



 REPORT HIGH WAGE AMERICA

# Why Manufacturing Jobs Are Worth Saving

JUNE 13, 2017 — ANDREW STETTNER, JOEL S. YUDKEN AND MICHAEL MCCORMACK

After decades of decline and political indifference, the U.S. manufacturing is getting fresh attention. “American Manufacturing Is Having a Moment,” declared CNN in a recent headline.<sup>1</sup> During his reelection campaign, President Obama set a goal of bringing back 1 million of the manufacturing jobs that had been lost after the recession, and supported bold new investments in the nation’s manufacturing capacity.<sup>2</sup> President Trump made restoring manufacturing jobs a key part of a winning campaign among Rust Belt states that carried him to election as president.

Is this renewed focus on the manufacturing sector sound economic policy, or as pundits from across the political spectrum have complained, is it just a nostalgic bid for middle-class jobs that are gone for good?

This report examines prevalent assumptions about the value of a renewed commitment to manufacturing, particularly from the vantage point of the needs of communities that have depended on manufacturing jobs, and on workers who have looked to this sector as a source of a living-wage career.

The report begins by reviewing the status of U.S. manufacturing activity today, including how it compares internationally. It looks at shifts in composition of U.S. manufacturing activity, identifying which industries within the sector have been growing, and which have been declining. It examines the debate over what caused the manufacturing decline of the past few decades and whether this decline was inevitable, or reversible, and how important a manufacturing recovery is to the nation’s economic future.

Most importantly, the report takes a deep dive into regional data on the current and future role of manufacturing to the economic recovery of communities across the country. It takes a hard look at the quality of manufacturing jobs today, and the major workforce challenges facing a manufacturing revival.

The report’s principal findings include:

- The U.S. manufacturing sector was reshaped by a steep decline in the first decade of the century, dropping from 13.1 percent of the total workforce in January of 2000 to 8.8 percent in January of 2010. But unlike after the 2001 recession, manufacturing has grown alongside the rest of the economy, adding 945,000 jobs from 2010 to 2017.
- Current growth and future potential of manufacturing is now focused on a concentrated core of goods, such as transportation, fabricated metals, machinery, chemicals, and food products—subsectors that account for 52.6 percent of manufacturing jobs nationwide as of January 2017.
- The steep decline of U.S. manufacturing during the first decade of the century was the result of changes in trade policy not automation. During this period, manufacturing productivity growth actually slowed, averaging only 7

percent in all manufacturing sectors other than computer and electronics.<sup>3</sup> At the same time, the entrance of China into the World Trade Organization allowed the trade deficit to increase from \$83 billion in 2001 to \$347 billion and was responsible for 2.4 million job losses.<sup>4</sup>

- Further economic recovery and the reshoring of manufacturing American jobs is indeed possible. Real foreign direct investment in manufacturing surged to \$243 billion in 2015, up from \$117 billion in 2007.<sup>5</sup> When all the costs of outsourcing are considered, 55 percent of manufactured goods could be produced more cheaply in the United States, while only 3 percent could be based on the sticker price alone.<sup>6</sup>
- Manufacturing has become more regionally concentrated, with three manufacturing regions (the Rust Belt, Agricultural Midwest, and the Industrial Southeast) holding most of the nation's manufacturing jobs. Seven Rust Belt states (Ohio, Pennsylvania, Indiana, Michigan, Illinois, Wisconsin, and Minnesota) have 3.7 million manufacturing jobs, more than seventeen large Western states including California and Texas. Manufacturing is now of greatest importance to mostly rural communities in these manufacturing states, where it makes up one-in-four private-sector jobs, as compared to either strictly rural or urban areas.
- Manufacturing jobs continue to provide above-average wages, especially for skilled positions that require on-the-job training but not college degrees. Among workers without a four-year college degree, manufacturing workers earn \$150 more per week than in other industries. On average, an econometric analysis finds that workers in manufacturing earn 9 percent more per week than workers in other economic sectors, holding other differences between workers equal. However, plummeting manufacturing unionization in the Rust Belt over the past twenty-five years (from 28.4 to 14.5 percent) has shrunk the real wage advantage of manufacturing jobs from \$220 to \$170 per week in the crucial region.
- The manufacturing sector must address major workforce challenges if it is to experience a revival. The aging of the manufacturing workforce will create a shortage of as many as 2 million qualified manufacturing workers, especially among skilled manufacturing positions such as industrial mechanics (paying \$51,890 per year and expected to add 18 percent more positions over the next ten years) and operators of computer-controlled machine tools needed for advanced means of production (paying \$39,500 and growing by 17.5 percent over ten years). Yet, only 13 percent of manufacturers recruit at high schools despite a coming workforce shortage that could be met by a new generation of high school graduates. Despite conventional wisdom, manufacturing is not a white male field. Hispanic workers (16.1 percent of all manufacturing workers) and Asian workers (6.8 percent) are just as likely to work in manufacturing as any other field. African-Americans represent 10 percent of manufacturing workers, only slightly less than their 12 percent share of the overall workforce. However, manufacturing has a much larger gender gap,

which got worse during the recession, with women dropping from 32 to 27 percent of those on manufacturing payrolls.

The rebound since the recession demonstrates that there is indeed hope for a revival of the manufacturing sector and of good manufacturing jobs. This is no small matter for an economy with flagging productivity and a declining share of worldwide innovation. Indeed, families in communities across the country, especially those in a cluster of twenty states in the Midwest and Southeast, are counting on that continued economic revival. The workforce and economic challenges in the way of further reshoring and renewal of manufacturing jobs are real, and require a dynamic high road recovery model and policies.

## The Recent Focus on Manufacturing

The 2016 presidential campaign brought about a startling transformation in the nation's conversation about the economy, circling around the deep economic anxiety of millions of voters in Midwest states. President-elect Donald Trump declared in his Republican National Committee speech that "I am going to bring our jobs back to Ohio and to America," while famously attacking unfair trade deals.<sup>7</sup> Democratic candidate Bernie Sanders asserted that free trade agreements have led to a loss of American jobs and depressed American wages, and that policies should make it harder for companies to outsource jobs to China and other countries. As president, Trump publicly intervened to reverse some of the planned Carrier plant closure outside of Indianapolis (although the company kept far fewer jobs than he claimed) launched a Manufacturing Jobs Initiative, and traveled to a former auto plant to announce new policies meant to ease regulations on U.S. auto manufacturers.

The focus on manufacturing in the 2016 election was not brand new, politically. Communities have long fought to retain manufacturing capacity. They have counted on manufacturing to provide family-sustaining jobs. Factories require numerous inputs to produce their goods with their impact multiplying throughout the economy and supporting employment and the tax bases. When manufacturing is healthy, its impact reverberates nationally. Manufacturers spend more on research and development, creating the potential for new products that can make the U.S. economy more competitive and increase prosperity for all Americans. And, the success of U.S. manufacturers would shrink the size of the trade deficit, which would increase incomes for Americans.

What was new in 2016 was the intensity of the focus on manufacturing revitalization as a cornerstone of economic policy. Economic thinkers across the political spectrum had relegated manufacturing to a smaller role in the nation's economic future, with the economy naturally evolving from agriculture to manufacturing to services as technology advanced.<sup>8</sup> Indeed, manufacturing employment as a share of the nation's total employment has been shrinking for

decades, and it endured a precipitous decline from 2000 to 2010.

