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# EXPORTS AND REGIONAL ECONOMIC RESTRUCTURING*

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## Introduction

The last decade has witnessed a significant restructuring within regional economies. Not only has the proportion of manufacturing employment in the nation's economy declined, but also a significant structural shift has occurred in the location of manufacturing across states and the composition of manufacturing within states. For example, the structure of Ohio's manufacturing sector has changed dramatically during the last decade, mainly as a result of changes in the share of primary metals and transportation equipment. Primary metal's share of Ohio's total manufacturing output fell from 13.6 percent in 1980 to 8.7 percent in 1986, while transportation's share rose from 14.7 percent to 25.3 percent of the state's manufacturing output in the six year period.

Numerous factors have contributed to the restructuring during the 1980s. Oil prices continued to display volatility, particularly between 1979 and 1981; defense spending was concentrated primarily in the two coastal economies, bolstering the demand for products of key industries in those areas; input substitution, such as plastics for steel in auto production, played a major role in restructuring regional economies heavily dependent on traditional industries. Increased integration of the world economy also should be included in the list. For the U.S., real imports as a share of GDP rose from 10.5 percent in 1980 to 14.3 percent in 1986. During the same period, the real export share remained relatively constant.

The impact of the expansion of world trade on domestic regional economies can be significant. Imports can decrease domestic production by competing head-to-head with domestic suppliers and displacing their output. Exports, on the other hand, can increase domestic production by expanding demand for domestic products. Because the mix of products demanded by foreign economies may not coincide with the present mix of domestic output, expansion of foreign demand can change the composition of domestic production by stimulating production in some industries and not in others.

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Two approaches have been pursued in the literature to examine the relationship between international trade and regional economic change. The first method estimates the effects of exchange rates and other important determinants of trade on exports and imports by industry using national data and then applies the results to states by weighting the national effects by the industry mix in the various states (e.g., Cox and Hill [5]). The second approach regresses state gross domestic product measures (or manufacturing shipments) on these same trade factors, which yields reduced form estimates of the net effect of these variables on exports and imports and the effect of exports and imports on domestic production (Carlino, Cody, and Voith [3] and Branson and Love [2]).

One difficulty with the first approach is that no consideration is given to differences in the comparative advantages of states or to differences in the mix of countries to which they export. A problem with the second approach is its inability to disentangle the layers of effects that link determinants of exports to regional economic restructuring. Although estimates of the net effect of exchange rates and foreign income on aggregate regional economic activity are informative, this literature does not consider some fundamental relationships between a state's exports and its production. For instance, to what extent can foreign exports stimulate domestic production (total production minus exports) and does this effect vary across industries and states? Are the effects of exports on a state's economy determined primarily by the mix of industries in the state or do state-specific factors influence the relationship between a state's exports and its production? Addressing these questions will further understanding of the sources of the effect of a state's export sector on its economic growth and restructuring.

This paper focuses on the relationship between exports and domestic production and the properties of this relationship that can lead exports to influence the structuring of state economies. These propositions are examined empirically using state level data for two digit industries for selected states between 1980 and 1986.

## Linkage Between Exports and Production

The linkage between international trade and regional economic restructuring can be represented by two equations. The first is the export equation that relates exports by states and industries ($x_{ij}$) to various determinants of exports, such as foreign exchange rates, foreign income, relative labor costs, and productivity differences, which are denoted by the vector $z_1$. The second equation relates domestic production ($y_{ij}$) to exports and other determinants of domestic demand

such as domestic income. Let these determinants be denoted by the vector $z_2$. These relationships can be written as

(1) $x_{ij} = x(z_1)$

(2) $y_{ij} = y(x_{ij}, z_2)$.

Studies such as Carlino, Cody, and Voith and Branson and Love substitute the first equation into the second to produce a reduced form relationship between domestic production and foreign exchange values, foreign income, and other determinants of trade.

The sensitivity of state domestic production to these determinants of international trade depends on the net effect of the relationships represented in the two equations. For example, Branson and Love find that states vary significantly in the sensitivity of their manufacturing sectors to foreign exchange rates and foreign income. Carlino, Cody, and Voith find that selected factors of international trade affect industries differently. This paper complements these two studies by examining the relationship between exports and domestic production described in equation (2).

