Estimating U.S. metropolitan area export and import competition

William Testa, Thomas Klier, and Alexei Zelenev

This article calculates estimates of the extent to which U.S. cities' manufacturers face competition from foreign producers. Foreign and U.S production can compete in the U.S. domestic market, foreign markets, or both. Accordingly, this article examines measures of metropolitan-area (MSA) level import competition, based on each city's industrial composition and industry-level data on import competition, as well as measures of metro-level export competition, based on U.S. export data. With these measures, we evaluate whether the growth experience of U.S. cities that face high competition from foreign producers substantially differs from that of cities with low competition. Measures of import and export competition at the MSA level may be helpful to metropolitan area residents and policymakers in evaluating their own actions in various arenas such as household movements, investment, and local development.

The International Trade Administration (ITA) tracks exports from U.S. metropolitan areas. However, there are no comparable statistics of actual *imports* into particular metropolitan areas. Nor, even if they existed, would such figures be particularly useful in measuring the degree to which metropolitan area economies (and their local industries) are impacted by import competition. To the extent that the manufacturing sector of a metropolitan area sells much of its output to markets located outside of its own metropolitan area, own-industry imports at the metropolitan area level would not fully measure the degree of competition to this metropolitan area's producers. As an alternative to such a hypothetical measure of local imports, we construct measures of metropolitan areas' exposure to *national* or U.S. market import competition.

In examining trends in imports into the U.S. market over time, we find robust growth in imports of manufactured goods during the 1990s. As one measure, we allocate such imports—good by good—to each metropolitan area based on its own size and mix of manufacturing industries. In constructing these estimates, we find a wide variation across U.S. metropolitan areas in import market share and in the growth of such imports from 1989 to 1999. A rapidly growing share of imports, however, does not necessarily accompany local production decline or stagnation, because rising imports may also be associated with a rising domestic demand for these products. For example, imagine the rapidly rising U.S. imports for pharmaceuticals not necessarily *displacing* domestic production, but simply serving a growing market (perhaps fueled by an aging U.S. population).

A separate and different accounting of import behavior over time, the degree of "import penetration," measures the extent to which the domestic U.S. market for goods is served by foreign sources rather than domestic producers. Here again, we find a wide regional variation, both for the current period and across time. Such evidence of market penetration does not, of course, measure changes in the economic well-being of workers and firms. Imports of capital goods and technology also assist domestic industry to improve and stay competitive in its production and export activity. Indeed, imports are often not final goods but intermediate products used in the production of other goods, which are ultimately sold both domestically and abroad.[1] And importantly, imports of consumer goods presumably improve well-being and quality of life for U.S. individuals and households. Even on its production side, displacement of manufacturing

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by imports may result in reallocation of workers and capital to higher-valued production, for example, in exports, non-traded goods, or in the service sector. In these ways, enhanced imports can lift domestic production and income rather than retard them.

On the *export* side, we analyze data gathered by the International Trade Administration for large metropolitan areas. These data are reported with several user cautions, the most important of which is that the production locale of exported goods often remains unknown or is misleading, with the reported geography perhaps attributed to the place of final shipment of goods by an intermediary or perhaps to an affiliate of the manufacturer, rather than to its origin of production. To offset the possible slant of these data toward cities where exports are shipped abroad or otherwise affiliated, we construct an alternative, hypothetical measure of exports. This measure allocates U.S. exports by location of similar production activity; in particular, it allocates exports associated with an individual industry in proportion to each MSA's employment share of that same industry in the U.S. Such a measure, imperfect in its own way, is slanted toward production origin of the good rather than toward the place of shipment. Both measures indicate a wide range of openness across individual metropolitan areas. In comparing the two measures of exports, we find significant and systematic differences, suggesting that each measure may reflect a different dimension of metropolitan area exports—both point of production and point of shipment overseas. As evidence, we find that metropolitan areas with large transportation sectors tend to have higher rankings in the ITA's reported MSA export series. The presence of large manufacturing company headquarters, however, does not appear to slant reported ITA export figures in any systematic way.

Given that our import measures are constructs rather than observed data, we would like to test whether these measures lend themselves to a plausible interpretation. We examine the cross-sectional growth behavior of metropolitan areas' net job creation in manufacturing from 1989 to 1999. Using a single-equation ordinary least square (OLS) regression, we regress the growth rate of manufacturing jobs on the growth rates of exports, import market growth, and export and import penetration specific to each U.S. metropolitan area. In this exercise, we find statistically significant regression coefficients that are plausible. That is, trends toward import penetration of an area's local industries are associated with short-term manufacturing job disruption (declines) in a metropolitan area; export growth is associated with manufacturing gain. Yet this simple modeling exercise does not allow firm inferences about causality. For example, increased metro area imports could be a response to a negative technology shock affecting a specific industry in the home country that faces import competition.

In the next section, we begin by looking at some previous studies of imports into the U.S. and then describe our measures of import sensitivity. In the following section, we focus on exports.

Imports

Previous attempts at attributing U.S. imports to regions have been made at broad geographic levels. In their work on the potential impact of the North American Trade Agreement (Nafta), Hayward and Erickson (1995) allocate manufactured imports from Canada and Mexico by individual industry in proportion to each state's share of domestic shipments by that industry. They find much variation among states, and highlight the fact that these trade flows are smaller than most people believe. Hervey and Strauss (1998) allocate manufactured imports for an industrial aggregation at the even-broader "durable" and "nondurable" industry categories, though in the process, they are able to identify imports as coming from 44 individual foreign countries. They attribute high overall import shares to the manufacturing East South Central and East North Central regions. These high import shares are ambiguous in that they might represent either imports into a region or that region's competition for markets served in the remainder of the U.S.

In this section, we improve on these import allocations in two respects. First, we use a much narrower industry breakdown to allocate finely defined U.S. imported goods to particular metropolitan areas. Using employment data for U.S. counties from the *County Business Patterns* (CBP) data, we can identify four-digit Standard Industrial Classification (SIC) based industry definitions for manufactured products.[2] This use of narrow industry definition means, for example, that automotive production (and attendant import competition) need no longer be erroneously attributed to the state of Washington; domestic aircraft production need not be erroneously attributed to Detroit.

A second refinement is that imports can be attributed to metropolitan areas rather than to states and multi-state regions. Metropolitan area economies are more cohesive than state or multi-state economies, in that they share a common work force and transportation infrastructure. In addition, metropolitan areas are not so arbitrarily defined by jurisdictional boundaries, as are state economies, for example.[3]

Import trends

Manufactured imports into the U.S. grew rapidly for most of the 1990s. This is not surprising, given that import growth is strongly influenced by the overall growth of the home country's economy. From 1991, the trough of the previous economic downturn, to 2000, the peak of the expansion, total U.S. imports increased by $722 billion in nominal dollars, and by $616 billion (or 109 percent) as deflated by the general price index for U.S. gross domestic product (GDP) (figure 1). Indeed, import expansion outpaced the more general and robust expansion of the 1990s. As measured against the yardstick of (nominal) GDP, (nominal) imports climbed from an 8.1 percent ratio to GDP in 1991 to over 12 percent in 2000 (figure 2).