The modest recovery since 2010, however, suggests a different future is possible, one in which manufacturing remains an engine of innovation and economic growth in the economy and a provider of quality jobs—especially in Heartland communities, which have long been dependent on manufacturing jobs. The fact that two successive presidents—Obama and Trump—won election by committing on the campaign trail to advance policies to rebuild manufacturing is evidence that the public, if not the economic elite, believes in a future for manufacturing. And indeed, polls after the election found that 64 percent of American voters agreed that “manufacturing is a critical part of the American economy and we need a manufacturing base here if this country and our children are to thrive in the future.”<sup>9</sup>

The goal of this report is to examine to what extent the data about manufacturing conform to the views of the voters. The aim is to provide contemporary look at the assumptions about the value of manufacturing from the vantage point of the needs of communities that have depended on manufacturing jobs, and the workers who have looked to manufacturing as a source of a living wage career.

## Status Check: Manufacturing Today

Any conversation about the future of manufacturing must be rooted in a close look at the state of manufacturing today.

- **Manufacturing is still recovering from the unprecedented decline in jobs since 2000.** Figure 1 looks at the level of manufacturing employment and manufacturing’s share of the private workforce. After holding steady at between 17 million and 18 million jobs for the past three decades of the twentieth century, manufacturing employment plummeted by 5.7 million jobs (a 33 percent decline) in the first decade of the twenty-first century, before gaining back 945,000 jobs by May 2017 (8 percent growth). Many manufacturing employers closed up shop, shutting down 56,000 establishments from 2000 to 2010.<sup>10</sup> Small establishments with fewer than 49 employees (37,000 establishments closed) were hurt the most, and have yet to bounce back. The manufacturing recovery has stabilized the share of manufacturing jobs at a level of about 10 percent of all private jobs. After the 2001 recession, while the rest of the economy grew, manufacturing jobs continued to decline. In contrast, during the recent recovery (2010–2016), manufacturing has grown alongside the rest of the economy. In other words, the recovery of manufacturing since 2010 has meant a change in the trajectory of the sector.

### FIGURE 1

- **Manufacturing remains a major employer of workers in the economy:** Figure 2 shows current manufacturing

employment in comparison to other large sectors in the economy. The sharp decline in employment since 2000 caused manufacturing to lose its long-standing place as the number one employer of U.S. workers, with the sector falling behind retail jobs in 2003, health care in 2004, and accommodation and food services in 2008. Outside of these service sectors (two of which are low-paid, and one which is a mix of high-wage and low-wage jobs), manufacturing companies still directly employ more workers in 2017 than many other sectors, such as construction and finance.

## FIGURE 2

- **The U.S. is the world's second-largest manufacturer.** China surpassed the United States as the largest manufacturing country in 2010 and, as a result of a larger population and increasing manufacturing intensity, it now has a dominant share of global manufacturing output.<sup>11</sup> However, as demonstrated in Figure 3, the United States remains firmly the second-largest manufacturer in the world, as measured by its share of the global value added in manufacturing, and is not likely to cede that position in years to come. Manufacturers add value by combining components into final products that are worth more than those components alone, and it is this added value that corresponds to manufacturing's share of gross domestic product and national wealth.<sup>12</sup>

## FIGURE 3

# Looking Deeper—Promising Manufacturing Subsectors

Every corner of the manufacturing sector hemorrhaged jobs during the first decade of this century. Figure 4 shows in detail the change in employment in manufacturing subsectors in the manufacturing “double recession” (2000–2010) and the modest economic recovery (2010–2016). While all subsectors declined during the recession, the recovery, however, displays a divergence, in which durable goods are favored over nondurable goods. In general, durable goods tend to be heavier and more expensive to ship, making domestic production more competitive for the U.S. market; U.S. producers of lighter nondurable goods have a more difficult time competing.<sup>13</sup> The durable sector also includes subsectors—aircraft, cars, machinery, and medical equipment—that tend to have more complex production processes, that require greater levels of worker skills for production, and that need access to capital-intensive technology.<sup>14</sup> Most subsectors for nondurable goods—clothing, paper products, and so on—have continued to decline during the broader manufacturing recovery. The major exception is food processing. From an economic perspective, the food processing subsector benefits from easy access to raw inputs and to the U.S. consumer market, and favorable trade and economic policies boost U.S. food producers more than other manufacturers.

## FIGURE 4

The recent era of turbulence in manufacturing in the United States has also seen a transformation in what manufacturing typically means. The U.S. Census Bureau defines manufacturing as “establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products.... Establishments in the Manufacturing sector are often described as plants, factories, or mills and characteristically use power-driven machines and materials-handling equipment.”<sup>15</sup> This definition encompasses a broader range of activities than conventional images of sweatshops or billowing smokestacks. Today’s manufacturing facilities are increasingly clean-technology-rich environments in which workers operate machines, many of which are computer controlled.<sup>16</sup> Frequently, regional economic development strategies list advanced manufacturing as a discrete sector that they are targeting for growth. In fact, even traditional manufacturing industries, such as automobiles or steel, are dependent on advanced technology. The average car runs on millions of lines of software code and traditional industries such as steel have based their recovery on capital-intensive technology.<sup>17</sup>

Case Western Reserve University economist Susan Helper offers a useful perspective on the state of manufacturing today.<sup>18</sup> The United States has maintained a competitive edge in a constellation of major industries, such as automobiles, aerospace and chemicals. Each of these industries depends on an ecosystem of suppliers, including fabricators of components. Entire manufacturing subsectors are in fact in competition globally with other similar sectors located in Asia and Europe.<sup>19</sup> The ability of both manufacturers and their suppliers (large, medium, and small) to improve their productivity is a central and yet often overlooked determinant of manufacturing revitalization.

The future of manufacturing depends on fostering these sectors, regaining our leadership in high-tech areas, and capturing new waves of innovation and products for U.S. producers. There is cause for concern, however—the United States is losing its edge in sectors such as computer and electronics manufacturing, as Asian manufacturers have developed an ecosystem that has enabled them to design and produce advanced semiconductors, solar panels, personal computers and other complex goods. The United States now has \$83 billion trade deficit in advanced technology products, double what it was a decade ago.<sup>20</sup>

## Is a Continued Decline of U.S. Manufacturing Inevitable?

There is a growing economic debate about whether the decline in manufacturing jobs is an immutable result of increasing automation and forces of globalization, or a result of intentional policy choices, such as trade agreements. If policy choices bear more responsibility for fueling the erosion of the U.S. industrial core, then there is a case for pursuing



a national and regional manufacturing strategy. If the decline is due to exogenous forces such as automation, then there is little policy makers can do to reverse the decline in employment and production.

As manufacturing has gained political relevance in recent years, prominent observers such as economist Brad DeLong have pushed back on the trade-based explanation, concluding that “most of the decline in the manufacturing employment share was inevitable.”<sup>21</sup> In this view, productivity increases have ravaged manufacturing jobs in the same way they did to agriculture a century and a half ago, leaving a sector that still contributes a meaningful share of economic output, but with exponentially fewer workers. A Ball State University report focused on the fact that manufacturing output has recovered to pre-recession level with millions of fewer workers. The report concluded that manufacturing sector would have 8.1 million more workers if productivity was at 2000 levels, but manufacturers do not need those workers to produce robust levels of output, given advances in automation.<sup>22</sup> The report’s conclusion is that the manufacturing sector is healthy, but automated.

