The Wisconsin Economy

MANUFACTURING

STRATEGY OPTIONS FOR THE STATE

Patterns of Economic Growth and Development

MAY 2018

AUTHORS
TESSA CONROY
MATT KURES
I-CHUN CHEN

Policy Brief No. 6

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

UW Extension
University of Wisconsin-Extension

ACKNOWLEDGEMENTS

This piece has benefited from the helpful comments of Paul Jadin, Randy Hulke and Buckley Brinkman. All errors and policy interpretations are the responsibility of the authors.

This work was supported by a grant from the United States Department of Commerce Economic Development Administration in support of Economic Development Authority University Center (Award No. ED16CHI3030030). Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the U.S. Department of Commerce Economic Development Administration.

KEY POINTS

Despite a recent increase in manufacturing employment, it is unlikely that employment in Wisconsin's manufacturing sector will return to its historical levels. Factors such as technological change and automation will likely continue to reduce the sector's long-term demand for labor.

Given past and projected employment trends, blanket policies that seek to maintain the status quo by simply tying incentives to jobs are unlikely to have lasting economic effects. Instead of focusing solely on job creation, policies to support Wisconsin's manufacturing sector should take a long-term approach of increasing productivity and innovation. State and local investments in nurturing early stage research, developing new technology platforms, and supporting later stage commercialization can help firms innovate.

Wisconsin's manufacturing firms are facing labor availability challenges more so than a skills gap. Current programs that encourage individuals to pursue manufacturing careers are positive steps, as are Wisconsin's efforts to coordinate regional workforce development initiatives across public and private-sector partners. An aging workforce, low unemployment rates, geographic mismatches in labor availability, and the low mobility of individuals in production occupations suggest that automation technologies will need to be embraced as a partial solution to future labor needs.

Wisconsin manufacturers currently export a large volume of products to international markets. Wisconsin's significant number of small-to-medium sized manufacturers could mean that many firms are unaware of international market opportunities. With potential changes to NAFTA, Wisconsin manufacturers could also face significant challenges to accessing two of their key trading partners (Canada and Mexico). Accordingly, policies aimed at supporting and growing international trade should continue.

Approximately 82 percent of Wisconsin's manufactured goods are shipped by truck alone. For Wisconsin to support its manufacturing sector, a long-term solution to road funding must be determined.

INTRODUCTION

Recent national data from the Bureau of Labor Statistics indicates that the manufacturing sector hired more workers on average in 2017 than any year since the depth of the Great Recession. The number of job openings in manufacturing seem to have come back even stronger than the number of new hires since the recession. In 2017 there were, on average, nearly 400,000 job openings per month, which is more than three times the average number of monthly job openings in 2009. A large number of job openings, however, are going unfilled due to an increasingly tight labor market. A perceived skills gap—a lack of workers with skills appropriate to suit the needs of modern manufacturing—could also be a factor in these unfilled job openings.

After losing nearly 4,000 manufacturing jobs between 2015 and 2016, based on the Quarterly Census of Employment on Wages for Wisconsin, the preliminary data for 2017 indicate that manufacturing employment is now trending upward. As of June 2017, Wisconsin manufacturing employed 472,257 people, just over 1,000 employees more than the same month in 2015 (0.25 percent growth). These modest gains came after spending nearly $300 million a year on tax cuts offered to manufacturing companies to reduce corporate and income taxes (WPR).

In an attempt to further spur Wisconsin's manufacturing sector, the state signed a recent deal with Foxconn, a Taiwanese electronics manufacturer. The deal provides three to four billion dollars in incentives, making it the most expensive deal in Wisconsin's history. In return, Foxconn is to invest in a large plant in Racine County and generate between 3,000 and 5,000 jobs with the potential to grow to 13,000 jobs. This deal has been followed by a national competition to lure Amazon's second headquarters with similarly large incentive packages.

The unprecedented incentive package to Foxconn, and the recent offer of a similar package to Kimberly-Clark to retain some of its paper mills in Wisconsin, raises several questions about the state of manufacturing. Why is manufacturing so important to the Wisconsin economy? Is manufacturing declining, growing, or stagnant? Should Wisconsin continue to aggressively pursue manufacturing as a key element of the state's economy? Does a skills gap explain unfilled manufacturing jobs, or are there other explanations such as a tight labor market or a growing desire to work in occupations unrelated to manufacturing? What are the possible policy interventions and are they effective?

This brief provides an overview of current trends in Wisconsin manufacturing, but more importantly, it offers a discussion of strategies that could be enacted at both the state and local level to enhance the manufacturing economy. Care must be taken, however, not to view manufacturing as a monolithic industry where individual strategies have uniform effects on all manufacturers. Some manufacturers face "ordinary competition" where the most efficient means to profitability are to focus on the costs of operations. These types of manufacturers may be unable

On the whole, Wisconsin has added 239 thousand non-farm jobs since 2000 despite losing 120 thousand jobs in manufacturing.

to raise wages or offer benefits to attract workers in tight labor markets. Other manufacturers focus on innovation, or "quality competition," to enhance their profitability by bringing new products to market or can and easily adapt to rapidly changing market conditions. Clearly, strategies that favor one type of manufacturing may not benefit another type of manufacturer.