Import competition

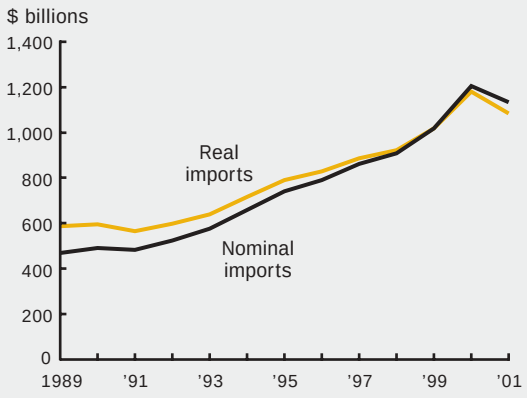
How did the run-up in imports play out across metropolitan areas? In order to link national import growth to the industries of a particular metropolitan area, we examine the industry-by-industry growth of foreign imports in the U.S. market. Therefore, we allocate actual U.S. imports by industry category to individual metropolitan areas according to the metropolitan presence of that same industry. In particular, we use employment data by industry at the county level of geography to construct a local employment share of each national industry for each of 269 metropolitan areas in the United States for 1989 and 1999.[4] Each MSA's employment share of the nation for a particular industry then becomes the metro area's share of national imports for that industry. For each metropolitan area, the sum total of these imports across all industries is taken as the measure of its total import competition.

Thus, import competition in MSA i = Sum over j M_{US}^{ij}, where $M_{US}^{ij} = L^{ij} \times M^{j}$ and L^{ij} = MSA i's share of U.S. employment for good j. M^{j} = U.S. imports of good j.

In examining the 25 most populous metropolitan areas in 1999, the allocated import pattern reveals an approximate but imperfect correspondence with the size of metropolitan population in 1999 (table 1).[5] Places with heavy manufacturing concentrations and large economies—such as Southern California—have an outsized measured share of estimated imports attendant to the region's industrial structure. However, there is much variation in these import allocations owing to varying industry (import) composition. As a yardstick, we can compare allocated imports against the size of each metropolitan economy. In order to do this, we construct estimates of gross metropolitan product (GMP) for each metropolitan area and report imports as a share of GMP.[6] For 1999, we find an estimated average ratio of imports to gross product of 9.48 percent for the 25 most populous metropolitan areas. The Detroit–Ann Arbor area is a leader in this measure with 19 percent. Heavy U.S. imports of automotive products—many of them from nearby Canada—coupled with Detroit's sharp concentration in automotive industries, lie behind the reported import competition. Manufacturing and technology-intensive San Francisco–Oakland–San Jose and Portland–Salem follow behind at 14 percent and 17 percent, respectively. At the other end of the spectrum, the

FIGURE 1

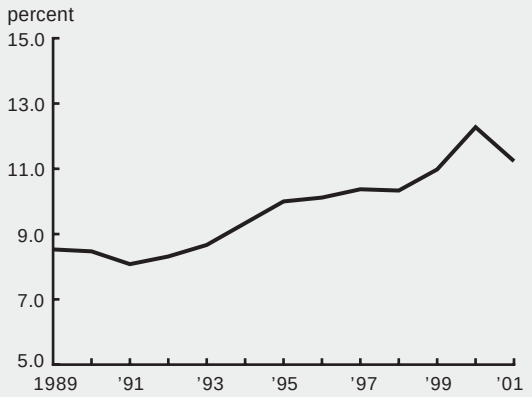
U.S. imports



Note: GDP deflator 1999=100.
Source: U.S. Department of Commerce, International Trade Administration, Trade Development, Office of Trade and Economic Analysis.

FIGURE 2

U.S. imports as percent of nominal GDP



Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Trade Development, Office of Trade and Economic Analysis; Haver Analytics; and U.S. Department of Commerce, Bureau of Economic Analysis.

TABLE 1

Manufacturing imports as percent of GMP (1999)

MSA (by 1999 population)		Rank by imports	Imports ($billions)	% of GMP	GMP ($billions)
1	New York–Northern New Jersey–Long Island, NY–NJ–CT	2	43.3	5.4	797
2	Los Angeles–Riverside–Orange County, CA	1	51.8	11.2	464
3	Chicago–Gary–Kenosha, IL–IN–WI	6	27.9	8.8	316
4	Washington–Baltimore, DC–MD–VA–WV	31	6.1	2.1	289
5	San Francisco–Oakland–San Jose, CA	3	43.1	14.0	308
6	Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD	9	16.6	8.6	193
7	Boston–Worcester–Lawrence, MA–NH–ME–CT	5	28.5	12.5	229
8	Detroit–Ann Arbor–Flint, MI	4	33.7	19.0	177
9	Dallas–Fort Worth, TX	8	17.0	9.1	186
10	Houston–Galveston–Brazoria, TX	7	18.1	11.0	164
11	Atlanta, GA	17	8.4	5.8	145
12	Miami–Fort Lauderdale, FL	40	4.7	5.0	93
13	Seattle–Tacoma–Bremerton, WA	11	10.3	7.8	132
14	Phoenix–Mesa, AZ	16	8.9	10.2	87
15	Cleveland–Akron, OH	18	8.2	9.6	86
16	Minneapolis–St. Paul, MN–WI	14	9.0	8.3	108
17	San Diego, CA	22	7.8	9.4	83
18	St. Louis, MO–IL	24	7.8	10.1	77
19	Denver–Boulder–Greeley, CO	19	8.1	8.5	96
20	Pittsburgh, PA	23	7.8	11.7	67
21	Tampa–St. Petersburg–Clearwater, FL	46	3.5	6.0	59
22	Portland–Salem, OR–WA	10	11.0	17.0	65
23	Cincinnati–Hamilton, OH–KY–IN	28	6.7	11.5	58
24	Kansas City, MO–KS	34	5.6	9.9	57
25	Sacramento–Yolo, CA	64	2.2	4.4	51

Notes: MSA is metropolitan statistical area. GMP is gross metropolitan product.
Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Trade Development, Office of Trade and Economic Analysis; Haver Analytics; and U.S. Department of Commerce, Bureau of Economic Analysis.

Baltimore–Washington, DC area registers only 2 percent on this metric.

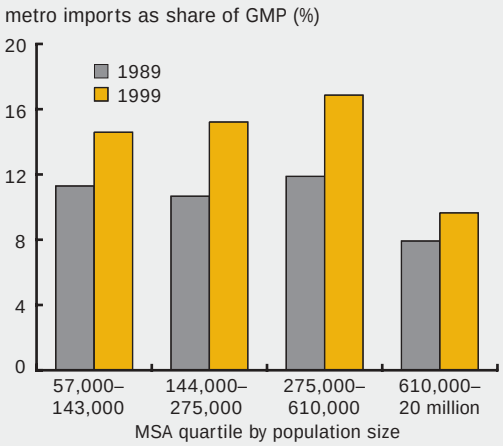
Looking more widely at all metropolitan areas taken as a group, the largest metropolitan areas average less direct import competition in manufacturing than smaller areas (figure 3).[7] In 1999, metropolitan areas greater in population than 610,000 approached 10 percent in import competition versus almost 17 percent for metro areas ranging in size from 275,000 to 610,000. The import competition for smaller metro areas differed little from this.