An increase in exports can increase domestic shipments for several reasons. First, there may be multiplier effects--producing more output for export requires more domestic shipments as intermediate inputs in the industry's production process. The export-induced expansion of production can occur both within an industry, because much of an industry's output is used as its own inputs, as well as between industries. Second, higher exports may result in higher income, which in turn stimulates demand and thus domestic production. Third, if an industry is characterized by decreasing average costs, then expansion of output from increased exports may lower unit production costs, which reduces prices and spurs domestic consumption. Fourth, increases in exports move the industry further down its learning curve, which increases productivity and improves product quality. Last, if exports are increasing because of favorable exchange rate movements, then domestic shipments could be increasing because domestic producers are better able to compete with imports.

A positive correlation between export growth and output, however, is not sufficient for exports to cause economic restructuring. For economic restructuring of domestic production within states to occur, the growth rates of output of the various industries that form a state's economy must grow at different rates. This results in changes in industry shares of the state's total output. Referring to equation (2), it is apparent that exports can induce this restructuring in two ways, assuming that a positive relationship holds between exports and

domestic production. First, the growth rates of exports may differ across industries. Second, the effect of exports on production may differ across industries. Satisfying either or both of these cases would bring restructuring of the state's manufacturing sector. The following section examines the patterns of export growth across states and industries and then looks at the relationship between exports and domestic production.

## Patterns of Growth in Exports and Domestic Shipments

### Signs of Restructuring

Structural change generally is measured by discrete changes in the industry shares of either output or employment for comparable periods over a business cycle. For this study, the basic measure of economic activity is shipment of goods manufactured in the U.S. This measure is preferable to employment because it accounts for regional differences in productivity. When examining the relationship between exports and production, total shipments are considered along with domestic shipments (total shipments minus exports). This distinguishes the effect of the tautological relationship of a change in exports on the export sector of each industry from the multiplier effect of a change in exports on production for domestic sales. Data on exports and value of shipments come from the *Annual Survey of Manufacturers.*

The analysis includes a sample of 31 states, as listed in Table 1. These states include most of the largest exporters of goods. Many of the omitted states lie in the interior of the country, particularly the West South Central and Mountain regions. The time period covered is 1980 to 1986, which corresponds roughly with the peak of the 1975 to 1980 expansion and the midpoint of the current expansion. Also, this period coincides with the general appreciation in the value of the U.S. dollar. The time period does include the episode after 1985 when the value of the U.S. dollar began to fall. This should not affect the analysis, as most studies show that it takes up to 18 months for the effect of a lower dollar to be realized in exports (see Anderson, Karamouzis, and Skaperdas [1]).

This paper adopts Lawrence's [6] index of structural change. Lawrence measures structural change within a regional economy as the summation across industries of the absolute difference between industry shares in cyclically comparable time periods, adjusted for the length of the time interval. One slight modification is made by using the mean instead of the sum. Because some states do not have the full complement of two digit industries, an index based on the summation of

these absolute differences instead of the mean would be biased downward.

Table 1 shows the ranking of states from greatest to least structural change, according to the modified Lawrence index. With respect to total shipments, Kansas tops the sample of 31 states with the most restructuring between 1980 and 1986. Petroleum and transportation equipment appear to account for most of the restructuring. Petroleum fell from 24 percent in 1980 to 9 percent in 1986, while transportation equipment increased from 17 percent to 25 percent. With respect to domestic sales, Vermont ranked highest in restructuring, although Kansas followed closely. Nonelectrical machinery appears to account for much of Vermont's restructuring, falling from 16 percent of the state's domestic shipments in 1980 to 9.4 percent in 1986. West Virginia has experienced the least amount of restructuring. It relies primarily on the chemical industry, which has maintained a constant share of total state domestic output over the period.

### Growth Rates of Exports and Domestic Shipments

As mentioned earlier, in order for industry shares of either exports or domestic sales to change over time, the growth rates of the various industries must differ. Table 2 displays the growth rates for exports and domestic shipments for the period 1980-1986. Because this period is marked by general appreciation of the dollar, it is not surprising that the growth rate of exports for the U.S. and for the sample of 31 states is lower than the growth rate of domestic shipments.

Eleven of the 31 states in the sample run counter to this general trend. Many of these states are relatively small, with the exception of Minnesota, Maryland, and Connecticut. Minnesota's export sector was spurred in part by nonelectrical machinery, which increased 74 percent over the seven year period. The electronics and electrical equipment industry helped to push the growth rate of Maryland's export sector above the growth rate in the state's domestic shipments. Connecticut owes much of its export growth to the nonelectrical machinery and transportation industries.

Behind these state growth rates is considerable variation across industries within states. For instance, although Pennsylvania's export sector declined by 18 percent, six of the state's 22 industries registered positive growth during the period. The opposite pattern also is found. Although Minnesota's export sector increased 43 percent between 1980 and 1986, 11 of its 24 industries experienced declines in exports.