WHY DOES MANUFACTURING MATTER?

In Wisconsin, manufacturing is a significant part of the economy in terms of jobs, income, and production. With almost 500,000 workers, Wisconsin's manufacturing sector employs more people than any other sector in the state. The number of workers employed in Wisconsin is nearly equal to that of 50 years ago, but the small net change hides important long-term trends. In the 1970s and 1980s, manufacturing employment increased but then declined consistently beginning in the mid-1990s until leveling off in recent years. At the same, time manufacturing output, measured by Gross State Product (GSP), has steadily increased. This increase in GSP combined with stagnant or declining employment is largely attributable to increases in productivity per worker (Figure 4). However, growth in productivity has slowed in recent years.

In addition to providing a large number of jobs, manufacturing also pays well. According to the U.S. Bureau of Labor Statistics, the median annual wage for all manufacturing was six percent higher than the median annual wage for all workers as of 2013. Similarly, the Brookings Institution finds that the weekly earnings in manufacturing from 2008 to 2010 were nearly 20 percent higher than the non-manufacturing average. Early 2017 data shows a similar pattern in Wisconsin in that manufacturing jobs paid average weekly wages close to 20 percent more than all industries combined (Authors' analysis of QCEW data). Such direct comparisons, though, do not account for differences in worker and job characteristics between sectors. According to an analysis by the Brookings Institution that controls for such factors, a manufacturing worker earns nearly eight percent more than a comparable worker in a similar job (i.e., occupation) in a non-manufacturing industry. They find that manufacturing pays especially well for low-skill workers compared to their alternative employment opportunities.

These favorable wage data, however, need to be placed in broader context. While it is the case that many positions in manufacturing still offer competitive wages, manufacturing jobs have been on a long-run decline. What recent increases there have been, do not offset the cumulative effect from two decades of losses. Meanwhile, many non-manufacturing sectors have substantially expanded employment. On the whole, Wisconsin has added 239,000 non-farm jobs since 2000 despite losing 120,000 jobs in manufacturing. Much of the growth has occurred in service-related industries, led by the health care and social assistance sector, which alone created 93,000 jobs (Figure 1). Several of these fast-growing sectors also pay higher wages than manufacturing. In 2016, the average wage was $31 per hour nationally in professional, scientific, and technical services; $28 per hour in health care; and $32 in financial activities; all of which were higher than $26 per hour in manufacturing (Author's Analysis of CES data from the Bureau of Labor Statistics).

Employment and wages are but one way to measure the contribution of manufacturing to the Wisconsin economy. If we are considering the contribution of manufacturing to Wisconsin's Gross State Product, we find that manufacturing accounts for about one in five dollars of state GSP. But since 2000, that share has been slowly trending downward (Figure 2). This is not to say that manufacturing is declining when measured by GSP, but rather the growth in manufacturing is not keeping pace with the overall growth of Wisconsin GSP. Specifically, overall GSP for Wisconsin increased in real terms (adjusted for inflation) by 22.7 percent but only 2.6 percent for manufacturing from 2000 to 2016.

In addition to offering a large number of well-paying jobs, manufacturing is a critical source of innovation. Manufacturers are responsible for a majority of the research and development (R&D) conducted by private businesses (Deller and Conroy 2017). Manufacturers are also more likely to produce a new product, process, or service and earn patents in the course of R&D (The Manufacturing Institute). Many of these advancements have led to significant increases in technology and productivity. Indeed, many of the advances in robotics and automation are flowing from the manufacturing sector. While this movement toward automation has allowed manufacturing to continue to grow in terms of GSP, it can do so with fewer workers. At the same time, however, economic theory suggests that those remaining workers should be more productive, and thus earn higher wages.

The long term trends nationally and for Wisconsin is are toward fewer jobs in manufacturing. Increases in automation and computerization have allowed fewer workers to be more productive. Wisconsin manufacturers that are better positioned to be innovative and adapt to new technologies are likely to be in a competitive position. This innovation is likely to come with fewer low-skilled and more high-skilled workers in manufacturing.