From 1989 to 1999, import intensity for all metro areas grew significantly, along with the general expansion of imports into the national economy. However, the average differences between large and small metro areas widened significantly, with the third quartile of metro area—with 275,000–610,000 in population—growing the most, from a ratio of 12 percent imports to GMP in 1989 up to almost 17 percent by 1999.

Are large metropolitan areas, then, not "open" economies compared with small metropolitan areas? Large metropolitan areas have increasingly become service economies and less hospitable to many types of manufacturing. Congested highways and high land costs in many large urban areas are not conducive to today's production processes in manufacturing. Nor have the tendencies toward global competition made it any easier for manufacturers in higher cost urban locales. In response, many domestic manufacturing facilities have sought out lower cost locales in small cities and rural areas, often adjacent or with close access to divided highways and the interstate highway system. There are countervailing forces at play, however. A counter-tendency has been the surge in technology and information intensity of the U.S. economy—both manufacturing and services alike. In this regard, urban areas are thought to have an advantage because key inputs to high-tech production—namely information and technology—may be acquired more easily in urban areas. At the same time, high-tech manufacturing industries often feature young firms that require proximity to the wide

FIGURE 3

Import competition by size of metro area, 1989 and 1999



Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Trade Development, Office of Trade and Economic Analysis.

array of specialized business, legal, and financial services that are to be found in large cities.[8]

The high service intensity that is attendant to manufacturing may also mean that data based on manufacturing location alone may belie the actual openness of the largest urban area economies. Embodied in the value of manufactured goods is an increasing service component—be it advertising, design, maintenance, management, marketing, or research and development. The service economy of a large city in America is in this way an unseen portion of international trade in goods. Such considerations are caveats to the traded good measures that we construct, and these caveats are inherent in almost all data on traded goods and their location of value added. More generally, globalization also means that the geography of production is stretched and expanded across wider and wider landscapes, making it more difficult to determine any meaningful and specific location of value added of exports.

Import penetration

An alternative way to measure imports into the U.S. domestic market more directly reflects "competition" to U.S. producers. Import penetration measures the ratio of imports for a particular industry to the sum of imports plus that portion of domestic production that is *not* exported abroad. Varying between zero and one, this measure of import penetration shows the share of domestic sales of a good that is imported rather than domestically produced. We measure an MSA's import penetration as a weighted average of national import penetration for each industry. For each metropolitan area, the weights are its own industry employment shares across all of manufacturing.

Import penetration in *MSAi* = Sum over all industries *j* MP^i, where $MP^i = L^{ij} \times MP^j$ and L^{ij} = *MSAi*'s share of its own manufacturing employment employed in industry *j*. MP^j = U.S. import penetration of good.[9]

Import penetration at the national level is often used to indicate the degree to which domestic sales in an industry have been penetrated or accounted for by imports.[10] For a particular region, we assume that an industry domiciled there tends to sell much of its output across the national domestic market. This assumption is somewhat realistic for U.S. metropolitan area economies because the U.S. market remains the primary market for domestic production plants. Exports as a share of U.S. gross domestic production remain below 8 percent overall. Meanwhile, domestic manufacturing plants sold between 64 percent and 82 percent of production domestically in the year 2000.[11]

We report import penetration estimates for the 25 most populous MSAs for 1999 (table 2). We see a wide range, from an import penetration of 11.7 percent for the Kansas City MSA, to upwards of 24 percent for San Diego. A pattern emerges that seems to suggest that high import penetration alone may not be indicative of local area industrial stagnation. For example, many MSAs known for a concentration in high technology also have high import penetration. These include Boston, the San Francisco Bay area, San Diego, Portland, and Phoenix. Translating metro area import penetration rates to the more familiar state level, we can map the geography of import competition for the entire country (figure 4 on p. 19).[12] One can see that in 1999 most of the states east of the Mississippi River (bold line on map) experienced import competition on par or above the U.S. average (16 percent). Somewhat surprisingly, eight states west of the Mississippi generally not associated with manufacturing report above-average levels of import competition as well.

Increases in import penetration *over time* may be more reflective of industrial competition. Here, the variation in growth of import penetration is again very wide (see table 2). Metro areas such as Miami and Kansas City registered under 30 percent growth in penetration from 1989 to 1999; metro areas as diverse as Seattle and Pittsburgh more than doubled their import penetration over the same period.

TABLE 2

Import penetration, 25 largest metro areas

MSA (by population)		Import penetration *(percent)* 1989	1999	% change 1989–99
1	New York–Northern New Jersey–Long Island, NY–NJ–CT	10.4	17.8	70
2	Los Angeles–Riverside–Orange County, CA	11.1	17.7	60
3	Chicago–Gary–Kenosha, IL–IN–WI	9.6	15.5	62
4	Washington–Baltimore, DC–MD–VA–WV	8.2	12.4	51
5	San Francisco–Oakland–San Jose, CA	16.7	23.7	42
6	Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD	9.3	16.5	77
7	Boston–Worcester–Lawrence, MA–NH–ME–CT	14.6	21.7	49
8	Detroit–Ann Arbor–Flint, MI	11.3	16.3	45
9	Dallas–Fort Worth, TX	10.4	16.1	55
10	Houston–Galveston–Brazoria, TX	8.8	13.9	58
11	Atlanta, GA	8.4	12.6	50
12	Miami–Fort Lauderdale, FL	13.2	16.7	26
13	Seattle–Tacoma–Bremerton, WA	7.9	16.7	112
14	Phoenix–Mesa, AZ	14.7	19.3	32
15	Cleveland–Akron, OH	8.8	13.8	56
16	Minneapolis–St. Paul, MN–WI	9.1	14.1	55
17	San Diego, CA	16.8	24.1	43
18	St. Louis, MO–IL	9.6	12.9	35
19	Denver–Boulder–Greeley, CO*	13.2	17.3	31
20	Pittsburgh, PA	8.7	17.8	104
21	Tampa–St. Petersburg–Clearwater, FL	9.5	16.2	70
22	Portland–Salem, OR–WA	13.2	21.7	64
23	Cincinnati–Hamilton, OH–KY–IN	10.0	16.9	68
24	Kansas City, MO–KS	9.2	11.7	28
25	Sacramento–Yolo, CA	7.9	12.8	62

Notes: MSA is metropolitan statistical area. GMP is gross metropolitan product.
Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration Trade Development, Office of Trade and Economic Analysis; National Bureau of Economic Research; and U.S. Department of Commerce, Bureau of the Census, Center for Economic Studies, *Annual Survey of Manufactures*.