There is a major flaw in this line of the argument. Nearly all of productivity growth that did occur in manufacturing from 2000 to 2015 was concentrated in one subsector: computer and electronic products. Most of this reported productivity growth was an anomaly, a result of the way the government calculates the value added of increasingly higher-powered computer chips.<sup>23</sup> With computer chips becoming more and more powerful, each computer component created was counted as adding large amounts of economic output. From 2000 to 2015, the government reported that real output in the computer and electronic products sector grew by 222 percent, while the other eighteen manufacturing subsectors have seen their real value-added increase by just 7 percent.<sup>24</sup> In fact, productivity growth has slowed over the past decade as compared to the decades of the 1970s to the 2000s, when manufacturing employment held steady and productivity grew at a steady clip.<sup>25</sup> During the recent period of decline, the problem has been exactly the opposite of what the Ball State team posited: productivity growth has slowed, making U.S. manufacturers less competitive, and employing far fewer workers.<sup>26</sup>

The technology-based explanations do not adequately explain the especially sharp decline in manufacturing jobs from 2000 to 2015. What has changed dramatically over the past two decades has been the increase in global competition, particularly with China. On the heels of China’s admission into the World Trade Organization, and granting it permanent favored-nation trading status, the U.S. trade deficit with China grew from \$83 billion in 2001, to \$347 billion in 2016.<sup>27</sup> And trade with Mexico went from being balanced in 1994, before the ratification of NAFTA, to a \$63 billion deficit in 2016.<sup>28</sup> The deficit with China was more damaging than the dollar figures indicate, however, as it coincides with the move of complete industries overseas, not just the creation of competitive sources for component parts for U.S.



manufacturers.<sup>29</sup> In a careful study, MIT economist David Autor found that areas of the country exposed to China lost 2.4 million jobs and experienced overall declines in income and well-being, as industries fled, never to be replaced.<sup>30</sup> Other economic estimates indicate that half or more of the manufacturing jobs lost this century were due to trade.<sup>31</sup>

Increasing technology and levels of manufacturing employment do not need to be inversely correlated. A full embrace of technology could allow the United States to be a leader in producing the next generation of advanced manufacturing goods and advanced materials. While these products may not be as labor-intensive as manufacturing products were in the past, the growth of these sectors would produce skilled technical and production jobs—jobs that would simply not exist if the country takes a laissez-faire approach to manufacturing. A strategy for pursuing advanced technology in manufacturing has been in place for many years in Japan and Germany, who have maintained a trade surplus in manufactured goods by investing in strategic sectors that require an increasing portion of high- and middle-skill labor as a share of value added. Fair trade policies, especially those that stop countries from using government subsidies to undercut viable U.S. industries, could be a key part of continuing the momentum built by U.S. manufacturers.

### *Can Manufacturing Jobs Come Back from Overseas?*

Is it realistic to expect manufacturers to bring back jobs from China and other countries, as President Trump has claimed he will do? The Reshoring Initiative estimates that 67,000 jobs were brought back to the United States in 2015—more than the number of jobs offshored that year.<sup>32</sup> Reshoring can also occur when foreign-based multinationals invest in U.S. production. Indeed, Department of Commerce data show an unprecedented \$24.3 billion in foreign direct investment in U.S. manufacturing, well above the recent inflation-adjusted peaks in 2001 and 2006 (see Figure 5).<sup>33</sup>

#### **FIGURE 5**

When all the costs of offshoring are considered, it can be in fact more expensive to produce goods overseas, even if the sticker price of a globally sourced product is cheaper. An analysis of the total cost of production ownership reveals the hidden costs of outsourcing, such as long shipping times, which increase the risk of oversupply or shortages; quality problems with imported goods; and the higher costs of quality assurance and knowledge transfer when using a foreign producer.<sup>34</sup> Data from users of the Reshoring Initiative's total cost of ownership tool found that only 3 percent of U.S. firms were competitive in price when compared to Chinese imported goods, but 55 percent of U.S. firms were competitive using the total cost of ownership method.<sup>35</sup>

While there are economic forces facilitating reshoring, there are also those working against a manufacturing renaissance. Wages in China have increased by 225 percent in the past decade, narrowing the gap between U.S. and Chinese production costs.<sup>36</sup> However, the U.S. dollar has risen by 15 percent against the Yuan since 2013, and over that

time, the dollar has gained 44 percent against the Mexican peso, making U.S. exporters less competitive.<sup>37</sup> Most important, shipping costs have dropped to historically low levels, after reaching record highs in 2008.<sup>38</sup> With these economic forces, further reshoring will depend on efforts by government and corporations to push forward on reshoring, by making U.S. firms innovative, productive, and cost-competitive; and push against offshoring, by ending tax incentives to offshore, and by changing corporate culture to prioritize domestic production when it is economically feasible with additional technology investments.<sup>39</sup>

Reshoring is not a parochial concern of manufacturing advocates. A persistent complaint about the current economic recovery is that the economy has grown at a disappointing clip of just 2 percent per year, compared to previous economic cycles when the economy touched growth rates of 3–4 percent.<sup>40</sup> In 2016, the trade deficit of \$481 billion alone shaved off 2.6 percent from U.S. GDP. The yawning trade deficit in goods (-\$750 billion) overwhelms the growing but still smaller trade surplus in services (+\$250 billion).<sup>41</sup> The large trade deficit is not an inevitable outcome of an industrialized nation like the United States. Advanced, developed nations typically make and create capital goods, which are then exported to developing nations, who then produce products for domestic consumption and export. The problem is that the United States has steadily increased its consumption of imported consumer apparel, electronics, and industrial components, with no corresponding increase in advanced manufactured goods. While the U.S. consumers have benefited from low-priced imported goods, those goods have been at the cost of increasing debt with other nations (especially China) that will eventually have to be paid back through increased ownership of U.S. assets by foreign nations or higher prices (inflation).<sup>42</sup>

Other industrialized nations have maintained a positive trade balance—such as Germany (whose trade surplus is 7.6 percent of GDP) and Japan (whose trade surplus is 3.76 percent of GDP)—even as China and other Asian nations have grown their industrial capacity. They have done that through national industrial policies that cultivate sectors where advantages in innovation can sustain high wages. A reasonable goal for U.S. manufacturing would be to produce an additional \$380 billion in output per year through increased imports or decreased exports that can bring the U.S. trade back into balance, which would equate to 2.7 million more manufacturing jobs (about half of what has been lost).<sup>43</sup> While this would not restore the manufacturing sector back to its end of the twentieth-century level in terms of employment, it represents an achievable, positive national target.

## Manufacturing’s Enduring Value to the Economy and Communities

*Innovation in Manufacturing Is a Key Part of a Healthy Economic Future*

As eloquently outlined by MIT economist Bill Bonvillian, the dominance of the U.S. economy in the twentieth century was predicated on leading the world in a number of breakthrough technologies, including aviation, electronics, space, computing, the Internet, and biotech, arising out of the huge U.S. federal investments in R&D for national defense, space exploration, and other national objectives.<sup>44</sup> World economic leadership in the twenty-first century economy will be determined by the countries that make advances in the next generation of technologies, including virtual reality, aerospace, medical devices, robotics, and advanced life sciences.<sup>45</sup> While some might look at manufacturing as part of the nation's economic past, maintaining a strong manufacturing core is critical for giving the United States a chance to maintain its world economic leadership.

