

# Multiplying Jobs:

How Manufacturing Contributes  
to Employment Growth in Chicago  
and the Nation

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MANUFACTURING CHICAGO'S FUTURE

**UIC** Center for Urban  
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# Multiplying Jobs:

## How Manufacturing Contributes to Employment Growth in Chicago and the Nation

Elizabeth Scott and Howard Wial<sup>1</sup>

### Summary

- **In the Chicago region, each manufacturing job supports 2.2 additional jobs.** Input-output analysis indicates that the manufacturing employment multiplier for the Chicago region is about 3.2. For every “direct” manufacturing job created in the region, 1.2 “indirect” jobs are created in supplier companies that provide goods and services for manufacturing and one additional “induced” job is created to provide the consumer goods and services that the direct manufacturing employee purchases. Taken together, these three job impacts create a manufacturing job multiplier of 3.2 for the Chicago region.
- **In the Chicago region, each job in petroleum and coal products manufacturing supports 7.3 additional jobs, while each job in textile product mills supports 0.5 additional jobs.** Manufacturing industries whose companies buy more goods and services from suppliers located in the region have larger job multipliers than those that buy fewer goods and services from within-region suppliers. High-productivity industries have larger job multipliers than low-productivity industries.
- **Nationwide, each manufacturing job supports up to 4.6 other jobs.** If a small number of manufacturing jobs are created throughout the United States, then each new manufacturing job is likely to lead to the creation of close to 4.6 additional jobs nationwide. However, if the nation gains a large number of manufacturing jobs, fewer additional jobs will be created nationwide for each manufacturing job added.

### Introduction

Economic development policymakers have long prized manufacturing for its job-creation potential. World Business Chicago, the city’s nonprofit economic devel-

opment organization, identified expanding Chicago's advanced manufacturing sector as one of the pillars of its Plan for Economic Growth and Jobs.<sup>2</sup> Suburban economic development organizations such as the Chicago Southland Economic Development Corporation are also actively pursuing manufacturing job creation as a driver of local economic growth and wellbeing.<sup>3</sup>

Recently, however, concerns about the increasing automation of manufacturing plants have led some to question manufacturing's potential for job creation.<sup>4</sup> Yet the importance of manufacturing as a generator of jobs depends not only on how many jobs exist on a manufacturer's factory floor but also on the other jobs—in both manufacturing and services—that would not exist in a metropolitan area such as Chicago, or in the entire United States, if that manufacturer were not present. This briefing paper, the second in CUED's *Manufacturing Chicago's Future* series, focuses on the ways in which manufacturing jobs are linked to other jobs and shows the numbers of jobs that depend on manufacturing employment in the Chicago region and the nation as a whole.

## Methodology

This briefing paper covers the Illinois counties of Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will, which make up the Chicago region as defined by the Chicago Metropolitan Agency for Planning. It uses the North American Industry Classification System (NAICS) definition of manufacturing, which includes as manufacturing workers everyone employed in a manufacturing establishment, production workers, engineers, managers, and maintenance workers alike. It does not include people who work in free-standing R&D centers, corporate headquarters, or other free-standing facilities that are not factories and are not immediately adjacent to factories, even if they work for manufacturing companies. This briefing paper generally classifies manufacturing industries at the NAICS three-digit level. However, it considers some industries (aerospace, medical devices, motor vehicles and parts, and pharmaceuticals) at a more detailed level because of their particular importance to the economy of the Chicago region or that of the nation.

The briefing paper uses 2011 IMPLAN data and input-output modeling software to estimate manufacturing employment multipliers—the total numbers of jobs that are created when a manufacturing job is created. Input-output models describe the way industries are connected to one another; they are based on the fact that each industry's non-labor production inputs are the outputs of other industries. IMPLAN is a standard software package that economic development analysts often use to project the jobs created in a region when a company moves to or expands within a region. (See the Technical Appendix for details.) The briefing paper includes separate analyses for manufacturing as a whole and for individual manufacturing industries, and for the Chicago region and the entire United States.