FIG 1

CHANGE IN WISCONSIN JOBS 2000–2015 (PERCENT TOTAL GROWTH)

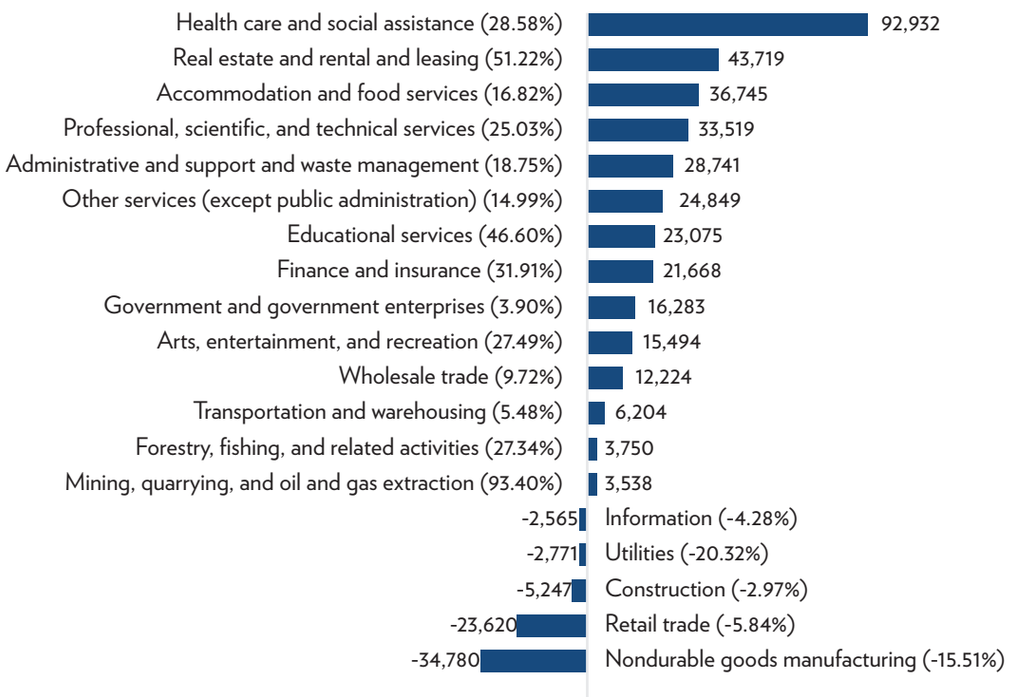
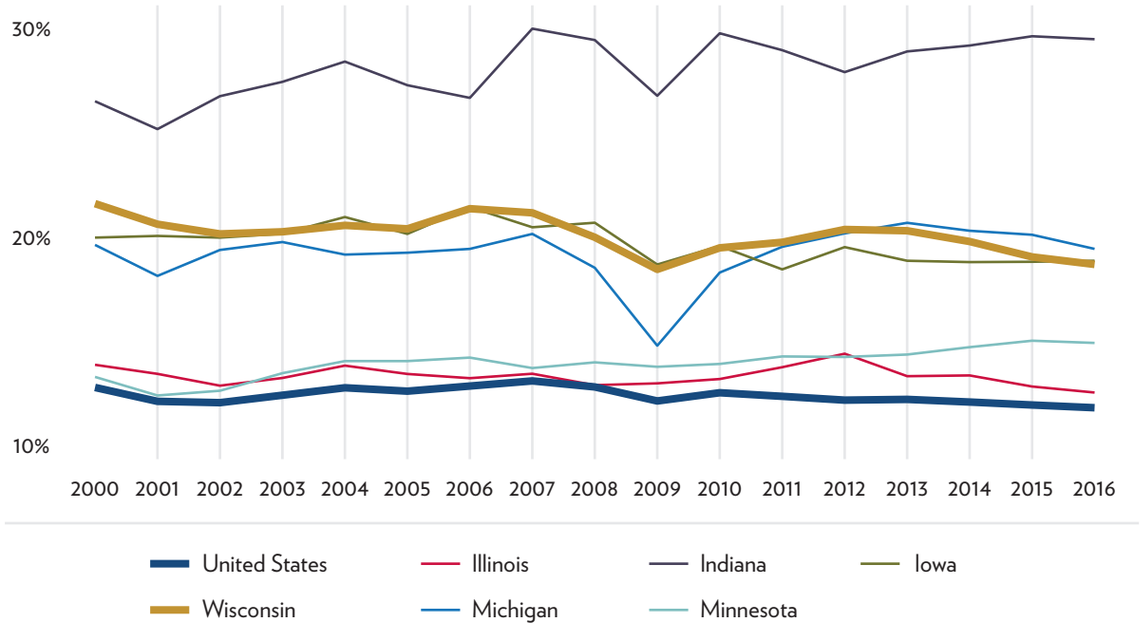


FIG 2

MANUFACTURING'S CONTRIBUTION TO STATE GDP 2000–2016 (ADJUSTED FOR INFLATION IN 2009 IN 2009 DOLLARS)



The large number of workers that remain in manufacturing, the quality of their jobs as measured by wages, as well as the innovative and productive capacity of manufacturing make it an important component of the economy nationally and in Wisconsin. Because of these factors, manufacturing continues to get significant attention from national, state, and local policy makers with the focus on boosting employment and the competitiveness of the industry. Perhaps most effective, in terms of lasting impact, are those policies that help facilitate the shift of manufacturing towards technological advancement, high value-added, and developing an appropriately skilled workforce. Several such policies and examples are discussed in the following section.