Some have argued that the United States can maintain its level of innovation without a strong manufacturing sector, maintaining innovation, but offshoring production.<sup>46</sup> The poster child for this approach is Apple, which designs its products in the United States, but produces them entirely overseas. In many cases, however, this “distributed model” fails, since research, design, and production are closely tied.<sup>47</sup> Production may move overseas first, but then subsequently it is followed by research and development, enabling other nations to introduce the next wave of innovative products. In the case of battery technology, for example, rechargeable battery production first moved to East Asia, along with the production of laptops. These nations then became leaders in advanced battery technology—and next thing you know, General Motors has no place to go but Asia for sourcing the rechargeable battery for the Chevy Volt.<sup>48</sup> Battery technology is a key example showing why the United States must retain manufacturing capacity if it wants to be a leader in industries such as green technology. Reducing the U.S. carbon footprint, for example, will require the manufacturing of new technologies, from wind turbines to batteries to much more. This economic need gives the United States an opening for a green manufacturing resurgence, but the erosion of the manufacturing base has made it much harder for us to do so.

Harvard Business School professors Gary Pisano and Willy Shih provide a useful theoretical framework for analyzing the innovation impact of outsourcing, proposing the dimensions of modularity and maturity of production.<sup>49</sup> It is easy for a U.S. company, say, to design luggage and produce overseas, because production is separate from design; and similarly, production of some mature products, such as consumer electronics, require little innovation and are not strategic for the U.S. manufacturing sector. But, in cases of products without mature production techniques, and products where the process of production is closely linked to innovation, manufacturing and R&D remain closely intertwined. In these cases, the lack of production capacity constrains U.S. economic leadership.

Even as the manufacturing sector has grown smaller, its firms remain the key source of innovation in the U.S. economy. Manufacturing firms make 68 percent of all investment in research and development spending, with the bulk of investment coming in three subsectors: chemicals, electronics, and transportation equipment.<sup>50</sup> The National Science

Foundation found that 22 percent of manufacturing firms had introduced a significantly improved good or service, compared to 8 percent of nonmanufacturing firms.<sup>51</sup>

U.S. productivity growth has slowed remarkably during the twenty-first century, averaging just 1.4 percent per year, compared to 2.2 percent in the post World-War II era (and 3 percent annually from the late 1940s to the 1970s).<sup>52</sup> Productivity grows when companies improve products, thus increasing economic output per hour. Innovation and investment are the drivers of productivity, yet the United States has maintained a flat intensity of R&D investment, while our competitors are increasing their intensity.<sup>53</sup> The U.S. share of worldwide R&D decreased from 35 percent in 2003, to 27 percent in 2013, with Asian countries now accounting for 40 percent of world R&D.<sup>54</sup> Over the same period, both Japan and Germany have increased their investment intensity at double the rate of the United States.<sup>55</sup>

Innovation is also critical for national security. The U.S. military depends on a manufacturing base to produce the next generation of advanced military technology, and there are significant security risks in relying on foreign components. But the erosion of key components of our manufacturing base, such as semiconductors, machine tools, and advanced materials (biomaterials, magnetic materials, metal, polymers; catalysts; and nanomaterials), has complicated efforts to meet our national security needs, and makes the United States a less competitive production location for new advanced civilian technologies.<sup>56</sup>

## *Manufacturing Delivers a Large Economic Punch*

Economic developers have long treasured manufacturing facilities, even when their employment may seem small compared to the overall population. One reason is the way in which manufacturing operates. Manufacturing employers require a wide number of “inputs”—materials, components, devices—to which they transform and add value. Manufacturers generate economic activity from a diverse array of suppliers, which in turn contributes to the health of local economies. By one measure, manufacturing accounts for 35 percent of all economic output in the economy, meaning that manufacturing’s share of economic output is four times its share of employment.<sup>57</sup> The Manufacturing Alliance for Production and Innovation (MAPI) estimates that as production ripples throughout the economy creates an additional \$1.38 in the economy for each dollar of production, a far higher multiplier than other sectors like health care (\$0.72) and retail (\$0.66).<sup>58</sup> MAPI estimates that manufacturers support 5.5 million jobs in other sectors.<sup>59</sup>

Figure 6 illustrates the intermediate outputs and final value added of two major sectors in the economy: manufacturing, and professional and business services. As a reminder, the value added of an industry what remains after you deduct the value of intermediate goods and services supplied by other sectors from the industry’s total output; this represents the industry’s share of GDP. Manufacturing and professional and business services both contribute about \$2.2 trillion to

GDP. Manufacturing consumes \$1.68 trillion in intermediate goods and services: \$309 billion in construction goods, \$146 billion in professional and business services, and \$137 billion in transportation and warehousing. Professional and business services, however, consume a much smaller \$669 million in intermediate goods and services. The faith of economic development officials in the ability of manufacturing firms to boost other parts of their local economies is validated by this data.

## FIGURE 6

Manufacturers increasingly depend on disparate supply chains for their talent, too—everything from engineering services to employment services that supply production workers. The implication here is that over half of those directly involved in manufacturing are employed in a sector other than manufacturing.<sup>60</sup> For example, there are as many as half a million well-paid computer programming jobs doing manufacturing-like work, not to mention large groups of engineers who work for professional and technical services firms that exist to consult with or take on work from manufacturers.<sup>61</sup>

# Manufacturing Jobs Are Still the Heart of the Heartland

## *U.S. Manufacturing Is More Regionally Clustered Than Ever*

The reverberating impact of manufacturing is most important in those regions that continue to count on manufacturing as a core of their economy. Outside of California (which has the largest absolute manufacturing sector, with 1.2 million jobs) and Texas (second in the nation), eight of the top ten states in terms of manufacturing jobs are from either the traditional Great Lakes manufacturing region or the Southeast (Ohio, Pennsylvania, Illinois, New York, Michigan, Indiana, North Carolina, and Wisconsin).<sup>62</sup>

Manufacturing work has become more regionally concentrated in the wake of the sharp decline in manufacturing jobs during the first decade of the twenty-first century. In part, this is a result of manufacturing concentrating their production facilities and supply chains. For example, the Big Three automakers (General Motors, Ford, and Fiat Chrysler) permanently shut down major assembly plants in peripheral regions such as New Jersey, Delaware, and California. The resulting automotive footprints and supply chains are now primarily located in the Midwest, with supply chains extending north to Canada and South to Mexico. Transplant manufacturers (foreign based auto companies like Toyota and BMW that locate production in the United States) have focused their investment in the South, contributing to a Midwest-Southeast footprint for U.S. manufacturing today:

- The top ten states in terms of percentage of private-sector manufacturing employment are Indiana, Wisconsin, Alabama, Michigan, Mississippi, Iowa, Kentucky, Arkansas, Ohio, and South Carolina (see Table 1). In these states, on average, one out of every six private-sector jobs is in manufacturing.
- Eight of the top ten states in terms of manufacturing job growth are in the states with the greatest density of manufacturing jobs. And, a number of states with historically large manufacturing sectors, such as Illinois, Pennsylvania, North Carolina, and New York, have struggled to make progress in recovering from the hundreds of thousands of jobs lost during the recession. The red boxes in Table 1 highlight those states that lost the most manufacturing jobs during the first decade of the century, and green boxes are the states that have recovered the most jobs during the mild manufacturing jobs recovery from 2010 to 2016.
- Manufacturing represents 30 percent of the state gross domestic product of Indiana, and approaches 20 percent in large manufacturing states, such as North Carolina, Michigan, Kentucky, Alabama, and Ohio.<sup>63</sup>