## Box I. Employment Multipliers

Economists and urban planners often divide regional economies into two components: industries that export goods or services to other regions—thus bringing income into the region from elsewhere—and local-serving industries that provide services and a few goods that are sold to the people who live in the region. Nearly all manufacturing industries are regional export industries because nearly all the products produced by a factory in a particular region are sold to people who live elsewhere. The same is true of some service industries, such as stock exchanges, corporate law firms, hotels, and parts of higher education and health care. Supermarkets, dentists’ offices, and dry cleaners are examples of local-serving industries.

The idea of a multiplier is based on this division of the economy into export and local-serving industries. Employment multipliers measure the interconnectedness of different industries in the local economy, estimating how many total additional jobs will be created in a region as a result when the region gains one new job in a particular industry.<sup>5</sup> In general, regional export industries have multipliers greater than 1.0.

Multipliers have three components, commonly called direct, indirect and induced effects. The direct effect of the manufacturing employment multiplier is one additional job in manufacturing in a region. The indirect effect measures how many more jobs will be created in the companies in the same region that supply the goods and services that that manufacturing worker’s employer needs to produce the additional annual output of that worker. The induced effect represents the way that worker spends his or her wages within the region, creating jobs in local-serving industries.

For example, petroleum and coal products manufacturing has an employment multiplier of 8.3 in the Chicago region. This multiplier is composed of a direct effect of 1.0, an indirect effect of 4.7, and an induced effect of 2.6. This means that the when one new job in petroleum and coal products is created in the region, 4.7 jobs are created in industries that produce intermediate inputs for petroleum and coal products manufacturing and 2.6 local-serving jobs are created. All of these together make up the multiplier:

$$\begin{aligned}
 & 1 \text{ “direct” petroleum and coal products job} \\
 & + 4.7 \text{ “indirect” jobs in supplier industries} \\
 & + 2.6 \text{ “induced” jobs in local-serving industries} \\
 & = 8.3 \text{ employment multiplier}
 \end{aligned}$$

Note that 8.3 includes the one direct job in petroleum and coal products. Thus, it is correct to say either that one new petroleum and coal products job adds 7.3 other jobs to the local economy or that one new job in coal and petroleum products results in the creation of a total of 8.3 jobs overall. Politicians and news reporters often overstate multipliers by confusing these two interpretations.

## Findings

### **A. In the Chicago region, each manufacturing job supports 2.2 additional jobs.**

The IMPLAN analysis indicates that the manufacturing employment multiplier for the Chicago region is about 3.2. For every direct manufacturing job created in the region, 1.2 indirect jobs are created in supplier companies that provide goods and services for manufacturing and one additional induced job is created to provide the consumer goods and services that the direct manufacturing employee purchases.

This result is consistent with the most reliable estimates of metropolitan manufacturing multipliers found in the economic development literature from the 1950s to the present. The estimates in the literature place the employment multiplier for manufacturing as a whole somewhere between 2.5 and 6, with the most reliable academic estimates ranging from 2.5 to 3.5. This variation is a result of three factors: the timeframe of the data, the geography under analysis, and the specific analytical tools and assumptions used. However, multiplier estimates between 2.5 and 3.5 appear in the most reliable studies regardless of metropolitan area, time period, the industry classification system used to define manufacturing, and the type of economic model (regional input-output model, econometric model, or simple ratio of export to local-serving jobs) used to produce the estimates.<sup>6</sup>

### **B. In the Chicago region, each job in petroleum and coal products manufacturing supports 7.3 additional jobs, while each job in textile product mills supports 0.5 additional jobs.**

Table I shows IMPLAN estimates of manufacturing employment multipliers for individual manufacturing industries in the Chicago region. The variation in size between these manufacturing industry employment multipliers is primarily due to the amount of within-region purchasing done by firms in the industry and the industry's labor productivity. Industries whose firms buy more goods and services from suppliers located in the region (e.g., because they have large local supply chains) generate more indirect jobs as a result of each direct job created in the industry. Industries with high labor productivity (measured by value added per job) typically offer high average wages, leading to a large amount of within-region purchasing by people employed in the industry and, hence, a large number of induced jobs created.

