0.10
Arizona	13.4	1.86
Arkansas	13.8	0.38
California	9.1	15.83
Colorado	10.7	0.88
Connecticut	7.9	1.22
Delaware	6.9	0.37
District of Columbia	3.2	0.05
Florida	8.3	4.35
Georgia	12.7	2.24
Hawaii	5.5	0.04
Idaho	9.8	0.24
Illinois	10.6	4.92
Indiana	10.9	2.11
Iowa	9.3	0.80
Kansas	9.2	0.65
Kentucky	12.7	1.33
Louisiana	4.3	1.61
Maine	8.7	0.29
Maryland	7.9	0.80
Massachusetts	5.9	2.65
Michigan	4.1	4.90
Minnesota	6.9	1.45
Mississippi	6.6	0.38
Missouri	9.2	0.98
Montana	3.4	0.05
Nebraska	9.6	0.32
Nevada	12.0	0.11
New Hampshire	6.4	0.29
New Jersey	7.7	2.58
New Mexico	28.2	0.31
New York	4.7	6.05
North Carolina	10.5	2.50
North Dakota	12.9	0.10
Ohio	8.8	4.19
Oklahoma	7.6	0.47
Oregon	10.4	1.33
Pennsylvania	8.6	2.69
Rhode Island	9.1	0.17
South Carolina	11.4	1.34
South Dakota	18.1	0.07
Tennessee	13.3	1.58
Texas	10.4	13.14
Utah	14.0	0.52
Vermont	14.1	0.62
Virginia	7.9	1.92
Washington	9.7	6.25
West Virginia	4.4	0.23
Wisconsin	9.5	1.58
Wyoming	8.6	0.08

Table 2

Manufacturing Exports as a Share of Gross State Product

State	1998 (percent)*	1988 (percent)	Difference between 1998 and 1988 (percentage points)†
Alabama	5.93	3.64	2.30
Alaska	2.60	9.36	–6.76
Arizona	8.69	5.24	**3.44**
Arkansas	3.88	1.91	1.97
California	8.84	6.11	2.73
Colorado	3.88	3.00	0.87
Connecticut	5.38	4.04	1.34
Delaware	6.88	6.97	–0.09
District of Columbia	*0.59*	0.66	–0.07
Florida	6.49	5.46	1.03
Georgia	5.52	3.37	2.15
Hawaii	*0.56*	0.51	0.05
Idaho	4.90	3.99	0.91
Illinois	7.22	4.53	2.69
Indiana	7.56	4.76	2.80
Iowa	5.92	4.26	1.65
Kansas	5.30	3.66	1.64
Kentucky	7.77	4.14	**3.64**
Louisiana	7.79	8.06	–0.28
Maine	5.52	3.64	1.88
Maryland	3.05	2.31	0.74
Massachusetts	6.92	6.21	0.71
Michigan	**10.39**	11.68	–1.28
Minnesota	5.62	5.23	0.39
Mississippi	3.79	3.50	0.29
Missouri	3.75	2.62	1.13
Montana	1.58	1.89	–0.32
Nebraska	3.84	2.74	1.10
Nevada	1.11	0.90	0.21
New Hampshire	4.35	4.21	0.15
New Jersey	5.06	3.93	1.12
New Mexico	4.06	0.68	**3.38**
New York	5.35	5.27	0.09
North Carolina	6.62	4.53	2.09
North Dakota	3.72	1.96	1.76
Ohio	7.67	5.47	2.20
Oklahoma	3.60	2.71	0.90
Oregon	7.95	6.32	1.63
Pennsylvania	4.63	3.34	1.28
Rhode Island	3.54	2.31	1.23
South Carolina	8.36	4.93	**3.43**
South Dakota	1.95	0.70	1.25
Tennessee	6.19	3.26	2.93
Texas	**12.72**	9.16	**3.56**
Utah	5.46	3.26	2.20
Vermont	**23.80**	10.07	**13.72**
Virginia	5.21	4.29	0.92
Washington	**20.24**	16.36	**3.89**
West Virginia	3.66	3.61	0.05
Wisconsin	6.27	4.51	1.76
Wyoming	2.90	1.90	1.00

*Export shares of 10 percent or above are shown in bold; values of 1 percent or below are shown in italic.
†Increases in export share exceeding 3 percentage points are shown in bold.

Table 3

U.S. Export Growth by Industry 1988-98

SIC	Description	Compound annual rate (percent)
20	Food and kindred products	5.3
21	Tobacco products	5.4
22	Textile mill products	11.4
23	Apparel and related products	16.8
24	Lumber and wood products (except furniture)	1.1
25	Furniture and fixtures	18.6
26	Paper and allied products	6.8
27	Printing and publishing	9.9
28	Chemicals and allied products	6.4
29	Refined petroleum and coal products	4.5
30	Rubber and miscellaneous plastics products	11.2
31	Leather and leather products	7.3
32	Stone, clay, glass, and concrete products	8.3
33	Primary metal products	6.6
34	Fabricated metal products (except machinery and transportation equipment)	10.3
35	Industrial and commercial machinery and computer equipment	7.9
36	Electrical and electronic machinery, equipment, and supplies	13.1
37	Transportation equipment	8.7
38	Scientific and professional instruments; photographic and optical goods, etc.	8.8
39	Miscellaneous manufactured goods	10.0
20-39	All manufacturing industries	8.7

wood products (SIC 24) exports grew slowest (1.1 percent), while furniture and fixtures (SIC 25) exports grew fastest (18.6 percent). If the industry mix of exports was identical across states, then these differences in growth rates of industry exports at the national level would not explain differences in export growth at the state level. An obvious question is: Was the industry mix of state exports identical?