EMPLOYMENT TRENDS IN MANUFACTURING

The U.S. lost 41 percent of its manufacturing jobs between the peak in 1979 and the low point in 2009 (Brookings). Job losses in manufacturing during the last decade were the most severe in U.S. history (ibid.). Nationally, the share of workers employed in manufacturing reached its lowest point at 8.9 percent in December 2009, down from 13.2 percent in January 2000 (Figure 3). Since the end of the Great Recession, manufacturing has recovered to pre-recession levels in several aspects (U.S. Department of Commerce). Manufacturing has hired workers, increased production, and contributed to the rise in GDP since 2009. Manufacturing output has increased 22 percent since the low point of the recession (Congressional Research Service (CRS)). Employment has also increased, but more slowly, at a rate of just eight percent since it bottomed out in February of 2010. During the Great Recession (2007 to 2009), 65 thousand Wisconsin manufacturing jobs were lost, and just 33 thousand have been recovered.

Taking a long-run view, the number of manufacturing jobs has been declining nationally as well as in Wisconsin and the Midwest region. In Wisconsin, there were 510 thousand workers working in manufacturing in 1970 and, as of 2015, that had decreased only slightly to 485 thousand workers. But, during that period, the economy grew as did the number of workers. So, though

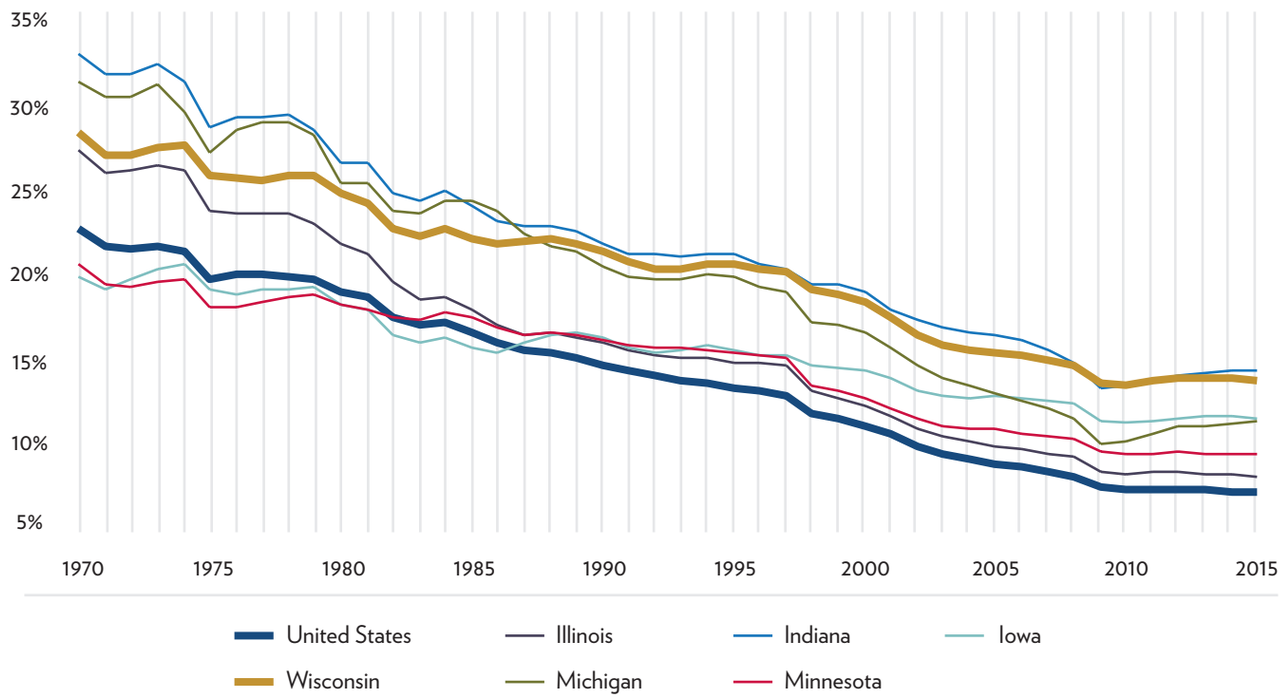
manufacturing offers close to the same number of jobs that it did decades ago, its share of total employment has decreased dramatically.

Importantly, focusing on the small net change in jobs or employment gains during the recovery ignores the lasting and perhaps more powerful long-term trends. The small change in jobs results from what could be considered two consecutive long-term trends: 1) a manufacturing expansion in the 1970s and 1980s, and 2) a contraction that started in the 1990s and continues. While it is true that employment has rebounded from 2007, there is a long-term decline in manufacturing that predates the recession and could continue despite business cycle fluctuations.

MOVING OUT OR GONE COMPLETELY?