Manufacturing industries with large induced employment effects also tend to have large indirect employment effects (figure 1). There is an extremely high correlation across manufacturing industries (0.86) between number of indirect jobs and the number of induced jobs created for each direct job created in the region.

Manufacturing industries with large local supply chains (often the more capital-intensive industries) and/or higher value added per job (typically more capital- or skill-intensive industries) generally have the highest employment multipliers because they have high indirect and induced job impacts.

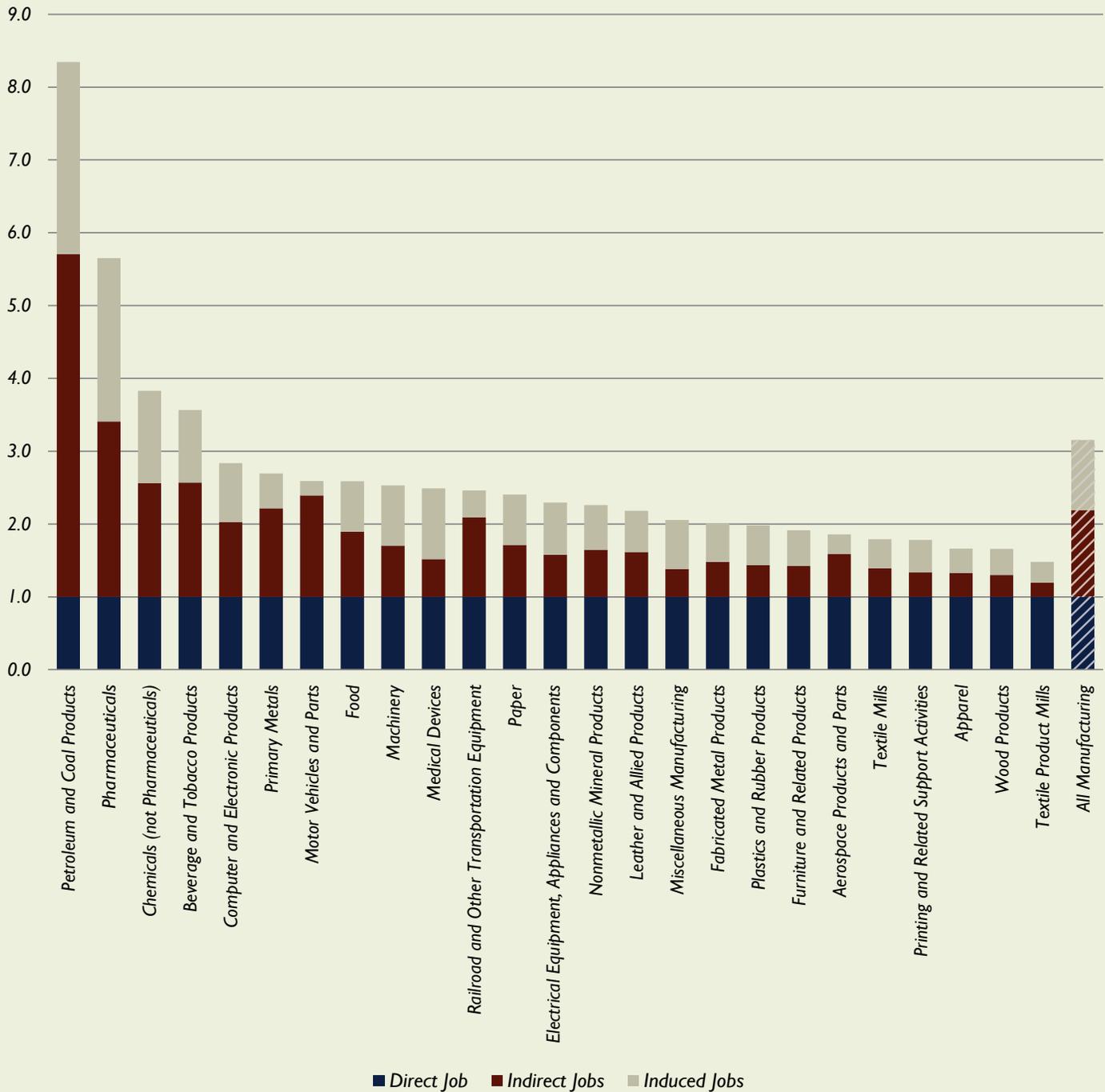
**Table 1. Chicago Region Manufacturing Employment Multipliers, 2011**