Using an index proposed by Finger and Kreinin (1979) for a slightly different purpose, we calculate a measure of the similarity between the sectoral concentration of a state's exports and that of the United States overall.[5] The range of this index is from zero, indicating complete dissimilarity, to 100, indicating the state's sectoral distribution of exports is identical to the national distribution. Table 4 reveals a wide range of export similarity with values for 1988 ranging from 19.4 for Alaska, which indicates very little similarity with the national distribution, to levels exceeding 80.0 for Florida, Indiana, Kentucky, Maryland, and Pennsylvania.

Table 4 also provides information on how export similarity in each state changed during 1988-98. For 36 of the 51 states, this export-similarity index increased, indicating that the industry distribution of exports from these states became more similar to the national distribution. Twenty-three states had increases of more than 5

[5] This export-similarity index is calculated quite easily: For a specific state, calculate the state's share of its total exports by a specific industry and corresponding national share for each of the 20 SIC categories. For each industry, compare the state share with the national share, take the minimum, and then sum these 20 values; next, multiply by 100.

Table 4

Export-Similarity Index on an Industry Basis

State	1988	1998	Difference between 1998 and 1988*
Alabama	72.4	71.4	–1.0
Alaska	19.4	34.1	**14.7**
Arizona	69.6	72.5	3.0
Arkansas	66.0	66.8	0.8
California	79.5	77.0	–2.5
Colorado	55.9	64.0	**8.1**
Connecticut	78.3	73.9	–4.3
Delaware	46.1	55.6	**9.5**
District of Columbia	56.7	59.1	2.4
Florida	81.8	89.5	**7.7**
Georgia	69.7	78.5	**8.8**
Hawaii	37.9	52.3	**14.4**
Idaho	55.0	58.7	3.7
Illinois	74.2	88.2	**14.1**
Indiana	82.5	78.5	–4.0
Iowa	66.9	69.6	2.7
Kansas	59.1	59.0	–0.2
Kentucky	80.1	74.2	*–5.9*
Louisiana	36.6	36.7	0.1
Maine	39.4	45.6	**6.2**
Maryland	82.7	81.8	–0.9
Massachusetts	61.2	71.9	**10.8**
Michigan	47.3	63.1	**15.8**
Minnesota	60.9	68.5	**7.6**
Mississippi	51.3	61.1	**9.8**
Missouri	78.8	77.7	–1.2
Montana	39.7	54.3	**14.6**
Nebraska	53.8	56.6	2.8
Nevada	48.5	71.6	**23.1**
New Hampshire	61.6	66.5	5.0
New Jersey	74.3	72.9	–1.4
New Mexico	62.0	31.8	*–30.2*
New York	70.2	75.9	**5.6**
North Carolina	65.3	71.5	**6.2**
North Dakota	64.5	52.7	*–11.8*
Ohio	77.5	78.5	1.0
Oklahoma	73.9	74.5	0.6
Oregon	62.1	71.4	**9.2**
Pennsylvania	81.9	85.3	3.4
Rhode Island	64.0	65.9	1.9
South Carolina	59.5	70.1	**10.6**
South Dakota	62.4	65.2	2.8
Tennessee	78.2	84.3	**6.0**
Texas	74.7	82.0	**7.3**
Utah	55.5	63.2	**7.6**
Vermont	52.1	35.0	*–17.0*
Virginia	67.4	73.1	**5.7**
Washington	48.5	41.3	*–7.2*
West Virginia	37.0	34.3	–2.6
Wisconsin	67.8	73.0	**5.2**
Wyoming	29.6	17.5	*–12.1*

* Increases of 5 or more index points are shown in bold; declines of 5 or more index points are shown in italic.

index points. The increase was largest in Nevada—roughly 23 points. Seven other states—Alaska, Hawaii, Illinois, Massachusetts, Michigan, Montana, and South Carolina—experienced increases of 10 or more index points. On the other hand, only six states experienced declines of 5 or more points. Of these states, New Mexico had the largest decline, about 30 points.

A Geographic View of Manufacturing Export Growth

The importance of specific destinations has also changed over time and varies across states. Table 5 separates the world into eight regions: the three leading countries for U.S. exports (Canada, Mexico, and Japan) and five areas (Africa, other Asia, Europe, Oceania, and other Western Hemisphere).[6] The data show that during 1988-98 U.S. export growth ranged from 14.8 percent in Mexico to 4.9 percent in Africa. If the geographic mix of exports was identical across states, then differences in growth rates of exports by geographic area at the national level would not explain differences in export growth at the state level.