**Table 1. Manufacturing Employment by State (2001-2016)**

State	<i>Thousands of jobs</i>					
	Manufacturing Employment Level, January 2001	Manufacturing Employment Level, January 2010	Manufacturing Employment Level, December 2016	Jobs Lost 2001-2010	Job "Gains" 2010-2016	Manufacturing Density December 2016
Indiana	639	440	519	-200	79	19.5%
Wisconsin	1258	424	474	-834	50	18.8%
Alabama	336	237	265	-100	29	16.6%
Michigan	846	453	596	-392	143	15.9%
Mississippi	212	137	141	-75	4	15.8%
Iowa	248	199	209	-50	10	15.7%
Kentucky	303	208	245	-96	38	15.3%

<b>Kentucky</b>	300	200	270	30	30	15.0%
<b>Arkansas</b>	236	158	152	-78	-6	15.0%
<b>Ohio</b>	998	612	690	-386	77	14.6%
<b>South Carolina</b>	329	206	242	-124	37	14.2%
<b>Kansas</b>	198	158	161	-40	3	14.1%
<b>Tennessee</b>	476	298	343	-179	46	13.4%
<b>North Carolina</b>	745	431	463	-313	32	12.7%
<b>Minnesota</b>	394	288	316	-106	28	12.7%
<b>Oregon</b>	225	163	186	-62	24	12.0%
<b>Vermont</b>	47	30	30	-17	0	11.6%
<b>New Hampshire</b>	104	65	67	-39	2	11.5%
<b>South Dakota</b>	43	36	41	-7	5	11.4%
<b>Nebraska</b>	114	91	96	-23	5	11.4%
<b>Idaho</b>	71	53	65	-18	12	11.3%
<b>Connecticut</b>	234	165	160	-70	-5	11.1%
<b>Illinois</b>	851	554	565	-297	12	10.9%
<b>Pennsylvania</b>	856	557	567	-299	10	10.9%
<b>Utah</b>	126	111	129	-15	18	10.8%



<b>Missouri</b>	359	244	259	-115	15	10.8%
<b>Washington</b>	327	258	284	-69	26	10.5%
<b>Georgia</b>	531	343	387	-187	44	10.3%
<b>Maine</b>	78	51	50	-27	-1	9.8%
<b>Oklahoma</b>	176	121	126	-54	5	9.7%
<b>Rhode Island</b>	72	41	41	-31	0	9.4%
<b>California</b>	1868	1244	1283	-624	39	9.1%
<b>Texas</b>	1067	814	844	-252	30	8.2%
<b>Louisiana</b>	177	137	133	-41	-4	8.0%
<b>Massachusetts</b>	410	253	251	-156	-2	8.0%
<b>West Virginia</b>	75	49	46	-26	-2	7.6%
<b>Virginia</b>	356	233	230	-123	-3	7.1%
<b>North Dakota</b>	24	22	25	-2	2	7.0%
<b>New Jersey</b>	415	253	241	-162	-12	7.0%
<b>Arizona</b>	210	148	160	-62	12	6.9%
<b>Delaware</b>	39	27	26	-12	0	6.7%
<b>Colorado</b>	186	123	141	-63	17	6.4%
<b>Alaska</b>	10	13	16	3	3	6.2%
<b>New York</b>	739	458	443	-281	-15	5.6%
<b>Montana</b>	22	17	20	-5	3	5.3%

<b>Maryland</b>	170	116	108	-54	-8	4.9%
<b>Florida</b>	470	309	356	-161	47	4.8%
<b>Wyoming</b>	11	9	10	-2	1	4.7%
<b>New Mexico</b>	42	29	27	-13	-3	4.1%
<b>Nevada</b>	44	38	43	-6	4	3.7%
<b>Hawaii</b>	17	13	14	-4	0	2.6%

Source: Bureau of Labor Statistics.

There is a distinctive regional character in the types of manufacturing today. Seven Rust Belt states (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, and Pennsylvania) have more manufacturing jobs than seventeen western states that are less reliant on manufacturing today. Likewise, seven states in the Southeast (Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee) have more manufacturing jobs than thirteen heavily populated east coast states. The industrial character of the states in the Southeast has changed remarkably over the first two decades of the twenty-first century. In 2001, five of these seven states had furniture or textiles as one of their top manufacturing industries; today, only two states do. Transportation-related manufacturing (primarily automobiles) has taken up some of the slack, and is now the leading manufacturing industry in five of these seven states. The other states with above-average manufacturing concentrations are in a region that can be loosely termed the Agricultural Midwest (Iowa, Kansas, Missouri, Arkansas, South Dakota, and Nebraska), and the manufacturing sectors in these states are disproportionately in food processing. In eastern and western states, there is a greater concentration of innovation-intensive manufacturing, such as chemicals and computers/electronics.

### *American Small Towns Depend on Manufacturing the Most*

County-level data from the Quarterly Census of Employment and Wages (2015–2016), displayed in Map 1, adds more detail to the picture of manufacturing jobs today. The map shows manufacturing jobs as a percent of total private-sector employment in established firms as of 2015. While manufacturing jobs are a smaller share of overall employment (including government jobs and the self-employed), this ratio illustrates manufacturing's share of private economic activity, which fuels economic growth and tax revenue of communities. A careful view of the map confirms that while

factories are a smaller part of the landscape of big cities (especially on the coasts), manufacturing jobs remain a mainstay of smaller cities and towns in states in the Midwest and Southeast.

Take tiny Price County, Wisconsin (population 13,000) in the rural Indian Head region, where manufacturing comprises 44 percent of private-sector payrolls. Price County is the birthplace and home of Phillips Medisize, a multinational corporation that provides advanced molding and engineering services for the medical device and specialty commercial sectors. Or St. Joseph, Michigan (population 8,270), best known for its Lake Michigan waterfront, but also the home of Edgewater Automation, a medium-size producer of automated systems for factories, and LECO corporation, a similar-sized manufacturer of precision scientific and laboratory equipment. The term “high-tech” is normally associated with software and engineering jobs in places such as Silicon Valley, but manufacturing is the sector that brings high-tech, value-added activities in our economy to small towns like Price County and St. Joseph.

#### MAP 1. CONCENTRATION OF MANUFACTURING AMONG PRIVATE-SECTOR JOBS, 2015–2016

The data presented in Figure 7 confirm the small-town dependency of today’s manufacturing. In heavily manufacturing states (defined as being in one of the three manufacturing regions described above: the Rust Belt, the Industrial Southeast, and the Agricultural Midwest), just about one-in-four jobs in mostly rural counties come from manufacturing (counties classified in the 2010 census as having between 50 and 99.99 percent of their population living in rural areas). And rural counties in these states are much more reliant on manufacturing jobs (18 percent of private-sector jobs in 2015–2016) than those in nonmanufacturing states. In terms of the share of jobs, cities in manufacturing states and nonmanufacturing states do not have a large difference in their share of manufacturing jobs.

#### FIGURE 7

### *The Role of Manufacturing in American Cities*

The role of manufacturing in cities is a complicated story. While manufacturing jobs are a smaller *share* of employment in these diversified economies, there are more manufacturing jobs in urban counties than in rural or mostly rural counties. The decline of manufacturing in cities had a particularly large impact on African-American communities, withdrawing a source of living wage employment and deepening poverty and racial wealth gaps.<sup>64</sup> Still, a vocal strain within the urban planning community has argued that cities need to reinvent themselves as magnets for a creative class of young college graduates, focusing on professional jobs and sectors such as technology, education, and medicine.<sup>65</sup> A careful analysis by Howard Wial and colleagues of the 114 metropolitan areas most dependent on manufacturing in the 1980s concluded, first, that all had lost a significant share of their manufacturing base. However, those that maintained

a relatively healthy manufacturing sector (the top third of these metropolitan areas in terms of manufacturing employment) gained more nonmanufacturing jobs than those who lost the most manufacturing jobs.<sup>66</sup> Manufacturing jobs bring additional employment and wealth that spills over into expanding service industries—such as education and health services—that directly and indirectly benefit from a strong manufacturing sector.