Exports

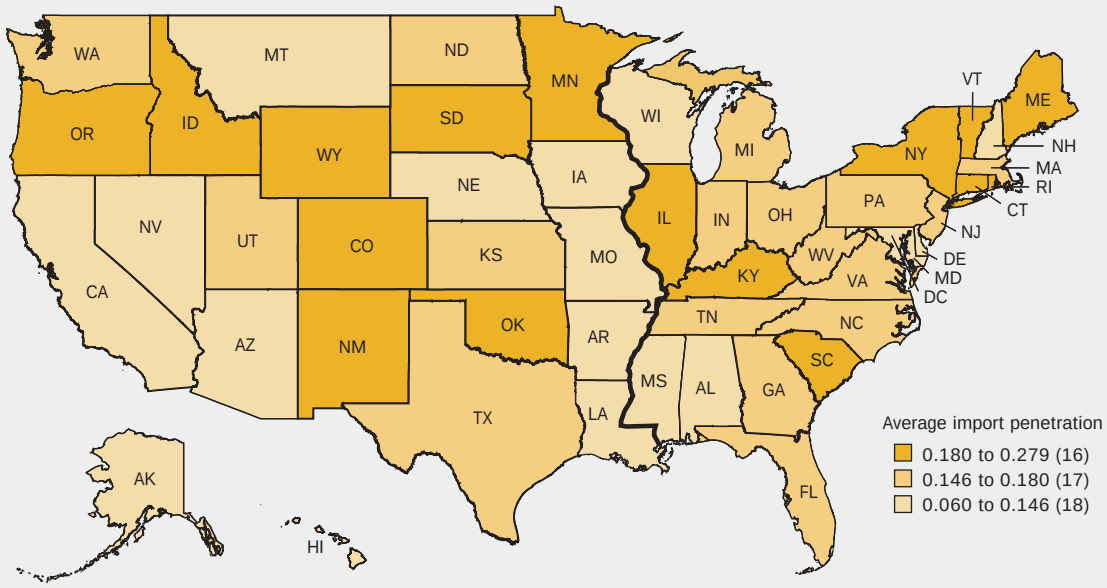
The flip side of import penetration has been the rapid export expansion of U.S. manufacturing. Both economic growth in overseas markets and lower tariff barriers to trade have helped to expand U.S. exports. Until the currency crises beginning in 1997, rapidly developing countries in Asia such as Thailand, Malaysia, Korea, Singapore, and Taiwan led the world in rates of economic growth. Though growth was export-led there, imports of manufacturing goods from developed countries—especially capital goods—grew as well, largely to meet the development needs of manufacturing industries in these nations. The manufacturing sectors of the industrial economies, including the U.S., grew rapidly to meet the demands of both the developing economies and a general worldwide expansion.

The nominal value of manufactured exports attributed to U.S. metropolitan areas was $567 billion for the last reported year, 1999, up from $374 billion in the first reported year, 1993 (see figure 5). Exports began to level off in 1997, coincident with the Asian economic crisis. As measured against the gross domestic product of metropolitan areas, exports declined from a peak of 8.8 percent in 1997 to 7.9 percent by 1999 (see figure 6).

For individual metropolitan areas, export data are telling but not straightforward to interpret. The only publicly reported export figures for MSAs are drawn from information of the U.S. Census Bureau, compiled and reported by the International Trade Administration. In particular, exports are reported by businesses in "export declarations," which identify location using five-digit zip codes. Yet the exporter of record is not necessarily the entity that produced the merchandise, so the data do not fully reflect the production origin of manufactured goods. Instead, the exporter of record is the party "principally responsible for effecting export from the United States."[13] This means that if the exporter of record is a manufacturing company, the location may either be the production plant

FIGURE 4

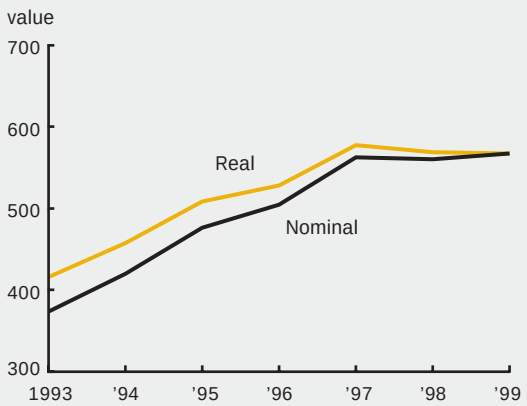
Import penetration 1999: Metro areas by state



or an administrative establishment of the company, such as a corporate headquarters. Similarly, exporters of record can be service companies, typically wholesalers, but also other intermediaries, such as retailers.[14] This means that the wholesaler, headquarters, or marketing arm of manufacturing—to which the export may be attributed by the data—actually tends to be responsible for some significant value added.[15] Yet, the location of export production often tends to be coincident, with wholesalers of a manufacturing product likely to locate in the same region as the producer. The larger metropolitan areas are likely to

FIGURE 5

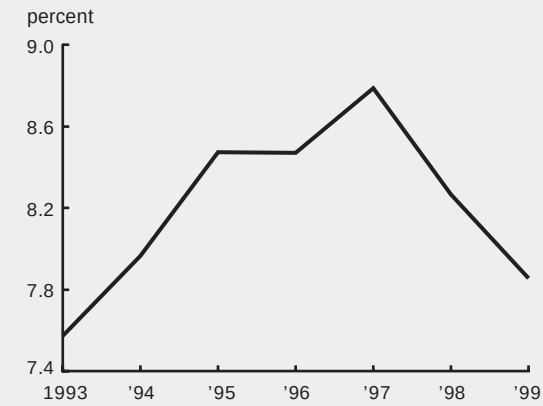
Sum of MSA exports ($ billions)



Notes: GDP deflator 1999=100. Non-manufacturing commodities are subtracted from total exports in 43 MSAs.
Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis and U.S. Department of Commerce, Bureau of Census, *Exporter Location Series.*

FIGURE 6

Metro area exports as share of nominal GMP



Note: Non-manufactured commodities are subtracted from total exports in 43 MSAs.
Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis, *Exporter Location Series*, and U.S. Department of Commerce, Bureau of Economic Analysis.

more accurately represent the location of value-added exports because larger areas are more likely to contain all parties in the transaction—all contributors to value added of the exported good.

Accordingly, we aggregate to the largest possible MSA geographic definition, the so-called consolidated metropolitan statistical area or CMSA. In this way, we minimize the errors inherent in geographical assignment versus site of production. In addition, in reporting on individual metropolitan areas, we focus on the largest MSAs. Wherever possible, we exclude commodities, such as coal and minerals, from our measures of manufacturing exports. Commodities are more likely to be produced outside metropolitan areas, but to be shipped abroad from them.[16]

Export levels tend to correlate with size of the metropolitan area. As a result, a "mega-sized" NY–Long Island–Northern New Jersey consolidated metropolitan area yields very large reported manufactured exports, leading with $46.6 billion in 1999 (table 3).