The question of where manufacturing has gone pertains mostly to employment—where have the manufacturing jobs gone? Conventional wisdom suggests that manufacturing jobs are leaving Wisconsin to go elsewhere—to other states or even other countries. That is likely only part of the story. It is true that the decline in U.S. manufacturing employment accelerated after China joined the World Trade Organization, however, the decline started long before China became a major manufacturer (The Economist). The decline in manufacturing in industrialized countries around the world (The Economist) predates the Great

FIG 3 **MANUFACTURING EMPLOYMENT AS A SHARE OF TOTAL NONFARM EMPLOYMENT BY STATE, 1970-2015**



Radical changes in manufacturing technologies have changed the labor demands of manufacturers. Increasingly, manufacturers are requiring people with math and computer skills and rudimentary engineering skills. Workers must also be able to adapt to changes in these technologies. Workers must be able to learn, for example computer software upgrades, more quickly. The need for continuing education opportunities, whether this is in face-to-face seminars or workshop settings or through distance education (broadband), will heighten the need for public-private partnerships.

Recession and major competition from China. In the United Kingdom, manufacturing employment declined nearly 50 percent between 1990 and 2015 (CRS). In Germany, it declined 27 percent, and 38 percent in Japan during the same period. Thus, the idea that manufacturing is declining purely because of global pressures is somewhat misleading.

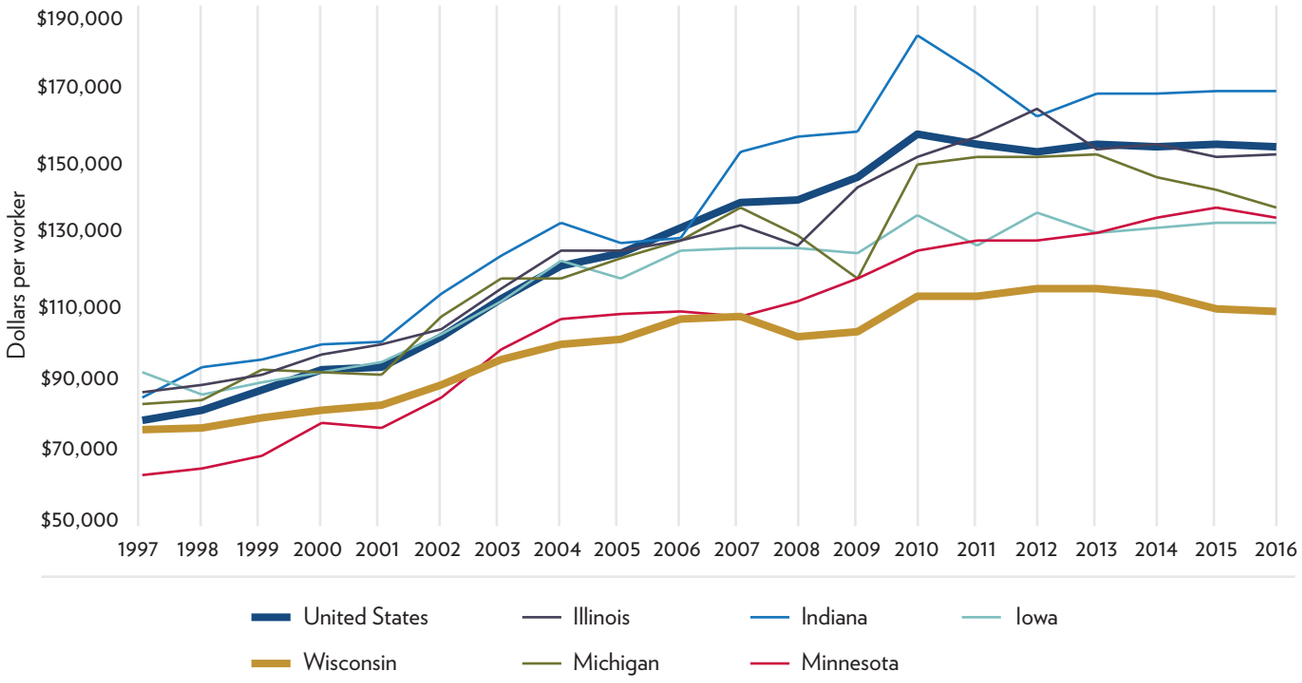
Despite declining employment, the notion that manufacturing is "gone" or has "left" is somewhat misplaced. Manufacturing has changed, but not disappeared. Some evidence indicates that most of the decline in manufacturing is due to increasingly productive processes, including but not limited to automation and the use of robotics. As much as 88 percent of the job losses in manufacturing have been attributed to increasing productivity (Ball State Report). A comparatively small share, or just 13 percent, of job losses are attributed to changes in international trade. Furthermore, innovation in manufacturing has changed the number, skill-requirements, and location of the jobs it offers. At the same time, production has increased and manufacturing's share of GDP has been relatively steady (Figure 2). So, focusing only on employment understates healthy aspects of manufacturing that have led to productive gains.