The future of manufacturing in cities has been boosted by the development of the urban “maker” movement of small producers designing, prototyping, and producing newly developed manufactured goods. Technologies such as 3D printing and the broad availability of printed circuit board and computer-controlled machine tools have made it possible for entrepreneurs to create sophisticated products with very small capital investments.<sup>67</sup> At the same time, the growth in demand for locally sourced products, such as foodstuffs, have created a growing market for these goods and have inspired several cities to foster local production through “Made in X” campaigns and municipal-procurement policies.<sup>68</sup> The maker movement is particularly strong in former manufacturing cities such as Chicago, Portland, and New York that have been successful in attracting creative talent while retaining connections to manufacturing capital, as well as in traditional manufacturing centers such as Youngstown, Ohio, which is now home to the federally funded America Makes innovation institute.<sup>69</sup> The best thing about the maker movement is that it underscores that the future of American manufacturing will be driven by creativity and innovation—the same things that are powering new urban industries such as software development. Many cities embracing the revitalization of manufacturing as part of a dynamic economic mix have heartily embraced the maker movement, which is still in its early stage and will need significant policy help (such as new zoning) and business assistance to convert their ideas into viable manufacturing businesses.

## Is Manufacturing Still a Source of Good Jobs?

The strong public support for manufacturing is based in large part on the belief in many peoples’ minds that such jobs are more likely to provide living wages than other opportunities. This association is particularly strong in those parts of the country where manufacturing jobs have traditionally been a route to a middle-class lifestyle.

How much has the pay advantage held up in the face of global competitive pressures? Manufacturing pay has eroded. Take the auto industry. The near collapse of the Big Three forced the United Auto Workers (UAW) to accept a two-tier contract that lowered wages for new hires and set wages and benefits on parallel with foreign manufacturers that had set up shop in low-wage states.<sup>70</sup> Twenty years ago, nonsupervisory and production jobs in manufacturing paid 5 percent more than those in other sectors, and today they pay about 5 percent less.<sup>71</sup>

A full look at the data suggests why many Americans hold onto their fond feelings for manufacturing. Even though hourly wages are no longer consistently higher, manufacturing jobs continue to provide more hours and weeks per year,

which translates into better annual pay, even if hourly pay has declined. A Department of Commerce report found that manufacturing jobs provide six more hours per week than other private-sector jobs, and these workers work for a greater portion of the year (48.8 weeks versus 46.4 weeks).<sup>72</sup> Figure 8 ranks average annual pay for major industry sectors, and shows that this annual pay gap between manufacturing jobs and other sectors remains substantial. With average pay of \$64,395 per year, manufacturing continues to pay better wages than the sectors of retail trade, health care and social assistance, and accommodation and food services—all of which have in the last fifteen years surpassed manufacturing as an employer of Americans. When looked at through the vantage point of annual wages, manufacturing has maintained its overall distinction as a high-wage industry.

#### FIGURE 8

Of particular interest, manufacturing employs a large number of individuals without a four-year college degree, and manufacturing jobs pay better than positions available in other industries for workers with that level of education. Despite the major changes rocking manufacturing, Figure 9 shows that the weekly wage for manufacturing workers with some college has remained consistently ahead of that for other industries—a separation of about \$150 a week. Workers with less than a four-year college degree represent about 60 percent of the workforce.<sup>73</sup>

#### FIGURE 9

The wage advantage between manufacturing and nonmanufacturing jobs varies within manufacturing regions, as illustrated in Figure 10. While the Rust Belt still can tout the highest manufacturing/nonmanufacturing wage gap among the three dominant manufacturing regions, the observed advantage in manufacturing jobs over nonmanufacturing jobs has declined, from \$220 per week in 1990 to \$170 per week in 2016 (in real dollars). The Industrial Southeast has benefited from the changing mix of manufacturing jobs from nondurable goods (furniture, textiles, and so on) to heavier industries (transportation and fabricated metals), with the wage differential growing from \$61 in 1990 to \$93 in 2016. This is part of an overall convergence of manufacturing wages between the Rust Belt, the Agricultural Midwest, and the Industrial Southeast since the mid-2000s.

#### FIGURE 10

The convergence in wages between the Rust Belt and other manufacturing regions has been in large part because of declining union power, and the steep decline in overall wages as nonunion firms increasingly characterize U.S. manufacturing. Figure 12 presents this stark reality. Manufacturing used to be much more unionized than other private-sector industries, but the sharp decline in unionized workplaces in steel, auto, machinery, and other industrial sectors has brought the union coverage rate in manufacturing down to just 9.6 percent in 2010, only slightly better than the

national rate of 7.3 percent among all private-sector employers. This had the biggest impact in the Rust Belt. On average, from 1990 to 1999, 28.4 percent of manufacturing workers in the Rust Belt were represented by a union, compared to 12.2 percent in the Industrial Southeast. From 2010 to 2016 on average, union participation had dropped to just 14.5 percent of workers in Rust Belt states—a much larger decline than in the Industrial Southeast, which had fallen from 12.2 percent in the 1990s to to 6.8 percent in the 2010s). The decline of the wage premium in the Rust Belt since 1990 exacerbated wage declines that began in the late 1970s.<sup>74</sup>

## FIGURE 11

While unionized workers still earn more than their nonunion counterparts the edge has declined significantly. Figure 12 shows the real wages of unionized and nonunionized production workers from 1990 to 2016. It is startling to see that unionized production workers now earn less on a real basis than they did in 1990, and that nonunion production workers have made up some of the difference. The decline in wages among union workers was especially stark over the past decade, with real wages of unionized production workers dropping from a peak of \$968 per week in 2007 to \$884 per week in 2017. These drops in wages came as unions such as the UAW, United Steel Workers, and the International Association of Machinists had to accept a concessionary climate to survive the twin-hits of the recession and blistering competition from China and other low-wage countries.<sup>75</sup> However, manufacturing workers still do significantly better than their nonunion counterparts, earning substantially more per week and having access to more generous benefits. This does not account for any differences in employee benefits in health insurance and nonpecuniary benefits, such as work rules geared to protecting a worker's safety. In this context, it is not surprising that union drives continue to garner strong interest among workers, even against formidable odds and an anti-union culture among government and the public.<sup>76</sup>

## FIGURE 12

The wage differences described here are only descriptive data. Many factors may contribute to these wage differences. For example, some have claimed that the positive wages associated with manufacturing are due to the high rates of unionization, not to other elements of the industry and the skills of the workforce.<sup>77</sup> To understand the distinct effects of manufacturing on wages, we conducted a regression analysis of data from the Current Population Survey's Outgoing Rotation Groups. In the baseline model, manufacturing workers earn 9.4 percent more in weekly wages than their nonmanufacturing counterparts, holding constant other factors that influence wages, such as education, experience, and gender. The results suggest that working in manufacturing correlates with higher weekly wages, and is not simply because those workers are more likely to be in unions, live in high-wage areas, or be male.