As we might expect from their large size and manufacturing orientation, the greater Chicago and Los Angeles areas round out the top three in value of exports. However, the correspondence between size of economy and level of exports is highly variable across the top 25 largest metropolitan areas. The ratio of exports to gross metropolitan product averaged 8.7 percent in 1999, but the standard deviation was a sizable 5.2. At the low end, service industry and domestically oriented regional areas such as the Washington–Baltimore–Northern VA area reported a low 3.2 percent of regional product. At the top of the spectrum, shipping-oriented and aerospace-intensive Seattle reported a ratio of 25 percent. High-tech San Francisco–Oakland–San Jose (at 14.8 percent) aligns with our high prior expectations for that economy. Auto-intensive Detroit–Ann Arbor's ratio (at 17.2 percent) may be surprising to some, since the automotive sector is not always known as a U.S. export industry. However, the Detroit auto corridor to Ontario ranks among the

TABLE 3

Metro area export intensity, 1999

	MSA (by population)	Exports ($billions)	% of GMP	GMP ($billions)
1	New York–Northern New Jersey–Long Island, NY–NJ–CT	46.6	5.8	797
2	Los Angeles–Riverside–Orange County, CA	34.7	7.5	464
3	Chicago–Gary–Kenosha, IL–IN–WI	21.5	6.8	316
4	Washington–Baltimore, DC–MD–VA–WV	9.4	3.2	289
5	San Francisco–Oakland–San Jose, CA	45.6	14.8	308
6	Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD	14.2	7.4	193
7	Boston–Worcester–Lawrence, MA–NH–ME–CT	15.5	6.8	229
8	Detroit–Ann Arbor–Flint, MI	30.5	17.2	177
9	Dallas–Fort Worth, TX	11.8	6.4	186
10	Houston–Galveston–Brazoria, TX	19.3	11.8	164
11	Atlanta, GA	7.2	4.9	145
12	Miami–Fort Lauderdale, FL	13.9	15.0	93
13	Seattle–Tacoma–Bremerton, WA	33.0	25.0	132
14	Phoenix–Mesa, AZ	7.3	8.5	87
15	Cleveland–Akron, OH	7.4	8.6	86
16	Minneapolis–St. Paul, MN–WI	8.4	7.8	108
17	San Diego, CA	8.7	10.4	83
18	St. Louis, MO–IL	4.4	5.7	77
19	Denver–Boulder–Greeley, CO[a]	2.6	2.7	96
20	Pittsburgh, PA	3.6	5.4	67
21	Tampa–St. Petersburg–Clearwater, FL[a]	2.4	4.1	59
22	Portland–Salem, OR–WA	7.9	12.1	65
23	Cincinnati–Hamilton, OH–KY–IN	6.6	11.4	58
24	Kansas City, MO–KS	1.6	2.9	57
25	Sacramento–Yolo, CA[a]	2.6	5.1	51

[a]Exports include nonmanufactured commodity shipments

Notes: MSA is metropolitan statistical area. GMP is gross metropolitan product.

Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis; U.S. Department of Commerce, Bureau of the Census, *Exporter Location Series*; and U.S. Department of Commerce, Bureau of Economic Analysis.

most integrated binational economic relationships in the world.[17]

Exports appear to have added to metro area growth in the 1990s, assuming no displacement. For the 25 most populous regions reported in table 4, estimated export growth added an average of 3.4 percent to the size of metropolitan economies from 1993 to 1999. In comparison, import growth (also measured against GMP) for the same period and sample averaged 8.4 percent. The Asian crisis falloff post-1997 in U.S. exports accounts for some of this difference; U.S. exports flattened out, even while domestic demand (and import purchases) continued to grow robustly.

Export-led growth contributed more to large metropolitan area economies than to smaller ones. Over the 1993–99 period, exports contributed an average of over 3 percentage points to growth in metropolitan areas with over 500,000 in population, versus just over 1 percent in the smallest population size category, 250,000 and less.

Can we generalize about export orientation by size of metro area economy? Figure 7 confirms that larger metropolitan areas are more export oriented. The top quartile, with population of 900,000 and above, report a weighted average of over 8 percent exports in 1999. In contrast, smaller metropolitan areas report smaller average export intensities for 1999, with an average of 6.95 percent for the second largest quartile, 6.36 for the third, and 6.74 for the fourth and smallest quartile. Still, these data suggest that smaller metropolitan areas *do* fully participate in export trade. In this regard, it is noteworthy that export intensity increased across all MSA size classes from 1993 to 1999.

A different explanation for the high degree of export intensity in the San Francisco Bay area is that reported exports may overstate actual exports along

TABLE 4

Prospective export intensity

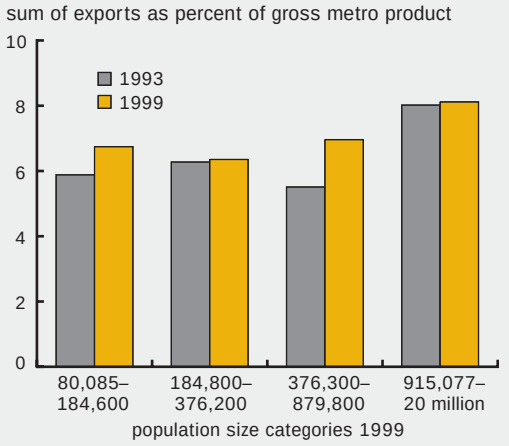
	MSA (by population)	GMP 1993 ($billions)	Exports 1993 ($billions)[b]	Exports 1999 ($billions)[b]	Growth[a] (GMP 1993)
1	New York–Northern New Jersey–Long Island, NY–NJ–CT	561	43.5	41.8	–0.3
2	Los Angeles–Riverside–Orange County, CA	343	25.6	31.1	1.6
3	Chicago–Gary–Kenosha, IL–IN–WI	221	13.8	19.3	2.5
4	Washington–Baltimore, DC–MD–VA–WV	206	8.5	8.4	0.0
5	San Francisco–Oakland–San Jose, CA	190	29.8	41.0	5.9
6	Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD	143	9.3	12.8	2.4
7	Boston–Worcester–Lawrence, MA–NH–ME–CT	152	10.0	14.0	2.6
8	Detroit–Ann Arbor–Flint, MI	128	19.7	27.4	6.0
9	Dallas–Fort Worth, TX	112	6.2	10.6	4.0
10	Houston–Galveston–Brazoria, TX	104	12.8	17.3	4.4
11	Atlanta, GA	86	3.6	6.5	3.3
12	Miami–Fort Lauderdale, FL	67	9.0	12.5	5.1
13	Seattle–Tacoma–Bremerton, WA	82	24.0	29.7	7.0
14	Phoenix–Mesa, AZ	48	4.3	6.6	4.8
15	Cleveland–Akron, OH	65	4.7	6.6	2.9
16	Minneapolis–St. Paul, MN–WI	72	6.2	7.5	1.9
17	San Diego, CA	56	4.3	7.8	6.4
18	St. Louis, MO–IL	57	3.0	3.9	1.6
19	Denver–Boulder–Greeley, CO	57	1.3	2.3	1.7
20	Pittsburgh, PA	51	2.6	3.2	1.2
21	Tampa–St. Petersburg–Clearwater, FL	38	1.3	2.2	2.3
22	Portland–Salem, OR–WA	42	3.6	7.1	8.2
23	Cincinnati–Hamilton, OH–KY–IN	40	3.8	6.0	5.4
24	Kansas City, MO–KS	39	1.1	1.5	0.9
25	Sacramento–Yolo, CA	33	1.2	2.3	3.3