Using an export-similarity index based on export destination, Table 6 reveals a range of export similarity in 1988 from 34.1 for Alaska to 92.5 for Alabama.[7] Three other states—Mississippi, North Carolina, and Pennsylvania—had index values exceeding 90.0. Numerous other states, 24 to be precise, had index values between 80.0 and 90.0. Consequently, the geographic distributions of exports for nearly half the states matched very closely with the national distribution of exports.

Table 6 also provides information on how the geographic concentration of each state's exports have changed during 1988-98. Although there is clear evidence that the industry mix of exports by states became more similar to the national distribution, there is little evidence that the distribution of exports based on destination changed much. Most states, 32 to be precise, experienced a change in this index in the range of –5 to 5 index points. Only eight states experienced increases of more than 5 points, with Delaware having the largest (roughly 38 points). On the other hand, 11 states experienced declines of 5 or more points, with New Mexico's index declining the most (roughly 46 points).

Table 5

Manufacturing Export Growth by Foreign Market 1988-98

Region	Compound annual rate (percent)
Canada	9.7
Mexico	14.8
Other Western Hemisphere	10.8
Japan	5.3
Other Asia	8.4
Africa	4.9
Europe	7.1
Oceania	5.6
World	8.7

THE BASICS OF SHIFT-SHARE ANALYSIS

Shift-share analysis is a method of separating a change, in our case the change in a state's manufacturing exports between 1988 and 1998, into meaningful components. The insert discusses the difference between this accounting explanation and an economic explanation of the change in a state's manufacturing exports. An economic explanation identifies factors that interact to determine the pattern and level of trade flows. Various international trade theories provide guidance as to the potential determinants. Similarly, the existence of alternative shift-share formulations reflects differences of opinion as to exactly which components are most useful.[8]

The Classic Shift-Share Model

Using the classic shift-share model, the change in a state's manufacturing exports is separated into a national growth effect, an industry mix effect, and a competitive effect. The national growth

[6] The Middle East is included in other Asia.

[7] This export-similarity index is also calculated quite easily: For a specific state, calculate the state's share of its total exports that are shipped to a specific region for each of the eight regions and the corresponding national share. For each destination, compare the state share with the national share, take the minimum, and then sum these eight values; next, multiply by 100. The range of this index is from zero, indicating complete dissimilarity, to 100, indicating the state's regional distribution of exports is identical to the national distribution.

[8] See Loveridge and Selting (1998) for a review of seven shift-share models.

Table 6

Export-Similarity Index on a Destination Basis

State	1988	1998	Difference between 1998 and 1988*
Alabama	92.5	87.9	–4.6
Alaska	34.1	61.4	**27.3**
Arizona	76.3	73.9	–2.3
Arkansas	89.2	88.3	–0.9
California	81.5	82.4	0.9
Colorado	77.2	77.1	–0.1
Connecticut	84.9	82.6	–2.3
Delaware	45.7	84.1	**38.4**
District of Columbia	53.5	66.1	**12.6**
Florida	57.6	50.7	*–6.9*
Georgia	85.2	86.9	1.8
Hawaii	49.2	34.2	*–15.0*
Idaho	77.4	76.2	–1.2
Illinois	87.3	84.9	–2.4
Indiana	83.1	74.5	*–8.6*
Iowa	78.7	77.7	–1.0
Kansas	86.6	82.6	–4.0
Kentucky	78.8	80.2	1.4
Louisiana	78.8	73.8	*–5.0*
Maine	80.9	69.6	*–11.3*
Maryland	82.8	80.5	–2.4
Massachusetts	76.8	81.4	4.6
Michigan	49.2	63.9	**14.8**
Minnesota	84.8	84.6	–0.1
Mississippi	90.5	83.4	*–7.1*
Missouri	85.0	82.5	–2.5
Montana	55.2	72.9	**17.7**
Nebraska	79.2	73.4	*–5.7*
Nevada	71.8	78.9	**7.1**
New Hampshire	82.1	81.9	–0.2
New Jersey	85.0	89.8	4.9
New Mexico	80.8	35.1	*–45.7*
New York	85.1	87.9	2.8
North Carolina	91.8	90.9	–0.9
North Dakota	47.7	61.3	**13.6**
Ohio	79.4	72.9	*–6.5*
Oklahoma	84.2	85.5	1.3
Oregon	77.9	76.9	–1.1
Pennsylvania	91.2	88.9	–2.3
Rhode Island	87.0	87.5	0.5
South Carolina	86.8	87.7	0.9
South Dakota	76.5	79.6	3.1
Tennessee	87.3	89.4	2.0
Texas	72.5	67.5	–4.9
Utah	86.7	69.5	*–17.2*
Vermont	52.3	54.9	2.7
Virginia	80.2	81.3	1.1
Washington	81.7	66.5	*–15.2*
West Virginia	82.4	89.1	**6.8**
Wisconsin	83.1	82.7	–0.3
Wyoming	72.9	71.6	–1.4

* Increases of 5 or more index points are shown in bold; declines of 5 or more index points are shown in italic.