INDUSTRY	DIRECT JOBS	INDIRECT JOBS	INDUCED JOBS	EMPLOYMENT MULTIPLIER*
<b>All Manufacturing</b>	<b>1.0</b>	<b>1.2</b>	<b>1.0</b>	<b>3.2</b>
Petroleum and Coal Products Manufacturing	1.0	4.7	2.6	8.3
Pharmaceutical Manufacturing	1.0	2.4	2.2	5.7
Chemical Manufacturing (not Pharmaceuticals)	1.0	1.6	1.3	3.8
Beverage and Tobacco Products Manufacturing	1.0	1.6	1.0	3.6
Computer and Electronic Products Manufacturing	1.0	1.0	0.8	2.8
Primary Metal Manufacturing	1.0	1.2	0.5	2.7
Motor Vehicle and Parts Manufacturing	1.0	1.4	0.2	2.6
Food Manufacturing	1.0	0.9	0.7	2.6
Machinery Manufacturing	1.0	0.7	0.8	2.5
Medical Device Manufacturing	1.0	0.5	1.0	2.5
Railroad and Other Transportation Equipment Manufacturing	1.0	1.1	0.4	2.5
Paper Manufacturing	1.0	0.7	0.7	2.4
Electrical Equipment, Appliance and Component Manufacturing	1.0	0.6	0.7	2.3
Nonmetallic Mineral Products Manufacturing	1.0	0.6	0.6	2.3
Leather and Allied Products Manufacturing	1.0	0.6	0.6	2.2
Miscellaneous Manufacturing	1.0	0.4	0.7	2.1
Fabricated Metal Products Manufacturing	1.0	0.5	0.5	2.0
Plastics and Rubber Products Manufacturing	1.0	0.4	0.5	2.0
Furniture and Related Products Manufacturing	1.0	0.4	0.5	1.9
Aerospace Products and Parts Manufacturing	1.0	0.6	0.3	1.9
Textile Mills	1.0	0.4	0.4	1.8
Printing and Related Support Activities	1.0	0.3	0.4	1.8
Apparel Manufacturing	1.0	0.3	0.3	1.7
Wood Products Manufacturing	1.0	0.3	0.4	1.7
Textile Product Mills	1.0	0.2	0.3	1.5

\* total jobs created when one direct job is created

Source: Authors' estimates using IMPLAN 3.0 2011 Illinois data for Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties.

Figure I. Components of Chicago Region Manufacturing Employment Multipliers



Source: Authors' estimates using IMPLAN 3.0 2011 Illinois data for Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties.

### **C. Nationwide, each manufacturing job supports up to 4.6 other jobs.**

The IMPLAN analysis shows that the nationwide manufacturing multiplier is 5.6. Every direct manufacturing job supports 2.4 indirect and 2.2 induced jobs. This indicates the high degree of intensity with which manufacturing firms are interconnected with one another and the economy as a whole.

There are very few credible estimates of national employment multipliers for any industry. One such analysis placed the national manufacturing employment multiplier at only 2.9.<sup>7</sup> However, this estimate is based on inferences from and assumptions about labor market data, rather than on national input-output tables (the preferred source, on which the IMPLAN analyses are based).

National employment multipliers vary among manufacturing industries in much the same way as multipliers for the Chicago region do. They range from a high of 31.1 in petroleum and coal products to a low of 2.6 in printing (table 2). The national manufacturing employment multiplier is much larger than the Chicago (or any other metropolitan) multiplier because the nation as a whole contains more of the supply chain and encompasses more of the induced spending for any given manufacturing job than does the Chicago region (or any other metropolitan area). For example, a manufacturing job in the Chicago region (or anywhere else in the nation) is linked to supply chain jobs located throughout the nation, not just in the region, so the indirect job impact is greater for the nation than for the region. Similarly, the worker employed in that job spends his or her earnings throughout the nation, not just in the region, so the induced job impact is also greater for the nation than for the region.