[a]Real growth in 1993–99 exports as a percent of 1993 GMP.
[b]Deflated to 1993.
Notes: MSA is metropolitan statistical area. GMP is gross metropolitan product.
Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis; U.S. Department of Commerce, Bureau of the Census, *Exporter Location Series*; and U.S. Department of Commerce, Bureau of Economic Analysis.

some dimensions. In particular, seaports such as Portland and San Francisco may have more exports attributed to them in the reported data than they would under an alternative method that reflected the origin of production. To explore the possible bias in the reported export data further, we construct a second, hypothetical set of export figures (see table 5). We allocate (impute) to metropolitan areas national-level U.S. Department of Commerce, ITA data on exports. Export data at the national level are available for detailed industry classifications. We apportion these exports to particular metropolitan areas according, again, to the area's national share of employment in the corresponding

FIGURE 7

Export intensity by size of metro areas



Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis; U.S. Department of Commerce, Bureau of Census, *Exporter Location Series*, and U.S. Department of Commerce, Bureau of Economic Analysis.

industry. We then develop an overall measure of exports from each metropolitan area by summing across all industries. In this measure, since we are apportioning exports directly by the location of production, the export total will tend to reflect "origin of movement." Thus, this measure will have the opposite bias to the reported exports, which may reflect point of shipment or arrangement to ship. Note that there will be errors in assigning the exports in the new measure due to the fact that not all industries in locales actually have the same propensity to export. In addition, our measure assumes that labor intensity is uniform geographically within each industry.

Looking individually at the most populous metropolitan areas, we see a general tendency for the reported exports to exceed the estimated and hypothetical measures, though this is not the case for nine of the metro regions. More startling is the extent to which the reported metro area figures exceed the production-oriented estimates that are imputed from ITA data in a number of metro areas with significant international ports or trans-shipment industries: In New York, the reported data exceed the imputed estimate by $22.2 billion (91 percent); in the San Francisco Bay metro area by $18.7 billion (69 percent); in Seattle–Tacoma by $18.5 billion (128 percent); in Miami by $11.6 billion (207 percent); in Houston by $8.1 billion (72 percent); and in Detroit by $15.8 billion (108 percent). On the other hand, interior cities such as Denver, Dallas, and St. Louis display a hypothetical export base, according to the production method of allocation, that is greater than the reported export figures for these cities.

To explain the variance between these data series, we ran an OLS regression with the metropolitan export estimates reported by the ITA as the dependent variable (see table 6 on p. 24). We used the sample of all 208 metropolitan areas for which data were reported for 1998 and 1999. We included an independent variable for each observed metropolitan area, "percent of its employment in transportation industries," to test for the effect of shipment rather than production location on manufacturing exports. Even after accounting for the estimated exports based on the location of manufacturing, the transportation variable is positive and significant at the 1 percent level.

Another source of bias in the reported metro export series is suspected to arise from the separate location of a manufacturer's corporate headquarters from its production plants. In particular, exports may tend to be attributed to the location of the headquarters rather than to the location of the production plant. Large companies in particular have a very high propensity to export, and they also tend to have separate headquarters locations. Accordingly, the presence of a single or multiple large company headquarters in an MSA might tend to inflate the reported export figures compared with our estimated (imputed) export figure, the latter being based on the production employment location of industries. When we account for large headquarters in our regression equation, we find no apparent *systematic* relationship between headquarters location and the levels of reported exports. Of course, there may be significant individual instances in which large-scale exports are attributed to company headquarters, and thereby serve to inflate the reported exports of particular MSAs.

TABLE 5

Export sensitivity test: ITA export data versus estimates

MSA (by population)		1999 ITA exports ($billions)	1999 estimates ($billions)	1999 $X_{ITA} - X_{est.}$ (billions)	1993 $X_{ITA} - X_{est.}$ (billions)
1	New York–Northern New Jersey–Long Island, NY–NJ–CT	46.6	24.4	22.2	23.6
2	Los Angeles–Riverside–Orange County, CA	34.7	32.4	2.3	4.2
3	Chicago–Gary–Kenosha, IL–IN–WI	21.5	17.5	4.0	2.2
4	Washington–Baltimore, DC–MD–VA–WV	9.4	4.5	4.9	5.2
5	San Francisco–Oakland–San Jose, CA	45.6	27.0	18.7	15.6
6	Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD	14.2	10.2	4.0	1.7
7	Boston–Worcester–Lawrence, MA–NH–ME–CT	15.5	18.5	–3.0	–0.9
8	Detroit–Ann Arbor–Flint, MI	30.5	14.7	15.8	6.6
9	Dallas–Fort Worth, TX	11.8	14.6	–2.8	–1.7
10	Houston–Galveston–Brazoria, TX	19.3	11.2	8.1	4.0
11	Atlanta, GA	7.2	5.6	1.6	–0.2
12	Miami–Fort Lauderdale, FL	13.9	2.3	11.6	7.3
13	Seattle–Tacoma–Bremerton, WA	33.0	14.5	18.5	15.5
14	Phoenix–Mesa, AZ	7.3	7.9	–0.6	0.4
15	Cleveland–Akron, OH	7.4	6.4	1.0	0.1
16	Minneapolis–St. Paul, MN–WI	8.4	6.5	1.9	1.4
17	San Diego, CA	8.7	6.5	2.2	0.0
18	St. Louis, MO–IL	4.4	8.4	–4.1	–3.0
19	Denver–Boulder–Greeley, CO	2.6	3.5	–0.9	–1.4
20	Pittsburgh, PA	3.6	4.5	–0.9	–0.3
21	Tampa–St. Petersburg–Clearwater, FL	2.4	2.0	0.4	–0.1
22	Portland–Salem, OR–WA	7.9	7.5	0.4	–0.3
23	Cincinnati–Hamilton, OH–KY–IN	6.6	4.9	1.8	0.7
24	Kansas City, MO–KS	1.6	2.6	–1.0	–1.3
25	Sacramento–Yolo, CA	2.6	1.9	0.7	0.4

Notes: The two datasets overlap between 1993 and 1999. In the data reported by the International Trade Administration (ITA), the non-manufactured commodity shipments have been subtracted in 43 metropolitan statistical areas (MSA).

Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis; U.S. Department of Commerce, Bureau of the Census, *Exporter Location Series*; and U.S. Department of Commerce, Bureau of Economic Analysis.

Examining trade and growth

Are the measures of trade—exports, export competition, import growth, and import penetration—meaningful measures that affect the growth and composition of metropolitan areas? One way to explore this question is to examine the relationship between MSA economic growth and these trade-related measurements over time. To do that, we can relate the growth or decline in MSA total manufacturing employment to changes in these variables using multiple regression. We use manufacturing employment as the growth indicator—the dependent variable to be explained—owing to general data availability of these figures at the MSA level of geography over the 1989–99 period. In particular, because MSAs vary in size, we use the percent change in total manufacturing employment as the dependent variable for the 269 U.S. MSAs.