The different growth rates in exports among the state's industrial sectors signals restructuring within the export sectors of states.

According to the modified Lawrence index, the export sectors of states have undergone considerably greater restructuring during the 1980-1986 period than either total shipments or domestic sales. As shown in Table 1, Vermont ranks at the top in terms of restructuring within its export sector and second in restructuring of its manufacturing sector. The industry that experienced the most change, nonelectrical machinery, is also Vermont's second largest export industry--12 percent of its shipments are exported. This restructuring in exports presumably weighs heavily in the restructuring of Vermont's manufacturing sector, 9 percent of its shipments of manufactured goods are exports, placing it fifth in the sample of 31 states in terms of this measure of an open regional economy.

### Explaining Changes in Exports Across States and Industries

Most studies of the determinants of international trade consider only the behavior of exports at the national level and consequently ignore variations that may occur across states. Export growth can differ across states, however, primarily because each state exports its products to a different mix of foreign countries. As a result, each state's exports are influenced by a different set of foreign exchange, foreign income growth, productivity differences, and relative labor costs. Smith [8] shows, using a recently released export dataset, that destination shares of manufactured exports vary among regions. For instance, he shows that 24.3 percent of West manufacturing products are shipped to Japan, whereas only 7.8 percent of Great Lakes manufactured products reach that destination.

Proximity is not necessarily the primary determinant of the destination of exports. For instance, although New England is further from Japan than the Great Lakes region, 23.5 percent of their exports go to Japan. Furthermore, proximity to specialized ports does not necessarily explain these trade patterns. Although the South Atlantic states are on the same eastern seaboard as New England, they ship only 6 percent of their products to Japan.

The change in exports also can vary across industries for many of the same reasons they can vary across states: differences among nations in productivity, in labor costs, and in product quality. Ceglowski [4], using estimates based on national data, demonstrates the variation in sensitivity among industries to foreign exchange rates and foreign income.

How much of the variation in exports can be attributed to differences across states and across industries? To address this question, the percentage change in exports was regressed on state and

industry dummy variables. Results, shown in Table 3, provide little insight into the determinants of export growth, however. State and industry dummy variables explain only 13 percent of the total variation in export growth. The small percentage of total variation that is explained by these dummy variables is split fairly evenly between states and industries. Variation across states accounts for 57 percent of this explained variation, and variation across industries accounts for 43 percent. In comparison, the value of shipments exhibit a different pattern of variation. State and industry dummy variables explain 43 percent of the variation, which is a much larger percentage than for exports. The variation across industries accounts for 65 percent of the explained variation, and the remainder is due to differences across states.

The reason why state and dummy variables explain a much larger percentage of total variation of shipments than of exports has to do with the amount of variation across states within a particular industry; that is, the interaction effect. For exports, 87 percent of the total variation of exports are attributable to this interaction effect. For shipments, the interaction effect accounts for only 57 percent.

Therefore, exports exhibit relatively little systematic variation among states or industries. This means that a state's growth rate of exports cannot be explained by the mix of industries in the state. Rather, exports appear to be sensitive to factors that are a combination of both state-and industry-specific factors. Thus, the growth rate of a particular industry's exports will vary according to conditions specific to the state, such as wage rates and tax rates, and to conditions specific to countries to which these products are shipped. In comparison, growth rates of total shipments appear to behave more similarly across states, which means that the output growth rate of a state is linked more tightly to its industry mix.

In summary, exports vary significantly across states and industries, but little of this variation can be explained by examining either states or industries separately. Most of the variation results from the interaction of these two effects. The randomness of the variation in export growth is consistent with the first condition for export-induced restructuring.

## Exports and Domestic Output

The second condition that must hold in order for exports to affect domestic economic restructuring calls for variation across industries in the relationship between exports and domestic output, as shown in equation (2). To test this relationship, the percentage change in domestic output is regressed on the percentage change in exports. The

data consist of observations of two digit industries across states between 1980 and 1986. Implicit in this analysis is the assumption that exports are determined exogenously; therefore, the direction of causation runs from exports to output.

The results are summarized in Table 4. Of the 18 industries considered, exports exhibited a positive and statistically significant effect on total shipments for 11 industries and on domestic shipments for eight industries. Textiles, nonelectrical machinery, and leather exhibited the largest sensitivity between exports and total shipments. On the other hand, the relationships for fabricated metals, food processing, and instruments, for example, were not significantly different from zero.