The national manufacturing employment multiplier of 5.6 does not mean that adding one million more manufacturing jobs to the nation as a whole will lead to the creation of 4.6 million other jobs in the nation as a whole. This is because input-output is a demand-side model that does not consider supply constraints, including labor supply.<sup>8</sup> For a metropolitan area or other small geographic area, multipliers can be interpreted in cause-and-effect terms (adding a manufacturing job causes total employment to increase by more than one job) because it is relatively easy for a region to add jobs by drawing in additional workers from other regions when within-region product demand increases.

This is much more difficult for the nation as a whole. When one industry (such as manufacturing) expands, some new immigrants may come to the United States to work and some unemployed workers or people who were not previously looking for jobs may obtain jobs. However, it is much more difficult for the United States as a whole to meet the increased demand for workers from an expanding industry than it is for a metropolitan area to meet the increase in labor

demand from a proportionally equal expansion of production in that industry.<sup>9</sup>

Overall, the impact of constraints on the supply of available workers at the national level is likely to matter more for large expansions of manufacturing than for small ones. If a small number of new manufacturing jobs are created throughout the United States, then it will be relatively easy for companies to fill the new

**Table 2. United States Manufacturing Employment Multipliers, 2011**

INDUSTRY	DIRECT JOBS	INDIRECT JOBS	INDUCED JOBS	EMPLOYMENT MULTIPLIER*
<b>All Manufacturing</b>	<b>1.0</b>	<b>2.4</b>	<b>2.2</b>	<b>5.6</b>
Petroleum and Coal Products Manufacturing	1.0	16.9	13.2	31.1
Pharmaceutical Manufacturing	1.0	5.7	4.9	11.6
Chemical Manufacturing (not Pharmaceuticals)	1.0	3.6	4.3	9.0
Beverage and Tobacco Manufacturing	1.0	4.1	3.1	8.2
Computer and Electronic Products Manufacturing	1.0	4.0	2.2	7.2
Primary Metal Manufacturing	1.0	3.2	2.6	6.9
Motor Vehicle and Parts Manufacturing	1.0	3.2	2.6	6.8
Food Manufacturing	1.0	2.7	2.4	6.1
Machinery Manufacturing	1.0	2.4	2.6	6.1
Medical Device Manufacturing	1.0	2.4	2.6	5.9
Railroad and Other Transportation Equipment Manufacturing	1.0	2.4	2.3	5.8
Paper Manufacturing	1.0	1.8	1.6	4.4
Electrical Equipment, Appliance and Component Manufacturing	1.0	1.5	1.8	4.3
Nonmetallic Mineral Products Manufacturing	1.0	1.3	1.4	3.7
Leather and Allied Products Manufacturing	1.0	1.1	1.3	3.4
Miscellaneous Manufacturing	1.0	1.2	1.2	3.4
Fabricated Metal Products Manufacturing	1.0	1.1	1.3	3.4
Plastics and Rubber Products Manufacturing	1.0	0.8	1.5	3.3
Furniture and Related Products Manufacturing	1.0	1.2	1.0	3.2
Aerospace Products and Parts Manufacturing	1.0	0.9	0.9	2.8
Textile Mills	1.0	0.7	1.1	2.8
Printing and Related Support Activities	1.0	0.8	1.0	2.8
Apparel Manufacturing	1.0	0.8	0.9	2.7
Wood Products Manufacturing	1.0	0.7	0.9	2.6
Textile Product Mills	1.0	0.7	0.7	2.4

\* total jobs created when one direct job is created

Source: Authors' estimates using IMPLAN 3.0 2011 national data.

jobs with unemployed workers, people who previously were not looking for jobs, or new immigrants, and each new manufacturing job is likely to lead to the creation of close to 4.6 additional jobs nationwide. However, if the nation gains a large number of manufacturing jobs, then most of the jobs linked to each new manufacturing job, whether direct, indirect, or induced, will be filled by people already employed in other industries in the United States. In that case, fewer additional jobs will be created nationwide for each manufacturing job added. If the national economy is operating at full employment and there is no new immigration in response to the expansion of manufacturing, then no additional jobs will be created.