The general estimation strategy is to examine a cross-sectional panel of the percentage change in manufacturing employment—a variable of growth relative to the size of each particular MSA over a ten-year period. The estimation is in "changes" or first difference form. This functional form has the advantage of differencing out variables which presumably remain constant for individual MSAs over the period, but which vary significantly in level across MSAs—the so-called omitted variable problem. A possible downside is that, in first differencing, any measurement errors in the regression variables tend to be magnified—leading to inefficient estimators or large standard errors in the coefficients.

The explanatory variables are also measured in percent changes, so that the coefficients can be read as elasticities. In this, there are two exceptions. One is that the MSA's predominant broad geographic region is entered as a fixed effect. This is intended to pick up the broad inter-regional shifts of economic activity, which have been taking place from Frost Belt regions to Sun Belt and from the Northeast–Midwest to the

TABLE 6

OLS regression: ITA annual manufacturing exports by metro area (natural log)

	1	2	3
Constant	–6.36**	–3.41**	–4.72**
	(.40)	(.35)	(.46)
Year (1998=1, 0 otherwise)	.075	.067	.071
	(.072)	(.07)	(.069)
Estimated exports (log)		.66**	.46**
		(.05)	(.071)
Gross metro product (log)	1.21**	.49**	.73**
	(.041)	(.06)	(.083)
Employment share, transportation (log)	11.40**	14.0**	14.14**
	(2.00)	(2.00)	(1.95)
Employment share, manufacturing (log)	5.27**		2.64**
	(.049)		(.62)
Number of large manufacturing HQs	–.002	.003	.001
	(.005)	(.005)	(.005)
Adjusted R-squared	.80	.81	.82
	N=416	N=416	N=416

** Denotes statistical significance at the 1 percent level. Standard error in parentheses.

Notes: OLS is ordinary least squares. HQs is headquarters. Regressions were also estimated substituting "all manufacturing headquarters" for "large" with different results. The signs on independent variables, including transportation, remained the same. However, statistical significance dropped. "Large headquarters" is defined as worldwide employment of 2,000 or more. The calculations in this table are based upon $Exports_{MSA} = \beta_1(estExports_{MSA}) + \beta_2(GMP_{MSA}) + \beta_3(ShTr_{MSA}) + \beta_4(ShMfg_{MSA}) + \beta_5(HQ_{MSA}) + \beta_6(Year\ Dummy) + \varepsilon_{MSA}$.

Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis; U.S. Department of Commerce, Bureau of the Census, *Exporter Location Series*; U.S. Department of Commerce, Bureau of Economic Analysis; and Compustat.

South and West. Population in particular has been shifting in these directions, which would be especially reflective of regional shifts in nontraded manufactured goods. A second exception is the "size of MSA economy" variable. This measure reflects the fact that production activity in general has been tending to deconcentrate from large metropolitan areas. This trend has been ongoing for 50 years or more as production technology has been shifting from multi-story, railroad-dependent, labor-intensive modes to low-slung, truck-intensive, capital-intensive operations. We measure each of the remaining variables as percent change and define them identically to those discussed in the preceding sections.

In estimating this simple OLS regression, we find statistically significant results that are plausible (table 7). That is, both export and import growth are associated with manufacturing gains. That is consistent with imports having grown faster in industries with a strong expansion in domestic demand.[18] In addition, we find that import penetration is negatively related to manufacturing employment (column 3). Thus, an increase in the level of imports as a share of domestic demand is associated with lower labor usage over time across metro areas. Similarly, we find a negative relationship between a change in export intensity and manufacturing employment. A possible interpretation is that U.S. industries may need to become more efficient in order to compete in and capture foreign markets. Yet, caution is urged as this simple modeling exercise does not allow for confident inferences about causality. For example, increased metro area imports could be a response to a negative technology shock affecting a specific industry in the U.S. that faces import competition.

Conclusion

The process of globalization has moved ahead over the past ten to 15 years, albeit in fits and starts. Some have speculated that metropolitan economies are sure to undergo restructuring and upheaval attendant to globalization. Their industry structure and performance, along with local wages and prices, are thought to be

TABLE 7

OLS regression: Dependent variable as percent change in manufacturing employment by MSA, 1989–99

	1	2	3	4	5	6	7	8
Constant	–0.0562 (0.030)	–0.0504 (0.033)	–0.0003 (0.030)	–0.0154 (0.029)	–0.019 (0.027)	–0.014 (0.027)	–0.017 (0.029)	–0.062 (0.017)*
% Change exports	0.0873 (0.0144)*	0.0881 (0.0145)*	0.1311 (0.014)*	0.1131 (0.01382)*	0.186 (0.017)*	0.178 (0.018)*	0.179 (0.018)*	0.196 (0.018)*
% Change imports	0.0202 (0.00948)*	0.0212 (0.00950)*		0.0492 (0.0097)*	0.021 (0.008)*	0.027 (0.01)*	0.028 (0.010)*	0.035 (0.010)*
% Change import penetration			–0.1208 (0.0241)*	–0.1773 (0.0256)*		–0.039 (0.034)	–0.038 (0.035)	–0.036 (0.035)
% Change export penetration					–0.250 (0.027)*	–0.218 (0.039)*	–0.217 (0.040)*	–0.266 (0.039)*
% Change productivity, 1987–97		–0.0287 (0.0130)*					–0.015 (0.011)	–0.011 (0.012)
Size of MSA by GMP, 1989	–0.0009 (0.0003)*	–0.0007 (0.0003)*	–0.0009 (0.0003)*	–0.0009 (0.0003)*	–0.0006 (0.0003)*	–0.0006 (0.0002)*	–0.0006 (0.00002)*	–0.0007 (0.00002)*
Regional fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Sample size	269	269	269	269	269	269	269	269
R-bar squared	0.350	0.367	0.397	0.451	0.510	0.510	0.517	0.473

* T-stat significant at 5 percent level.

Notes: Standard errors in parentheses. OLS is ordinary least squares. MSA is metropolitan statistical area. GMP is gross metropolitan product. The calculations in this table are based upon $PchMfgEmp_{msa} = \beta_1(pChExports_{msa}) + \beta_2(pChImports_{msa}) + \beta_3(pChImPenetration_{msa}) + \beta_4(pChExportPenetration_{msa}) + \beta_5(pChProductivity) + \beta_6(regional\ dummies) + \upsilon_{MSA}$.

Source: Authors' calculations based on data from U.S. Department of Commerce, International Trade Administration, Office of Trade and Economic Analysis; U.S. Department of Commerce, Bureau of the Census, *Exporter Location Series*, Center for Economic Studies, and *Annual Survey of Manufactures*; and U.S. Department of Commerce, Bureau of Economic Analysis; National Bureau of Economic Research.

under pressure as global integration gives rise to greater trade opportunities and challenges. Many such changes will take place, regardless of direct outflows and inflows of tradable goods. Still, measures of exports and import competition may be important indicators to policymakers and others of the sources and direction of upheaval and change. Both exports and imports of manufactured goods have generally expanded for U.S. metropolitan areas over the past decade or more—imports more than exports—with wide variation across metropolitan areas.