Still, other research suggests that gains in productivity do not necessarily explain the decline in jobs in the U.S. In Canada and Italy, productivity increases have come alongside job growth. The simultaneous increase in employment and productivity can be explained simply: productivity lowers the price of products, which increases the size of the market, driving a need for more workers. Further, a study of the U.S. from 1948 to 2003 indicates that increases in productivity were associated with job growth (Nordhaus 2005). Thus, it seems that job loss is not necessarily a natural consequence of increasing productivity and the fear that technological advances will unambiguously reduce the need for labor may be an oversimplification.

Perhaps the reason productivity gains are often accepted as a convincing explanation for the decline in employment is because one form of technological advancement has been the implementation of automation and computerization, which often directly replace human labor. In a recent study examining the impact of robots on manufacturing, the results indicate that industries that robotize tend to increase output, but in locations where more robots are installed, both the number of jobs and wages fall.

FIG 4

MANUFACTURING INDUSTRY GROSS STATE PRODUCT PER WORKER (ADJUSTED FOR INFLATION IN 2009 DOLLARS)



In sum, the effects of robotics or automation are difficult to predict. In a widely cited study, two University of Oxford economists predicted that nearly half of jobs in the U.S. are "susceptible to computerization" in the next 10 to 20 years (Frey and Osbourne 2017). Automation will, of course, affect jobs, but jobs—their content and skill requirements—are constantly changing. It is unlikely that robots will categorically eliminate broad swaths of jobs. Sometimes robots are a complement to, rather, than a substitute for, for the jobs workers do. These technologies allow workers to be more productive and perform new tasks, often in a safer environment. Thus, it would be a mistake to presume that the relationship between automation and employment within one manufacturing sector necessarily applies to all manufacturing sectors. Looking for ways to develop the workforce in a way that enhances technological advancement and vice versa, as discussed in the following section, rather than viewing them as purely opposing interests may be most promising.