## Conclusion

Manufacturing remains a powerful engine of job growth through its indirect and induced job impacts as well as through its direct impacts. Manufacturing's contribution to job creation would grow if any of the three types of impacts were increased. This could occur if U.S. manufacturing employment increased. It could also occur if more supplier activity (in services as well as in goods) remained in the United States or if some consumer spending on imports were replaced with spending on domestically produced goods and services. Within the Chicago region, it could also occur if within-region supply chains were strengthened. Until recently, the nationwide growth of offshoring and of consumer spending on imported goods and the growing use of out-of-region suppliers by Chicago-area manufacturers worked to reduce manufacturing's impact on job creation.<sup>10</sup> The recent rebound of manufacturing employment nationwide and in the Chicago region, which is based on long-term economic trends as well as on the recovery of product demand after the Great Recession, may change this situation.<sup>11</sup>

## Technical Appendix

To estimate manufacturing multipliers, we used 2011 data for IMPLAN Pro 3.0 input-output modeling software. (2011 data are the most recent data currently available in IMPLAN. Input-output relationships are not likely to change rapidly in the course of one year, so 2012 data, if they were available, would not produce results that differ greatly from those reported here.)

IMPLAN has two distinct modes of operation, one descriptive and the other predictive. Most analysts use IMPLAN to predict the likely changes to a regional economy based on some change in final demand, e.g., the construction and staffing of a new airplane factory. In this case, however, we used IMPLAN's descriptive mode to deliver the best possible estimates of current manufacturing employment multipliers by industry in both the Chicago region and the nation as a whole.

The IMPLAN model is built through multipliers that are estimated based on an analyst's specified study area. In this case, Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties were analyzed to match the Chicago Metropolitan Agency for Planning's seven-county Chicago region. Within this geography, IMPLAN estimates all of the backward linkages between local industry sectors at, for the most part, the six-digit NAICS level by applying modified national input-output tables to region-specific data such as employment and value added. It further adjusts the model with econometrically derived regional purchasing coefficients. Once all these relationships are calculated, IMPLAN can describe multipliers for a number of fixed relationships within the regional model, including employment and output.

These estimates made through IMPLAN are the best possible using this model. However there are a few important elements to take into account that may inflate or deflate CUED's final results.

*Aggregation Bias.* IMPLAN provides data on trade flows and other aspects of the local economy at a very fine-grained level of detail. To aggregate these data sufficiently to describe multipliers for manufacturing in general, or NAICS three- or four-digit manufacturing industries, it is necessary to make certain changes to the model that introduce potentially serious aggregation bias. Aggregating several detailed industries (e.g., eyeglass, hearing aid, and prosthetic manufacturing into medical device manufacturing) effectively creates a new industry composed out of the industry details of the aggregated industries. The production function of the new aggregated industry becomes the output-weighted average of the individual production functions. For this reason, the component industries with the greatest output levels have the greatest influence on the aggregated industry. Therefore, the aggregated industries may not completely represent the underlying industries but may inflate or deflate the multipliers depending on the constituent industries.



*Geographic coverage.* This analysis covers the seven-county Chicago region as defined above, not the Chicago-Naperville-Joliet IL-IN-WI Metropolitan Statistical Area. There are a number of counties outside the seven-county region, particularly those in northwest Indiana, that contribute substantially to the metropolitan area's manufacturing economy. Metropolitan-level employment multipliers for industries concentrated in those omitted counties, such as primary metal manufacturing, may be larger than the multipliers reported in this briefing paper.