# Occupations in Manufacturing

There is considerable variation in the quality of jobs within manufacturing. Figure 14 digs into the heterogeneity of the wage structure within manufacturing. The trend is clear: the occupations that employ the most workers—production, office support, transportation, and material moving—pay the least. The largest of these groups—production occupations—will be examined in detail in the next section. One estimate finds that there is currently a highly skilled workforce of 1.4 million workers in manufacturing, with “highly skilled” defined as workers in occupations jobs that require post-secondary education or more than short-term on the job training.<sup>78</sup> Manufacturing firms employ nearly 800,000 high-paid engineering workers, more than any other sector. A robust supply of engineers will become even more critical as production becomes more high tech.<sup>79</sup> The analysis concludes that, “the top five occupations in this group—machinists, welders, industrial-machinery mechanics, industrial engineers and operators of computer-controlled machine tools account for two thirds of skilled manufacturing work.”<sup>80</sup> Table 2 illustrates the pay, required education, and anticipated growth of these jobs (most of which are expected to grow faster than the economy, even in a smaller U.S. manufacturing sector). Among jobs that do not require a college degree, installation and repair occupations and sales occupations stand out as manufacturing occupational groups that pay family-sustaining wages. These installation and repair jobs will continue to have major importance within manufacturing, as companies utilize more robotics that will need to be well-maintained to ensure smooth production. These jobs typically only require a high school degree, but also require more than a year of on-the-job training.<sup>81</sup>

## FIGURE 13

While the manufacturing sector of today has the majority of its workers in lower-wage production and transportation/material moving occupations, the share of manufacturing jobs in these occupations could diminish over time, as companies use more automated production techniques. What is more likely to happen is that production jobs will require more robust basic skills required to operate high-technology production equipment. For this reason, there is a drive to create production job credentials that can certify that workers are capable of operating today’s advanced manufacturing equipment.<sup>82</sup>

### *Frontline Production Jobs Still Pay Better Than Many Alternatives*

Americans can no longer count on frontline production operations to consistently provide quality jobs. There is significant variation among these jobs. Of particular concern, factories are increasingly using temporary help agencies to staff their assembly lines.<sup>83</sup> In fact, employment staffing agencies now employ more production workers than any other



industry, and production workers employed by temporary firms earn significantly less on average (\$12.81 per hour) than other production workers (\$17.49). Temporary workers are less likely to get access to on-the-job training than regular workers, which can make it harder to move to more skilled occupations, such as repair jobs or operators of computer-controlled machine tools. A surprising one-out-of-three production workers had wages so low during the 2009 to 2013 period that they were forced to rely on some form of public assistance (food stamps, health care, tax credits) to make ends meet.<sup>84</sup>

Despite all these crosswinds, production jobs today provide better opportunities than similar occupations within the reach of lesser-educated workers. All told, production occupations pay an average of \$17.41 per hour and \$36,220 per year. Table 3 provides a list of the ten occupations expected to produce the most job openings for workers with only a high school degree, and those that do not require a high school degree, over the period from 2014 to 2024, ranked by their annual pay. Of the group requiring a high school degree, the only two that pay better than manufacturing-related jobs are ones that require supervisory responsibilities.

**Table 2. Major High Skilled Manufacturing Occupations, 2015**

	<b>Current Employment</b>	<b>Mean Annual Wage</b>	<b>Growth 2014-2024</b>	<b>Training</b>
Machinists	391,120	\$43,220	10%	High School + Long Term Training
Welders	382,730	\$42,450	4%	High School + Moderate Training
Industrial Machinery Mechanics	334,490	\$51,890	18%	High School + Long Term Training
Industrial Engineers	256,550	\$88,530	1%	Bachelor's Degree
Operators of Computer-Controlled Machine Tools	146,190	\$39,500	17.5%	High School + Moderate Training

Source: Bureau of Labor Statistics, Occupational Employment Statistics.

The declining quality of production jobs remains a critical issue. Manufacturing has begun to be divided between those employers who take the high road, staying focused on enhancing productivity and paying good wages to production workers, and those who take the low road, paying low wages for low productivity. Important research has found that even within narrow manufacturing subsectors such as stamping of metal parts, the most-productive firms (top quartile) pay twice as much or more than the least-productive firms (bottom quartile).<sup>85</sup> Worker engagement is particularly important in manufacturing. Improving production typically requires workers stationed in different parts of the production process to collaborate, which can be fostered by formal efforts such as quality circles and similar continuous improvement efforts. Engaged workers can make production more efficient and directly improve the bottom line.

In fact manufacturing appears to increasingly divided between those workplaces organized in twentieth century mass production techniques with repetitive tasks and little opportunities for worker input and high chance for future worker dislocation, and those that embrace a twenty-first century model of manufacturing with more varied and meaningful worker.<sup>86</sup> (These modern manufacturers also tend to present a physical space that looks like more like a research or technology firm.) Not surprisingly, the latter group of firms tend to pay better wages and offer a more attractive workforce option to young people.<sup>87</sup>

## Providing the Workforce for a High Road Manufacturing Future

The manufacturing workforce has two problems: a pipeline problem, and a skills gap problem. Often described as the same challenge, these in fact are two different problems. One is a lack of workers interested in manufacturing careers, and the other is the lack of skilled workers. Deloitte and the Manufacturing Institute went so far as to predict a gap of 2 million manufacturing workers over the next ten years.<sup>88</sup>

Figure 14 reveals this relatively new problem. Both before and during the recession, there were consistently more manufacturing workers hired each month than the number of openings listed. In other words, manufacturing jobs were quickly filled and there were few unclaimed openings. The trend curiously diverged after the end of the recession. In all but six months of the past five years, there were more job openings than hires—meaning that manufacturers were unable to fill jobs and positions remained open.<sup>89</sup>

### FIGURE 14

The shortage of skilled workers is a part, but not all, of the workforce challenge facing manufacturing. One detailed study of core production workers indicates that between 16 percent and 25 percent of manufacturing establishments have long-term vacancies, which indicates a genuine shortage of qualified workers.<sup>90</sup>

The continued availability of a skilled workforce to fill these jobs is critical to the future of manufacturing in the United States. As the manufacturers of tomorrow increasingly incorporate technology into their workforces, they will need both college-educated engineers and well-trained workers to service industrial robots and to operate computer-controlled machine tools. With nearly 80 percent of employers stating that workforce shortages will hinder their ability to introduce new technologies, the United States simply will not be able to build its competitive position in the advanced manufacturing industries of the future if cannot produce a sufficient number of skilled workers<sup>91</sup>

**Table 3. The Top Ten Growing Occupations among Workers with and without a High School Degree, May 2016**

<i>Jobs requiring a high school degree but not college</i>		<i>Jobs without any educational requirement</i>	
<b>Job category</b>	<b>Median annual wage</b>	<b>Job category</b>	<b>Median annual wage</b>
Sales representatives, wholesale and manufacturing, except technical and scientific products	\$57,140	Laborers and freight, stock, and material movers, hand	\$25,980
First-line supervisors of office and administrative support worker	\$54,340	Janitors and cleaners, except maids and housekeeping cleaners	\$24,190
First-line supervisors of retail sales workers	\$39,040	Stock clerks and order fillers	\$23,840
Maintenance and repair workers, general	\$36,940	Retail salespersons	\$22,680
Secretaries and administrative assistants, except legal, medical, and executive	\$34,820	Home health aides	\$22,600
Customer service representatives	\$32,300	Personal care aides	\$21,920
First-line supervisors of food preparation and serving workers supervisor	\$31,480	Maids and housekeeping cleaners	\$21,820
Office clerks, general	\$30,580	Cashiers	\$20,180
Receptionists and information clerks	\$27,920	Waiters and waitresses	\$19,990
Child care workers	\$21,170	Combined food preparation and serving workers, including fast food attendant	\$19,440

## *Job Quality and Workforce Pipeline Problems Contributing to Labor Shortages*

The skills gap is only one part of a broader workforce problem. The good news is that today's production jobs are still within reach of Americans who have achieved a twelfth-grade education: 52 percent of core manufacturing jobs require extended reading skills (such as the ability to read complex technical documents); 42 percent require extended computer skills (such as the ability to program a machine to create a new piece); and 38 percent require extended math skills (such as algebra).<sup>92</sup> Younger manufacturing workers are no more likely to have achieved a college credential than older workers, suggesting that a high school degree is still sufficient to break into the manufacturing field.<sup>93</sup> Even more important than these technical skills are so-called soft skills, such as the ability to cooperate with other employees (identified by 81 percent of employers) and the ability to work in teams (64.2 percent).