The sensitivity of domestic shipments to exports exhibited the same general pattern. Furthermore, as anticipated, the effect of exports on total shipments was larger in all cases than the effect of exports on domestic shipments, as shown in Table 4. As discussed earlier, this follows from the fact that total shipments include the export sector of each industry, which increases proportionately with the change in exports.

Several hypotheses were presented earlier regarding the linkage between exports and domestic production. Two possible linkages are considered here: the size of the industry's export sector and the within industry multiplier effect. To test these two hypotheses, the export-sensitivity estimates, from Table 4, were regressed on the size of the industry's export sector, measured at the national level, and the magnitude of the multiplier, measured by the direct requirements from the national input-output table (for 1977). These results suggest the relative importance of these two factors.

The results from this estimation are presented in Table 5. The industry's export size (XSIZE and $XSIZE^2$) has no statistically significant relationship with the export-sensitivity measure. The direct requirement variable (DIRECT), on the other hand, has a positive and statistically significant effect on the export-sensitivity coefficient. This suggests that exports have a larger effect on industries that use a larger proportion of their output as their own intermediate inputs.

## Conclusion

This paper examines the proposition that exports can be a source of economic restructuring with regional economies. Two conditions were posited that could result in exports affecting economic restructuring. First, substantial variation must exist across industries in the growth rates of exports. Second, the effect of exports on domestic shipments also must vary by industry. Either or both of these

conditions would lead to economic restructuring as long as their exists a statistically significant relationship between exports and domestic shipments.

The results presented in this paper suggest that exports can be a significant factor in regional restructuring within the U.S. Using state data on exports by industry between 1980 and 1986, it is found that both conditions are met. Exports vary significantly among industries and states, and the effect of exports on domestic shipments also varies among industries. Furthermore, variation in export growth is idiosyncratic to states and industries. Export growth of a specific industry differs depending upon the state in which in the industry is located. In addition, it is found that the sensitivity of domestic shipments to exports depends on the within industry input requirements of each industry and not on the size of the export sector within each industry.

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**Table 1**
Ranking of States by Extent of Structural Change
1980-1986

| State | (1) Total Shipments | (2) Domestic Shipments | (3) Exports |
|---|---|---|---|
| Kansas | 1 | 2 | 12 |
| Vermont | 2 | 1 | 1 |
| Missouri | 3 | 4 | 10 |
| Minnesota | 4 | 5 | 22 |
| New Jersey | 5 | 6 | 25 |
| Maryland | 6 | 8 | 11 |
| Maine | 7 | 9 | 2 |
| Pennsylvania | 8 | 10 | 27 |
| Washington | 9 | 3 | 30 |
| Florida | 10 | 11 | 6 |
| Illinois | 11 | 13 | 15 |
| Ohio | 12 | 12 | 9 |
| California | 13 | 7 | 14 |
| Delaware | 14 | 16 | 3 |
| North Dakota | 15 | 14 | 7 |
| Massachusetts | 16 | 17 | 21 |
| New Hampshire | 17 | 15 | 17 |
| Georgia | 18 | 18 | 20 |
| South Carolina | 19 | 21 | 16 |
| Michigan | 20 | 19 | 28 |
| Indiana | 21 | 20 | 8 |
| Iowa | 22 | 23 | 5 |
| **United States** | 23 | 22 | 32 |
| Oregon | 24 | 25 | 19 |
| Virginia | 25 | 26 | 26 |
| Connecticut | 26 | 24 | 18 |
| North Carolina | 27 | 27 | 24 |
| Wisconsin | 28 | 28 | 23 |
| Nebraska | 29 | 29 | 29 |
| New York | 30 | 30 | 31 |
| West Virginia | 31 | 32 | 4 |
| South Dakota | 32 | 31 | 13 |

Note: States are listed in order of the difference between structural change in exports and structural change in domestic shipments. The rankings are from greatest to least amount of restructuring as measured by the change in shares between 1980 and 1986

Source: *Annual Survey of Manufacturers* (selected years) and authors' calculations