*Trade Flows.* It was necessary to use two trade flow models in IMPLAN to report results at both local and national geographies. For the counties in the Chicago region, econometric regional purchasing coefficients (RPCs) were used. These econometric RPCs set the level of the regional propensity to consume locally (i.e., the extent to which local businesses buy inputs from one another when those inputs are available for purchase in the region). As the region gets larger, more customers and suppliers will be available in the network, so the multiplier will get bigger. At the extreme, the national trade flow model is built through supply-demand pooling, which assumes that everything that can be purchased in the country will be purchased in the country. In IMPLAN, these estimates represent an upper bound for all possible multipliers. For this reason, the national estimates are necessarily larger and should not be taken as a sign that the Chicago region is substantially less prosperous or competitive than the nation as a whole.

*Other Issues.* IMPLAN relies mainly on modified national-level data. More specialized local information, such as concrete details about regional industries' wages, outputs, and supply chains might allow for different multipliers. These data are, however, difficult and costly to obtain.

All input-output models also assume fixed-proportions production functions. That is the amount of each input that is needed to make a unit of output remains constant, as in a recipe. This assumption implies constant returns to scale. (Doubling all inputs results in a doubling of output; there are no benefits or costs to high levels of production or to geographic agglomeration.)

IMPLAN cannot explicitly model the social or environmental impacts of economic activities. Therefore, it is important for policymakers to keep the quality and composition of impacts in mind as well as their magnitude.

## Endnotes

1. Elizabeth Scott is an economic development planner in the Center for Urban Economic Development at The University of Illinois at Chicago. Howard Wial is Executive Director and Associate Research Professor in the Center for Urban Economic Development at The University of Illinois at Chicago and Nonresident Senior Fellow of the Brookings Institution Metropolitan Policy Program.
2. World Business Chicago, *A Plan for Economic Growth and Jobs* (Chicago, 2012).
3. See, e.g., Center for Neighborhood Technology and South Suburban Mayors and Managers Association, "Chicago Southland's Green TIME Zone" (Chicago, 2010).
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5. Multipliers are estimated for many economic relationships, including output and wages. This briefing paper focuses solely on employment multipliers.
6. Enrico Moretti, "Local Multipliers," *American Economic Review* 100(2) (May 2010): 373-77; N. Edward Coulson, "Measuring and Analyzing Urban Employment Fluctuations," in Richard J. Arnott and Daniel P. McMillen, eds., *A Companion to Urban Economics* (Malden, MA: Blackwell, 2006); Gerald A. Carlino, Robert H. DeFina, and Keith Sill, "Sectoral Shocks and Metropolitan Employment Growth," *Journal of Urban Economics* 50(3) (2001): 396-417; Sheng-Wen Chang, and N. Edward Coulson, "Sources of Sectoral Employment Fluctuations in Central Cities and Suburbs: Evidence from Four Eastern U.S. Cities," *Journal of Urban Economics* 49(2) (2001): 199-218; N. Edward Coulson, "Sectoral Sources of Metropolitan Growth," *Regional Science and Urban Economics* 29(6) (1999): 723-743; Scott J. Brown, N. Edward Coulson, and Robert F. Engle, "On the Determination of Regional Base and Regional Base Multipliers," *Regional Science and Urban Economics* 22(4) (1992): 619-635.
7. Joshua Bivens, "Updated Employment Multipliers for the U.S. Economy," Economic Policy Institute Working Paper #268 (Washington: Economic Policy Institute, 2003).
8. In economic terms, an input-output model does not account for the impacts of price changes that may occur as a result of changes in the demand for inputs, including labor.
9. Of course, as in metropolitan areas, the expansion of demand for workers in a given industry can also be met by drawing into the industry unemployed workers or people not previously looking for jobs.
10. On the growth of out-of-region purchasing of intermediate inputs by Chicago-area manufacturers, see Geoffrey J.D. Hewings and Michael Sonis, "The Hollowing Out Process in the Chicago Economy, 1975-2015," *Geographical Analysis* 30 (1998): 217-233.
11. See Susan Helper, Timothy Krueger and Howard Wial, "Why Does Manufacturing Matter? Which Manufacturing Matters?" (Washington: Brookings Institution, 2012), and Howard Wial, "Locating Chicago Manufacturing: The geography of Production in Metropolitan Chicago" (Chicago: Center for Urban Economic Development, The University of Illinois at Chicago, 2013).
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