Manufacturing's image problem gets in the way for young people coming out of high school who otherwise might pursue careers in manufacturing. While 64 percent of Americans think a strong domestic manufacturing sector is important to the nation's economy, only 37 percent think that manufacturing is a good career for their children.<sup>94</sup> This is not surprising given that families in manufacturing have suffered waves of economic dislocation and permanent layoffs and don't want the same for their children. Although the trend appears to be reversing, career and technical education programs at the high school level that could have exposed young people to manufacturing jobs have waned.<sup>95</sup> Compounding matters, only 13 percent of manufacturers surveyed frequently recruit at high schools.<sup>96</sup>

The twin imperatives of engaging a new generation in manufacturing jobs and the continued ability of many manufacturing jobs without a college degree point to the need for an increased focus on apprenticeships and on-the-job training models. Already, employers see internal job training as the most important way they developed a skilled workforce, but corporate training intensity has decreased.<sup>97</sup> Apprenticeships offer a structured way to bring young people into those on-the-job training programs to learn those industry-specific skills and the cooperation and team skills needed to succeed on today's factory floors. Because entry-level manufacturing jobs only require only a high school diploma, they are ripe for apprenticeship. However, manufacturing apprenticeship programs have shrunk as it has become less unionized and more stressed by foreign competition.<sup>98</sup>

Manufacturing will not solve its workforce problem if the quality of jobs does not improve in terms of wages, benefits, and safety, as well as worker engagement. An industry truly suffering skill shortages should increase wages, but manufacturing wages have remained flat. For many years, American workers were willing to tackle physically demanding work requiring high levels of concentration in exchange for decent wages. Manufacturing companies cannot

expect workers to jump into manufacturing careers today if they do not pay more than in other fields that demand less from workers and often require less skill. Some have argued that better wages would solve manufacturing's workforce problems by increasing labor demand.<sup>99</sup> But, raising wages will not solve skill shortages. Better wages will make it more likely for workers to make the investment in developing the skills factories need, and manufacturers will need to find ways to pay higher wages in order to make manufacturing jobs attractive to the next generation of workers.

The twentieth-century workforce model based centrally on the provision of a public labor exchange that would match hard working Americans with available jobs will not create the pipeline for the twenty-first century. We need labor market institutions that are tightly intertwined with the needs of subsectors within manufacturing, starting at the high school level and continuing on at community college and our apprenticeship system.

### *Solving Manufacturing's Diversity Problem*

If the manufacturing sector is going to be able to restock its workforce as baby boomers retire, it will need to recruit a more-diverse workforce. Unfortunately, recent trends indicate that the sector has failed to hire equitably by gender and will need to do even more in the future to improve its racial diversity

Women today make up 47 percent of the workforce, but only 27 percent of manufacturing workers. This hiring trend has worsened an already problematic gender gap—women's participation in manufacturing peaked at 32 percent in January 1990, and has been dropping steadily, standing now at 27 percent.<sup>100</sup> During the two recessions experienced already this century, the decline in jobs was relatively even for women and men, but in the recovery periods, men gained jobs back more quickly, particularly in key sectors such as transportation equipment and fabricated metals.<sup>101</sup> (See Figure 15)

#### **FIGURE 15**

The racial and ethnic diversity picture shows some promise—doing better than the popular imagination would suggest—but still has problems. White, non-Hispanic workers are slightly overrepresented, comprising 67 percent of all manufacturing workers, compared with 65 percent of workers overall. Hispanic workers (16.1 percent of all manufacturing workers) and Asian workers (6.8 percent of all manufacturing workers) are just as likely to work in manufacturing as in any other field. Black workers, however, are now modestly under-represented in manufacturing, with black workers representing 11.9 percent of all workers, but only 10 percent of manufacturing workers. As America increasingly becomes a more diverse nation, the need for manufacturers to recruit a diverse workforce to replace aging workers will become even more important. The percentage of the workforce over 55 that is either Hispanic, black, or Asian is just 24 percent; for workers under the age of 35, that percentage is 41 percent.<sup>102</sup>

The low representation of women in manufacturing is partly just an image problem. While young women rank manufacturing last among career options, those who break through barriers and end up in manufacturing careers report that they are satisfied with the career choice.<sup>103</sup> Thus, a big part of the problem is encouraging women to think of pursuing a career in manufacturing in the first place—but less than one-third of automotive and industrial companies have a gender diversity recruitment program, a poor showing when compared to retail and life science companies.<sup>104</sup> As a purchaser of manufactured goods, government can play a key role pushing firms toward greater gender equity by making diversity programs one of the dimensions on which bids for government-supported work are scored on.<sup>105</sup>

The focus on urban manufacturing will be particularly important for maintaining and increasing racial diversity within manufacturing. Recall from the table above that metropolitan areas have the lowest concentration of manufacturing jobs. The trend away from cities began before the general decline of manufacturing, with factories leaving inner cities such as Milwaukee and Detroit for suburban and rural areas.<sup>106</sup> This decline in urban manufacturing jobs has had a tremendously hurtful impact on American society, posited as a causal factor in weakening of black families by sociologist William Julius Wilson, and most recently labeled as a civil rights issue by author Louis Uchitelle.<sup>107</sup> The promise of urban manufacturing is that it provides living wage opportunities for minority workers, who currently suffer from high rates of unemployment.

## Conclusion

The rebound since the Great Recession demonstrates that there is indeed hope for a revival of the manufacturing sector and of good manufacturing jobs. There is now a growing group of manufacturing subsectors that are adding jobs and helping to power economic growth, in durable industries such as transportation, machinery, and fabricated metals, and in nondurable goods, such as chemicals and food processing. This is no small matter for an economy with flagging productivity and a declining share of worldwide innovation. Continued manufacturing revival will be critical for the United States to maintain its leadership developing the products and technologies that will define the twenty-first century.

Indeed, families in communities across the country are counting on that continued economic revival. This is especially true in small towns in the cluster of twenty manufacturing states where factory work has become increasingly concentrated as a result of recession and recovery. The workforce and economic challenges in the way of further reshoring and renewal of manufacturing jobs are substantial. While manufacturing jobs continue to pay better than other alternatives for workers without a four-year college degree, the quality of frontline jobs in the nation's assembly



lines have declined. As the nation's manufacturing workforce ages and technical demands of jobs increase, there will be an acute need to create a diverse pipeline of skilled workers and entry-level workers interested in manufacturing careers. It is beyond time to raise the pay of manufacturing jobs, and tackle manufacturing's diversity problems head on.

Taking advantage of this opportunity will require a dynamic, high road recovery model—one that will address the interlinked challenges of manufacturing innovation and workforce readiness, and ensure that federal policies level the playing field for U.S. producers.

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