CONNECTING SHIFT-SHARE ANALYSIS TO INTERNATIONAL TRADE FLOWS

In the present analysis, shift-share analysis is an accounting tool to separate the change in a state's manufacturing exports into potentially meaningful components. The analysis, however, does not provide an economic explanation as to why a state's exports grew faster or slower than the national average. The following discussion elaborates on the distinction between an accounting and an economic explanation.

International trade occurs in response to differences in prices for the same good between countries.[1] If a potential U.S. consumer can purchase a product at a lower price from a producer in Mexico than in the United States, then an incentive exists to engage in international trade. Assuming the costs stemming from trade barriers, including governmental policies such as tariffs and natural barriers such as transportation costs, are not so large as to eliminate the price advantage, then the product will be exported from Mexico to the United States.

A focal point of international trade theory is to identify the reasons why prices differ across countries. Differences across countries in terms of labor forces, stocks of public and private capital, technologies, tastes—even labor laws and environmental standards—are some of the many reasons that might cause prices to differ. Moreover, the economic size of trading partners is likely to be a key determinant of the magnitude of the trade flows between two countries. Larger economic size is likely associated with larger trade flows.

All of these factors—trade policies, transportation costs, productive resources, technology, tastes, and income—and more interact to determine the pattern and level of trade flows. Consequently, changes in these factors will likely affect how trade patterns and levels change over time. In the present study numerous factors are undoubtedly responsible for the export performance of a state between 1988 and 1998.

The shift-share analysis we perform does not allow us to identify which factors determined the relative export performance of a state. At best it suggests which factors deserve scrutiny. For example, assume a state was found to have a favorable destination effect. In 1988 a specific state might have exported a relatively larger portion of its manufactured exports to Mexico than other states. This initial situation reflects the advantages possessed by the state with respect to exporting to Mexico. Transportation costs might have played a key role in this initial condition. Between 1988 and 1998, faster U.S. export growth to Mexico than to other regions throughout the world could be expected to benefit states with relatively larger dependence on the Mexican market. The shift-share analysis provides information as to the extent to which the state is likely to be affected by this development. For the estimate of the destination effect to be plausible, one must anticipate that the advantages under-lying the state's initial export relationship with Mexico are not altered substantially during the period under consideration. The shift-share analysis, however, does not provide the economic reasons for the actual change in a state's exports to Mexico. Two possible economic reasons that come to mind immediately are the implementation of the North American Free Trade Agreement and faster economic growth in Mexico than in other world areas.

Similar comments can be made concerning the insights revolving around the industry mix results. A state with a favorable industry mix is one whose exports initially were relatively more concentrated in industries that experienced relatively rapid growth between 1988 and 1998. The shift-share analysis provides information on the extent to which the state is likely to be affected by the rapid export growth in a specific industry. Additional analysis of economic factors is needed to determine the reasons for the actual change in a state's exports in a specific industry. Some resource or technological change may cause the relatively rapid export growth.

In summary, the shift-share analysis provides some basic information to begin the analysis as to why the export performance of a specific state was above or below the national average. Looking at a state's industry mix and geographic distribution of exports is a reasonable first step in trying to provide an economic explanation for a state's export performance.

[1] Trade may also result from a difference across countries in the quality or variety of goods.

effect is the amount that a state's exports would have increased (or decreased) had they grown at the same rate as the nation's exports. Because the focus of many studies is how well a specific state has performed relative to the nation, frequently this national growth effect is simply subtracted from the change in a state's manufacturing exports to yield a state's net relative change. Then the analysis focuses on the reasons that a state's performance differs from the nation's performance.

Regardless of the handling of the national growth effect in the classic shift-share model, differential state performance is accounted for by an industry mix effect and a competitive effect. The industry mix effect is the amount of change attributable to differences in the initial industry makeup of the state relative to the nation. A positive (negative) industry mix effect indicates that a state's exports were initially relatively more concentrated in industries whose exports expanded faster (slower) than the overall national average. The competitive effect measures state economic changes not attributable to national growth or industry mix effects; it captures how much the state deviates from what would be expected if state export growth were due solely to national export expansion and the state's industry makeup. In the classic shift-share model, a competitive effect indicates the quantitative difference between a state's exports and those of the nation caused exclusively by the difference in the growth rate of that state's industries compared with that of the nation. Thus, the competitive effect is a residual. It captures the effect of changes in various factors operating at the state level, such as endowments of human capital and, possibly, export promotion expenditures.[9]

Because a state's net relative change is simply the sum of the industry mix and competitive effects, this relationship can be expressed mathematically in a straightforward manner. Using the same notation as Gazel and Schwer (1998), the relationship can be expressed:

$$(1) \qquad NRC^s = \sum_i X^s_{i,o}\,(x^n_i - x^n) + \sum_i X^s_{i,o}\,(x^s_i - x^n_i)$$

where *NRC* stands for net relative change; *s* is a superscript designating a specific state; *X* is the dollar value of exports; *x* is the growth rate of exports over the entire period of the study; *o* is a subscript designating the first year of the period of study; *i* is a subscript designating a specific two-digit manufacturing industry; and *n* is a superscript designating the nation.