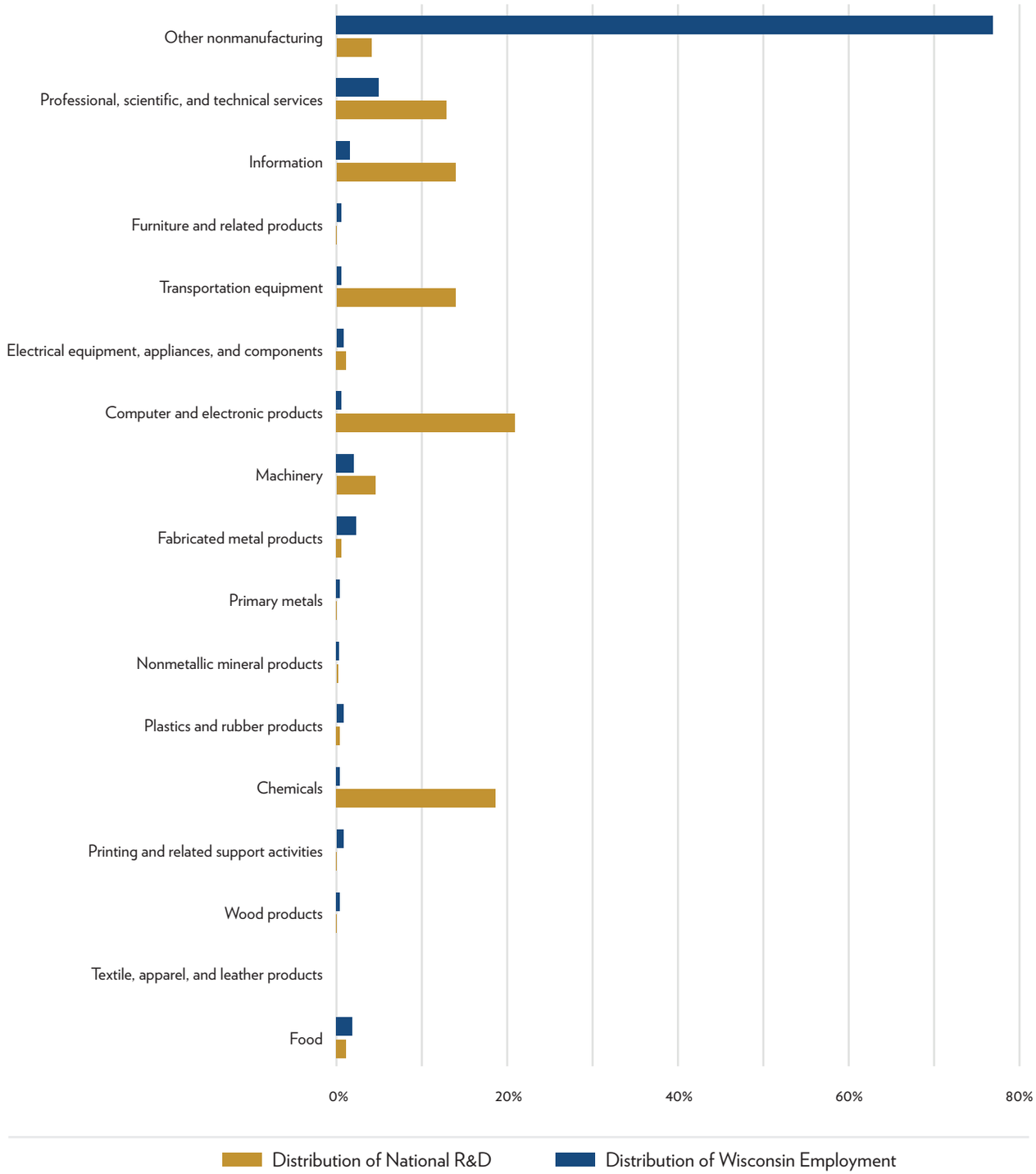
AN INNOVATIVE SECTOR

While the automation of manufacturing has alarmed some, it can be seen as part of a larger success story. Manufacturing is the nation's largest source of commercial innovation (Brookings, 2012). In recent years, manufacturers have conducted 70 percent of all research and development (R&D) conducted by businesses, and of that, the pharmaceutical; computers, electronics, and optical industries conducted nearly roughly half (CRS Levins0n 2018).. U.S. manufacturers also spend more on R&D than any other country except China where spending is roughly equal comparable (Levinson 2018).

In the U.S., manufacturers are more likely than non-manufacturers to use new production, distribution, and support activity processes. Similarly, manufacturers are more likely to introduce a new or significantly improved good or service. From the period from 2006 to 2008, 22 percent of manufacturers, compared to just eight percent of non-manufacturers, introduced a new or significantly improved good or service (National Science

FIG 5

DISTRIBUTION OF U.S. R&D SPENDING AND WISCONSIN EMPLOYMENT



Foundation's 2008 Business R&D and Innovation Survey). More recently, national spending on manufacturing R&D has slowed. Since 2008, growth in research and development spending has been modest in the U.S. (CRS) while other countries have increased their R&D spending much more. China, for example, increased its manufacturing R&D by 140 percent.

Specific to Wisconsin, Deller and Conroy (2017) showed that the most innovative industries, measured by R&D spending, are underrepresented in the state (Figure 5). For example, Wisconsin has substantial food processing as well as wood product and furniture manufacturing industries, and these industries do not spend as much on R&D compared to other manufacturers. This may also explain why productivity increases in the state have been modest compared to the U.S. and the rest of the region, as well as why skill requirements have been slow to change (Conroy, Kures and Chen, 2018). Yet, these "low technology" industries were still above the non-manufacturing average for product and process innovations (Brookings, 2012). Thus, even the least innovative manufacturing sub-sectors may still be more innovative than most non-manufacturing industries.

That said, there are also several innovative leaders in the state. Orion Energy Systems, which specializes in energy efficient lighting systems, invested in a plant overhaul to shift from fluorescent to primarily LED products. They also have 95+ granted and patent-pending applications. Kenall Manufacturing, a lighting producer in Kenosha, has also been moving forward by replacing fluorescent systems with more advanced LED light systems. In the medical field, Waukesha, Wisconsin is also home to one of GE's advanced manufacturing facilities (OZY) where engineers are developing 3D printing applications to improve surgical processes. WC Pallets, of Hudson, Wisconsin, has an international patent on the production of corrugated pallets using recycled corrugated containers. Thus, innovation in Wisconsin manufacturing, or the outcome of research and development investments, can range from complex medical systems to new uses of traditional resources. The key is to move Wisconsin manufacturing from "ordinary competition" where firms compete by driving down costs to "quality competition" where firms compete by introducing new products and innovations into the market.

SKILLS GAP OR BODIES GAP

Historically, manufacturing offered secure, well-paying jobs for mid-skilled workers. But, these jobs have become fewer and fewer. As manufacturing has changed, companies have invested in more sophisticated technologies that require a new set of skills. As argued by proponents, such advanced manufacturing could provide high-paying jobs in place of those lost in recent decades. To the extent that the technical training of the workforce has not kept pace with manufacturing technologies, there may be a skills gap.

Matching manufacturers with appropriately skilled workers is a complicated issue. First, as manufacturing has become leaner and the average size of firms has declined, the economies of scale that once existed for firms to train their own employees have diminished (Weaver and Osterman 2017). Firms may also be deterred from investing in training if they expect that their employees may not stay with the firm long enough for them to earn a return on their investment. Accordingly, the historical pattern of firms investing in the custom training of new employees, and those employees remaining with the firm for the long-term appears to have shifted. Firms today are less likely to invest in the formal training of new workers if those workers are increasingly footloose and take those skills to another company.