Heretofore, direct insights into trade-related restructuring for U.S. MSAs were sparse, because there is little data reporting directly on international trade at the metropolitan area level of geography. In constructing new estimates, and exploring the properties of existing data, we have suggested that there is a wide variation in the openness to trade in manufactured goods among U.S. metropolitan areas, both in direct exports from these areas and in measures of import competition and penetration for their specific industrial sectors.

Large metropolitan areas do not appear to be experiencing as high a level of import competition for manufactured goods as medium and smaller metropolitan areas. However, this may reflect the more general tendency of production activity to eschew large urban areas in favor of less densely populated areas. In reality, the increasing service intensity of large urban areas may belie their actual trade intensity in the global trade of manufactured goods. Services, many of them originating in large urban areas, are implicitly and increasingly embodied in manufactured goods—imports, exports, and domestically produced goods alike.

When it comes to exports, large metropolitan areas tend to report high export intensity for manufactured goods. Many large urban areas tend to ship or facilitate shipment of exported goods, and they are accordingly cited as the domicile of exports abroad. In one sense, this is misleading in that the origin of production for many of these exports is likely to be in smaller metro areas or rural areas. However, in another sense, it is appropriate to attribute value added to large metropolitan areas because, as mentioned above, services embedded in manufactured goods often originate in these areas.

These first explorations of trade-related data at the metropolitan level remain suggestive and rudimentary. There is much more that we don't know. Trade remains a single but important element contributing to shifting roles and structure of metropolitan areas.

NOTES

[1]See Campa and Goldberg (1997), who identify changes in the use of imported inputs for a set of manufacturing industries from the U.S., Canada, the UK, and Japan. They find manufacturing industries in the U.S. to have experienced a very strong increase in the use of imported inputs. The role of trade in imported inputs in the context of our article will be left for future research. See also Hummels et al. (2001), who show that the internationalization of the supply chain, a phenomenon they refer to as vertical specialization, has accounted for a large and increasing share of international trade over the last several decades. They find that this increase in vertical specialization accounts for a sizable piece of the growth in world trade.

[2]*County Business Patterns* is published by the U.S. Department of Commerce, Bureau of the Census, and contains information on employment, payroll, and number of establishments by industry for every county in the U.S. For 1998 and 1999, the North American Industrial Classification System (NAICS) replaced the Standard Industrial Classification (SIC) system. This new classification maps fairly well into the former SIC system for manufacturing industries. One exception is the auxiliary establishment employment of manufacturing companies (for example, corporate headquarters), which has been shifted to a separate NAICS category in "services."

[3]For example, the Chicago Consolidated Metropolitan Statistical area encompasses the primary metropolitan statistical areas of Chicago, IL, Gary, IN, Kankakee, IL, and Kenosha, WI. Yet, it is possible that the use of subregional entities, such as metropolitan areas, does not sufficiently account for regional economic linkages. Multi-state regions are often highly integrated in their trade between and among industries (see Hewings et al., 1998).

[4]The CBP industry data are available at a four-digit level based on SIC for 1977–97 and a six-digit industry level based on NAICS for 1998 and 1999. Undisclosed or "suppressed" CPB data were estimated by the Center for Public Policy at Northern Illinois University (see Gardocki and Baj, 1985).

The data on U.S. exports and imports by industry contain information on the value of physical goods that have cleared through customs. These were provided to us by the International Trade Administration of the U.S. Department of Commerce. Exports are limited to domestic exports and are valued "free alongside ship," while imports are restricted to goods imported for consumption (not for re-export) and are on a customs value basis.

The ITA data, which we use in our analysis, are classified according to four-digit SIC and six-digit NAICS codes, yet, in their original form, they do not strictly conform to the SIC and NAICS industry definitions. The trade and economic analysts at the ITA mapped original trade data categories from the Bureau of the Census' Foreign Trade (exports and imports) into industry classification codes (NAICS and SIC). They did so based on their knowledge of and familiarity with industry products in international trade into and out of the U.S. Between 2 percent and 3 percent of imports could not be reliably assigned, or were assigned to miscellaneous categories. These are dropped from our analysis.

[5]We construct these measures for 269 metropolitan areas of the U.S. The employment data at the fine level of industry detail are thought to be much more accurate for large metropolitan areas. In such places, the county-level employment by industry is likely to be less subject to errors of imputation. There, employment data will be reported directly rather than imputed due to "disclosure" problems of a thin presence in the number of establishments in any particular industry.

[6]We construct our own estimates of gross regional product. To do so, we allocate nonagricultural gross product for the U.S. to each metropolitan area in proportion to its share of nonfarm personal income.

[7]Metropolitan area figures here are constructed as if the regions were a single region, rather than taking an arithmetic mean with each metropolitan area as an observation. (Either way, the results differ little.)

[8]See Ono (2001).

[9]Import penetration is defined for an industry by the ratio of imports to domestic market sales.

[10]Yet this is not a wholly accurate accounting of the local impact of overseas activity. An unmeasured change in competition or displacement may take place in foreign markets that are now contested between U.S.-domiciled production plants and overseas producers.

[11]The estimated range is derived by taking the value of exports of manufactured goods to total production in the manufactured sector. The larger estimate measures production by "value added in manufacturing." The lower figure uses "value of shipments" in manufacturing as the base. Since "export" value includes value added from nonmanufacturing industries, value of shipments may be an appropriate basis of comparison. However, shipments also include re-shipments, some of which may be exported. Hence, there may be a double counting in the U.S. of shipments data, making value added another, perhaps preferable candidate.

[12]A state's value on the map represents the average of its MSAs' import penetration rates. The MSAs encompassing multiple states and component primary MSAs (PMSAs) are allocated to the state that includes the PMSA.

[13]See U.S. Department of Commerce (1999).

[14]As with other data, there are also flaws in reporting. In this case, the principle problems are that approximately 7 percent of exports do not report a location; and another 3 percent are not allocable to particular metropolitan areas using a zip code basis (the "crossover" or overlap problem). The data are f.a.s. (free alongside ship) basis and include re-exports.

[15]See Dow Jones and Company (2003), which reports that, of the 17 million manufacturing jobs in the U.S., 52 percent are production workers versus 68 percent ten years earlier. For regional perspectives, see Testa (1989). These articles document that the value of manufacturing shipments, exports or domestic shipments, is increasingly composed of both services produced by manufacturing companies and services purchased by manufacturing companies and "embedded" into the value of the final manufacturing shipment.

[16]In particular, for many of the largest MSAs, the reported data break out "commodity" exports, such as agriculture and mining, for metropolitan areas. In our tables listing exports by metropolitan area, we have extracted commodity exports whenever possible.

[17]See Klier and Testa (2002).

[18]See Hine and Wright (1997), who also point out that import and export growth rates tend to be strongly positively correlated.

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