The first term on the right side of equation (1) is the industry mix effect. The second term is the competitive effect. In terms of the notation, the industry mix effect for state *s* is the summation over the *i* two-digit manufacturing industries ($\sum_i$) of the difference between the growth nationally of exports of industry *i* (x^n_i) and the overall national growth rate of exports (x^n), multiplied by the level of the state's exports of industry *i* at the beginning of the period ($X^s_{i,o}$). The competitive effect for state *s* is the summation over the *i* two-digit manufacturing industries ($\sum_i$) of the difference between the state's growth rate of exports of industry *i* (x^s_i) and the corresponding national growth rate of exports of industry *i* (x^n_i), multiplied by the level of the state's exports of industry *i* at the beginning of the period ($X^s_{i,o}$).

INCORPORATING DESTINATION INTO SHIFT-SHARE ANALYSIS

Gazel and Schwer's incorporation of the destination of a state's exports into a shift-share model is straightforward. The destination effect is the amount of the net relative change attributable to differences in the state's initial export destinations relative to those of the nation. A positive (negative) destination effect indicates that a state's exports were relatively more concentrated in foreign markets whose purchases from the United States expanded faster (slower) than the overall national increase in exports.[10]

A state's net relative change is now the sum of the industry, competitive, and destination effects. The industry mix effect (the first term) is unchanged from equation (1), while the competitive effect from the formula is decomposed into a new competitive effect (the second term) and the destination effect

[9] Coughlin and Mandelbaum (1990) found that the percentage change in human capital per worker was a statistically significant determinant of the competitive effect for the change in state exports from 1976 to 1986.

[10] Cronovich and Gazel (1998) used state-specific trade weights to create a measure of trade-weighted foreign income and found this measure to be a positive, statistically significant determinant of state-level manufacturing exports.

(the third term). Thus, a state's net relative change becomes:

$$(2)\quad NRC^s = \sum_i X^s_{i,o}(x^n_i - x^n) + \left(\sum_i X^s_{i,o}(x^s_i - x^n_i) - \sum_j X^s_{j,o}(x^n_j - x^n)\right) + \sum_j X^s_{j,o}(x^n_j - x^n)$$

where j is a subscript designating a foreign market.

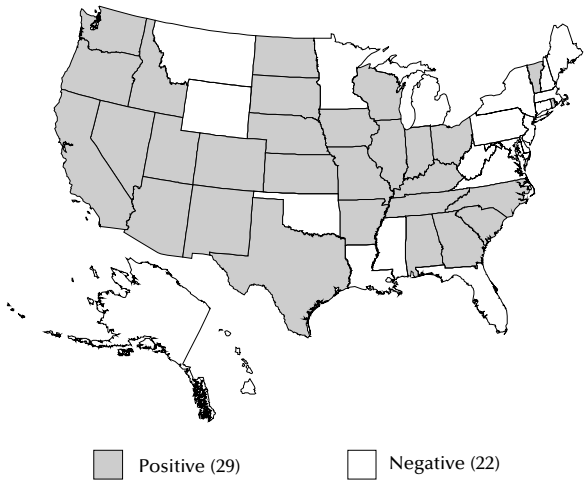
Focusing on changes from equation (1), it is easier to begin with the destination effect. In terms of the notation, this effect is the summation over the j foreign markets ($\sum_j$) of the difference between the growth rate nationally of exports to foreign market j, (x^n_j), and the overall national growth rate of exports (x^n), multiplied by the level of the state's exports to foreign market j at the beginning of the period ($X^s_{j,o}$). The redefined competitive effect is simply the competitive effect defined in equation (1) less the destination effect. By removing the destination effect from the competitive effect, Gazel and Schwer eliminate one of the explanations as to why exports from individual state industries grow at a rate different from that of the corresponding national industries. Gazel and Schwer argue that their modification is especially appealing because it retains the traditional shift-share approach, while highlighting factors that can be viewed as proxies for the supply side (the industry mix effect) and the demand side (the destination effect). The competitive effect, the residual, still may be picking up both unmodeled supply and demand factors.

SHIFT-SHARE ANALYSES OF MANUFACTURING EXPORTS

We present and discuss two sets of results. We examine the results using classic shift-share analysis and then the results using Gazel and Schwer's extension.

States in which exports grew more rapidly than the national average between 1988 and 1998 exhibit a positive net relative change, while those states whose exports grew less rapidly exhibit a negative net relative change. Over this period, exports of 29 states grew more rapidly than the national average, while exports of the remaining 22 states grew less rapidly. The map in Figure 2 distinguishes states on the basis of their net relative change. States with positive values for net relative change can be found throughout the continental United States; however, the states along the Atlantic Ocean northward from Virginia tend to have negative values for net relative change. Selected states in the South, Midwest, and the Rocky Mountains, as well as Alaska and Hawaii, also show slower export growth than the national average.