**Table 2**
Growth Rates of Exports and Domestic Shipments
1980-1986

| State | Percentage Change in Exports | Percentage Change in Domestic Shipments |
|---|---|---|
| **United States** | 5.4 | 23.5 |
| California | 4.5 | 29.2 |
| Connecticut | 40.2 | 26.9 |
| Delaware | 29.7 | 7.0 |
| Florida | -2.6 | 57.6 |
| Georgia | 18.6 | 59.7 |
| Illinois | -28.5 | 4.5 |
| Indiana | 6.1 | 20.3 |
| Iowa | -31.8 | 2.3 |
| Kansas | 27.5 | 25.9 |
| Maine | 113.7 | 26.9 |
| Maryland | 45.3 | 27.4 |
| Massachusetts | 17.5 | 42.8 |
| Michigan | 24.1 | 54.1 |
| Minnesota | 43.4 | 28.7 |
| Missouri | 79.2 | 48.6 |
| Nebraska | 1.0 | 11.5 |
| New Hampshire | 49.1 | 42.7 |
| New Jersey | -17.0 | 8.3 |
| New York | 4.9 | 24.7 |
| North Carolina | 16.7 | 53.7 |
| North Dakota | 76.3 | 4.1 |
| Ohio | 4.4 | 29.7 |
| Oregon | 4.1 | 16.1 |
| Pennsylvania | -18.5 | 1.7 |
| South Carolina | 6.7 | 45.8 |
| South Dakota | 25.4 | 46.1 |
| Vermont | 31.6 | 29.7 |
| Virginia | -15.7 | 48.9 |
| Washington | 17.7 | 20.3 |
| West Virginia | -1.3 | -4.7 |
| Wisconsin | -13.6 | 31.1 |
| All | 16.6 | 28.1 |

Source: *Annual Survey of Manufacturers* (selected years) and author's calculations

**Table 3**
Variation in the Growth of Total Shipments, Domestic Shipments, and Exports Across States and Industries

| Dependent Variable | Dummy Variables Included | | |
|---|---|---|---|
| | State (1) | Industry (2) | Both (3) |
| Total Shipments | .149 (35.1) | .281 (64.9) | .425 |
| Exports | .074 (56.1) | .055 (41.7) | .132 |

Note: The numbers in the table are the R-squared coefficients obtained by regressing the percentage change in total shipments on state dummy variables (column 1), industry dummy variables (column 2) in separate equations, then estimating both sets of dummy variables together (column 3). The same procedure was followed for exports. The numbers in parentheses are the percent of the total explained variation explained

Source: *Annual Survey of Manufacturers* (selected years) and authors' calculations

**Table 4**
Sensitivity of Total Shipments and Domestic Shipments to Exports

| Industry | Sensitivity Estimates Total Shipments (1) | Domestic Shipments (2) | (1)-(2) (3) |
|---|---|---|---|
| Textiles | .870* | .864* | .006 |
| Machinery, Excluding Electrical | .521* | .422* | .099 |
| Leather | .368* | .335* | .033 |
| Primary Metals | .354 | .306 | .048 |
| Transportation Equipment | .351* | .349* | .002 |
| Rubber & Plastics | .279* | .228* | .051 |
| Apparel | .269* | .208 | .061 |
| Chemicals | .264* | .191* | .073 |
| Stone, Clay, & Glass | .232* | .196* | .036 |
| Lumber | .218 | .197 | .021 |
| Electronics & Electrical Equipment | .193* | .120 | .073 |
| Petroleum | .121 | .114 | .007 |
| Instruments | .106 | .057 | .049 |
| Paper | .106 | .071 | .035 |
| Printing & Publishing | .083* | .074 | .009 |
| Furniture | .067* | .058* | .009 |
| Fabricated Metals | .060 | .007 | .053 |
| Food Processing | .052 | .007 | .045 |

Note: Sensitivity estimates are derived from regression estimates by regressing the percentage change in total (domestic) shipments on the percentage change in exports and the percentage change in exports squared. The net effect of these two coefficients related to percentage change in exports yields the sensitivity estimate. Asterisks indicate that at least one of the coefficients is statistically significant at the 10 percent level

Source: *Annual Survey of Manufacturers* (selected years) and authors' calculations

**Table 5**
Relative Importance of Industries Export Sector
Versus Within Industry Multiplier Effects

| Variable | Total Shipments Parameter Estimate | Total Shipments T-Ratio 12 df | Domestic Shipments Parameter Estimate | Domestic Shipments T-Ratio 12 df |
|---|---|---|---|---|
| INTERCEPT | 0.137 | 1.03 | 0.115 | 0.851 |
| XSIZE | -5.07 | 1.02 | -5.51 | -1.09 |
| $XSIZE^2$ | 33.4 | 1.22 | 34.3 | 1.23 |
| DIRECT | 1.33 | 2.58 | 1.36 | 2.59 |
| R-squared | 0.368 | | R-squared | 0.349 |

Source: *Annual Survey of Manufacturers* (selected years) and authors' calculations