Figure 2



The classic shift-share results are presented in Table 7. To increase comparability among states, each state's net relative change and the individual components accounting for the net relative change are expressed as percentages of the export levels that would have been achieved in 1998 had the state's exports grown at the national rate between 1988 and 1998. Thus, California's exports in 1998 were 4.1 percent higher than if its exports had grown at the national rate between 1988 and 1998. This normalization allows us to highlight the export performance of those states that have substantially over- and under-performed the nation as a whole. Export growth in 11 states was more than 30 percent higher than would have been the case had their exports grown at the national rate between 1988 and 1998. This difference was most pronounced in New Mexico. Meanwhile, seven states, with Alaska leading the way, had substantially slower export growth than that of the nation.

The net relative change in state exports was driven by the competitive effect, a result similar to that of Coughlin and Mandelbaum (1990).[11] For

[11] To check whether our results were sensitive to the time period, we also examined the periods 1988-93, 1993-98, and 1996-98 separately and found results similar to those reported in Table 7.

Table 7

Classic Shift-Share Results

State	Net relative change*	Industry mix effect	Competitive effect
Alabama	19.5	–3.2	22.7
Alaska	*–86.3*	–29.0	–57.3
Arizona	**53.3**	18.5	34.8
Arkansas	**59.2**	–8.9	68.1
California	4.1	6.2	–2.1
Colorado	20.0	1.8	18.1
Connecticut	–7.1	3.0	–10.2
Delaware	–14.7	–0.8	–13.9
District of Columbia	*–40.2*	8.9	–49.1
Florida	–3.2	1.2	–4.4
Georgia	**43.3**	0.5	42.9
Hawaii	–25.7	–9.8	–16.0
Idaho	11.1	4.0	7.1
Illinois	19.6	0.8	18.7
Indiana	22.7	–0.4	23.1
Iowa	5.9	–3.9	9.8
Kansas	4.9	–7.8	12.8
Kentucky	**44.1**	–4.4	48.5
Louisiana	*–33.9*	–19.9	–14.0
Maine	–0.1	–5.3	5.2
Maryland	–6.5	1.9	–8.5
Massachusetts	–22.9	1.8	–24.7
Michigan	*–35.0*	1.9	–36.9
Minnesota	–15.3	–0.6	–14.6
Mississippi	–17.7	–8.8	–8.9
Missouri	5.2	–1.0	6.3
Montana	*–39.0*	–16.1	–22.9
Nebraska	9.4	–8.4	17.8
Nevada	**34.7**	–1.8	36.5
New Hampshire	–19.2	5.4	–24.7
New Jersey	–8.4	–1.4	–7.1
New Mexico	**420.9**	–5.1	426.0
New York	*–31.2*	3.2	–34.4
North Carolina	18.3	–0.6	18.9
North Dakota	**46.5**	–7.1	53.5
Ohio	1.7	0.1	1.6
Oklahoma	–9.2	–2.1	–7.1
Oregon	16.8	–17.2	34.0
Pennsylvania	–0.8	3.5	–4.3
Rhode Island	4.4	6.4	–2.0
South Carolina	28.5	–0.1	28.7
South Dakota	**128.2**	–2.3	130.5
Tennessee	**52.0**	–0.2	52.2
Texas	17.1	–0.5	17.5
Utah	**61.7**	12.2	49.6
Vermont	**62.7**	23.1	39.6
Virginia	–6.8	–7.0	0.2
Washington	9.9	–9.5	19.4
West Virginia	*–33.2*	–12.7	–20.6
Wisconsin	7.4	–0.8	8.2
Wyoming	–0.4	–17.7	17.3

* Net relative increases of 30 percent or more are shown in bold; decreases of 30 percent or more are shown in italic.

example, for the 29 states with a positive net relative change, the competitive effect is positive for 27 states, whereas the industry mix effect is positive for only 10 states. For the 22 states with a negative net relative change, the competitive effect is negative for 19 states, whereas the industry mix effect is negative for 13 states.

Results based on equation (2) are presented in Table 8. The competitive effect remains the most important factor accounting for a state's net relative change. The industry mix and destination effects are similar in importance, with the destination effect arguably being slightly more important. Using the absolute values of the individual effects, one finds that the competitive effect is the largest effect for 45 of the 51 states, whereas the industry mix and destination effects are the largest for 4 and 2 states, respectively.[12] The destination effect is the second largest effect for 28 states, whereas the industry mix effect is the second largest effect for 20 states. Finally, the industry mix effect is the smallest effect for 27 states, whereas the destination effect is the smallest for 21 states.

California, Louisiana, Montana, and Rhode Island were the four states for whom the industry mix effect dominated the shift-share results. For California and Rhode Island the industry mix effects were positive, indicating that their exports were relatively more concentrated in industries whose exports were rising faster than the national average for all manufacturing exports. For California this was primarily the electrical and electronic machinery industry (SIC 36) and for Rhode Island these were the miscellaneous manufactured goods industry (SIC 39) and the electrical and electronic machinery industry. As Table 3 shows, exports of both of these industries grew faster than the average for all manufacturing exports.

For Louisiana and Montana the industry mix effects were negative, indicating that their exports were relatively more concentrated in industries whose exports were rising less than the national average for all manufacturing exports. Food (SIC 20) and chemicals (SIC 28) were the key industries for Louisiana, whereas primary metals (SIC 33), lumber and wood products (SIC 24), and chemicals were the key industries for Montana. All of these industries had export growth rates below the national average, as shown in Table 3.

Hawaii and Texas were the two states for whom the foreign destination effect dominated the shift-share results. For Hawaii this effect was negative, indicating that its exports were relatively more concentrated in markets whose purchases from the United States expanded less than the national increase in manufacturing exports. Japan accounted for over 50 percent of Hawaii's manufacturing exports in 1988. National exports to Japan rose more slowly than did exports to all countries, as shown in Table 5.

For Texas the destination effect was positive, indicating that its exports were relatively more concentrated in markets whose purchases from the United States expanded faster than the national increase in manufacturing exports. Mexico accounted for 28 percent of Texas's manufacturing exports in 1988. U.S. exports to Mexico rose much faster than exports to all countries, as shown in Table 5.

The absolute values of these three effects are not the entire story. For the 29 states with faster export growth rates than the national average, the competitive effect was positive in all 29 states. For these states, the industry mix effect was positive for 10 states and the destination effect was positive for 6 states. Thus, the industry mix and foreign destination effects were more likely to be *negative* than positive for these states. For the 22 states with slower growth rates than the national average, the competitive effect was negative for 18 of them. The industry mix and destination effects also tended to be negative. The industry mix effect was negative for 13 of the 22 states, whereas the destination effect was negative for 17 of the 22 states.[13]

In view of the conflicting results concerning the relationship between net relative change and the destination effect and between net relative

[12] Our discussion of the results makes no attempt to differentiate states on the basis of size; however, two of the six states in which the competitive effect is not the largest shift-share component were California and Texas. These two were the leading export states in 1998.

[13] When we examined the periods 1988-93 and 1993-98 separately, the results for these periods were very similar to the results reported in Table 8. For 1996-98 the competitive effect is the most important factor; however, it is not as dominant as in the other periods. The industry mix effect is the second most important factor, whereas the foreign destination effect is the least important factor. As Gazel and Schwer (1998) note, the results might be sensitive to the level of data aggregation. The use of a two-digit SIC aggregation rather than a four-digit SIC aggregation might result in a smaller industry mix effect; however, the absence of data precludes exploring this possibility. To see if our results were sensitive to the level of geographic aggregation, we recalculated the model using 20 foreign destinations with the same 20 manufacturing industries. The results are virtually identical to those reported in Table 8.

Table 8

Gazel-Schwer Shift-Share Results*

State	Net relative change	Industry mix effect	Competitive effect	Destination effect
Alabama	19.5	–3.2	**25.9**	–3.2
Alaska	–86.3	–29.0	**–35.4**	–21.9
Arizona	53.3	18.5	**24.9**	9.9
Arkansas	59.2	–8.9	**68.4**	–0.3
California	4.1	**6.2**	1.6	–3.6
Colorado	20.0	1.8	**26.7**	–8.6
Connecticut	–7.1	3.0	**–5.3**	–4.9
Delaware	–14.7	–0.8	**–21.1**	7.2
District of Columbia	–40.3	8.9	**–39.5**	–9.6
Florida	–3.2	1.2	**–12.1**	7.7
Georgia	43.3	0.5	**45.2**	–2.3
Hawaii	–25.7	–9.8	1.7	**–17.7**
Idaho	11.1	4.0	**13.5**	–6.4
Illinois	19.6	0.8	**21.3**	–2.6
Indiana	22.7	–0.4	**23.7**	–0.6
Iowa	5.9	–3.9	**12.5**	–2.7
Kansas	4.9	–7.8	**17.6**	–4.8
Kentucky	44.1	–4.4	**51.1**	–2.7
Louisiana	–33.9	**–19.9**	–11.5	–2.4
Maine	–0.1	–5.3	**7.5**	–2.3
Maryland	–6.5	1.9	**–7.1**	–1.3
Massachusetts	–22.9	1.8	**–15.4**	–9.3
Michigan	–35.0	1.9	**–46.3**	9.4
Minnesota	–15.3	–0.6	**–8.3**	–6.4
Mississippi	–17.7	–8.8	**–10.1**	1.2
Missouri	5.2	–1.0	**4.4**	1.9
Montana	–39.0	**–16.1**	–16.0	–6.9
Nebraska	9.4	–8.4	**21.8**	–3.9
Nevada	34.7	–1.8	**44.1**	–7.6
New Hampshire	–19.2	5.4	**–18.1**	–6.5
New Jersey	–8.4	–1.4	**–3.8**	–3.2
New Mexico	420.9	–5.1	**420.4**	5.6
New York	–31.2	3.2	**–31.1**	–3.3
North Carolina	18.3	–0.6	**23.6**	–4.7
North Dakota	46.4	–7.1	**43.4**	10.2
Ohio	1.7	0.1	**2.2**	–0.6
Oklahoma	–9.2	–2.1	**–7.1**	–0.0
Oregon	16.8	–17.2	**45.2**	–11.1
Pennsylvania	–0.8	3.5	**–4.6**	0.4
Rhode Island	4.4	**6.4**	0.3	–2.3
South Carolina	28.5	–0.1	**32.8**	–4.2
South Dakota	129.0	–2.3	**133.1**	–2.1
Tennessee	52.0	–0.2	**52.5**	–0.3
Texas	17.1	–0.5	0.6	**16.9**
Utah	61.7	12.2	**50.2**	–0.6
Vermont	62.7	23.1	**36.3**	3.3
Virginia	–6.8	–7.0	**7.1**	–6.9
Washington	9.9	–9.5	**30.1**	–10.7
West Virginia	–33.2	–12.7	**–17.8**	–2.8
Wisconsin	7.4	–0.8	**11.0**	–2.8
Wyoming	–0.4	–17.7	**22.7**	–5.4

* The largest effect for each state is shown in bold.

change and the industry mix effect, we calculated some simple correlation coefficients between net relative change and each of the shift-share components. Not surprisingly, a large positive and statistically significant correlation existed between net relative change and the competitive effect (0.87). Albeit positive, the correlation between net relative change and the destination effect (0.20) was not statistically significant. No statistically significant correlation between net relative change and the industry mix effect was found either, and, in fact, a weak negative correlation existed (–0.05).

The preceding results are similar to those generated by Gazel and Schwer using state export data for 1989-92; however, noteworthy differences exist. As with our results, they found that the competitive effect tended to be the most important factor in accounting for a state's net relative change. Using the absolute values of the individual effects, their results revealed that the competitive effect was the largest effect for 39 of the 51 states, whereas the industry mix and destination effects were the largest effects for 5 and 7 states, respectively. Furthermore, for the 35 states with faster export growth than the nation as a whole, their competitive effect was positive for 32 of them.

Meanwhile, somewhat contrary to our findings, their industry mix effect was positive for 21 of these states and the foreign destination effect was positive for 17 states. For the states with slower export growth than the nation as a whole, the signs of the shift-share components were more similar than those for the states with relatively fast export growth. For these 16 states, the competitive effect was negative for 12 states, whereas the industry mix and destination effects were negative for 10 states (not all of which were the same states). Finally, contrary to our findings, they found that both the industry mix and destination effects were correlated positively to a statistically significant extent with net relative change. The differences in their results and ours are due primarily to the dissimilarity in industry coverage. Our study is limited to manufacturing industries, whereas Gazel and Schwer include agricultural and natural resources.

CONCLUSION

State export performance over 1988-98 shows much variation. To account for this variation, the present study used both a classic shift-share analysis and an extension proposed by Gazel and Schwer. In the classic shift-share analysis, differences in state export growth relative to the nation are accounted for by differences in industry mix and competitive effects. The former is positive (negative) if a state's exports were relatively more concentrated in industries whose exports expanded faster (slower) than the national average. The latter effect captures differences accounted for by differences in industry mix. The Gazel and Schwer extension incorporates a destination effect. It is positive (negative) if a state's exports were relatively more concentrated in foreign markets whose purchases from the U.S. expanded faster (slower) than the overall national increase in exports. The competitive effect, now captures differences unaccounted for by the industry mix and destination effects. It is important to stress that these shift-share models are accounting identities and are not economic explanations of, in this case, relative state export growth.

Regardless of the shift-share formula, the competitive effect is the key determinant of whether a state's exports grew more or less rapidly than the national average. Increased knowledge of the factors determining this effect is essential for understanding the relative export performance across states. Prior research suggests one possible economic explanation for this result: that those states with larger increases in human capital per worker have seen their industries outperform the corresponding national industries in terms of export growth.

Generally speaking, the destination and industry mix effects were equally important but not necessarily in the ways one might expect. For example, for those states whose exports grew more rapidly than the national average, both the industry mix and foreign destination effects were negative. For those states with slower export growth rates than the national average, the industry mix and destination effects were negative, as expected. Overall, the destination effect was correlated positively with net relative change; however, this relationship was not statistically significant. Consequently, the results associated with the foreign destination effect, while enriching the shift-share formula, reveal that this effect is, at most, a small piece of the puzzle for understanding the relative manufacturing export performance across states between 1988 and 1998.

Looking forward, because the industry distribution of most states became more similar to the nation's between 1988 and 1998, the industry mix

effect is likely to become less important in accounting for state manufacturing export growth. Because the export similarity on a geographic basis has changed little, the importance of the foreign destination effect is likely to increase in importance relative to the industry mix effect.

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