Consequently, firms are relying more on external training for workers. This separation between firms and training providers can make it harder for firms to find appropriately skilled workers as they have to rely on universities, technical colleges, trade schools, and apprenticeships to correctly and quickly identify the needs of industry. The more disaggregated the industry and the entities that train workers, the more challenges that may arise in matching workers to firms.

From a national perspective, recent evidence, however, suggests that the large majority of manufacturers do not face a skills gap (Weaver and Osterman, 2017). Only a small set of companies that require math or reading-intensive jobs or unique skills may be facing a skills gap. They find that, overall, the demand for highly skilled workers is modest and most firms do not show signs of hiring difficulties based on skill. Even high-tech companies do not have an especially difficult time hiring.

The perceived skills gap issue is likely conflated with the effects of an aging workforce. According to a report by the NEW

Manufacturing Alliance, a third of workers in regional factories are 55 or older (Figure 7), or nearing retirement. Statewide, approximately 120,000 manufacturing workers are age 55 or older (Figure 5). The problem is potentially compounded by young workers who may not find employment in manufacturing to be particularly attractive. Perceptions persist that working in manufacturing is dirty and dangerous and less attractive than other types of work. Further, the labor market has become increasingly tight in Wisconsin. With unemployment at a historical low, and relatively few available workers per job opening (Conroy et al. 2018), employers may find it difficult to fill their open positions. Indeed, the large pools of workers that existed during the Recession have long eroded. Thus, it may not be a skills gap, but rather a "bodies gap" where there is a shortage of people pursuing these jobs, partly because younger workers prefer other types of work.

Given the pending loss of workers, manufacturers need to be more innovative in attracting and training workers. This could range from offering more flexibility in hours, improving the quality of the work space, paid vacation time, on-site child care, or other non-pay related characteristics of the workplace. Some communities have found that offering a community supported child-care program within the community's industrial park has been well received by both firms and employees. Some firms offer to pay tuition and fees for workers who wish to obtain additional formal training at local technical schools or continuing educational opportunities through local universities and colleges. In return, the employee agrees to remain in the employment of the company for a set period of time. Some firms have even offered ride sharing programs for commuters.

POLICY

RECRUITMENT AND RETENTION

Wisconsin has several policy options available that can be applied at the state and local level to increase manufacturing jobs and competitiveness. Tax policy is central to one of the most widely discussed strategies for developing a positive business climate for Wisconsin manufacturers and attracting and retaining firms such as Foxconn and Kimberly Clark. The research on the efficacy of tax incentive programs is mixed, however, varying with methodology, time period, region, and specific characteristics of the tax program and industries for which they're used. Conroy, Deller and Tsvetkova (2016, 2017), for example, find that, on average, tax incentives have a trivial effect on the relocation of manufacturers. In a study of small (less than 100 employees) rural manufacturers in Wisconsin and northern New England (Maine, New Hampshire and Vermont), Halstead and Deller (1997) found that owners placed significant value on public services such as police and fire protection and a quality transportation network and were willing to pay sufficient taxes to ensure those services are were of the highest quality. Williams (2017), however, finds that tax incentives, specifically the Wisconsin Manufacturing and Agriculture Credit, generated 20,000 manufacturing jobs.

The differing results on the efficacy of tax incentives may speak to variation between firms within manufacturing. Most manufacturers are unlikely to move given their cost structures, supply chain, labor pools, and owner preferences. For the typical manufacturer, taxes have little effect on location choices as shown by Conroy, Deller, and Tsvetkova (2016). Their study further finds that firms are not only insensitive to taxes on average, but very few manufacturers, less than five percent, ever move in a given year. Halstead and Deller (1997) were willing to pay sufficient taxes to ensure those services are were of the highest quality. Most of those that do move are quite small and tend to move very short distances, often to another site within the same community. Thus, the pool of firms that tax incentive programs may effectively target is quite small.

Yet, for a small a number of very large companies, such as Foxconn, their cost analysis is incredibly precise and they have the capacity to move nearly anywhere and are likely to be more responsive to incentive packages. Indeed, these very large manufacturers have found that they are in a unique position to leverage tax incentives from states that are competing for their investments. Thus, there are cases of incentive packages that successfully lure a large firm into a state or region, but these types of firms are the minority as are the places that can afford the expense of these packages.

Another eason for the mixed results on the efficacy of tax incentives may be based on the extent to which lower taxes for firms come at the cost of reduced public services that some manufacturers and other industries value. For example, reducing property taxes can come at the cost of reductions in police and fire protection as well as investments in public education which is vital to maintaining a quality workforce. These opportunity costs, the investments and purchases that are given up in choosing to grant tax relief, should also be considered. That is, the cost of incentives that could increase jobs in a region should be weighed

against alternative uses such as spending on infrastructure, education, and lower taxes for state residents that could also boost economic and employment growth.

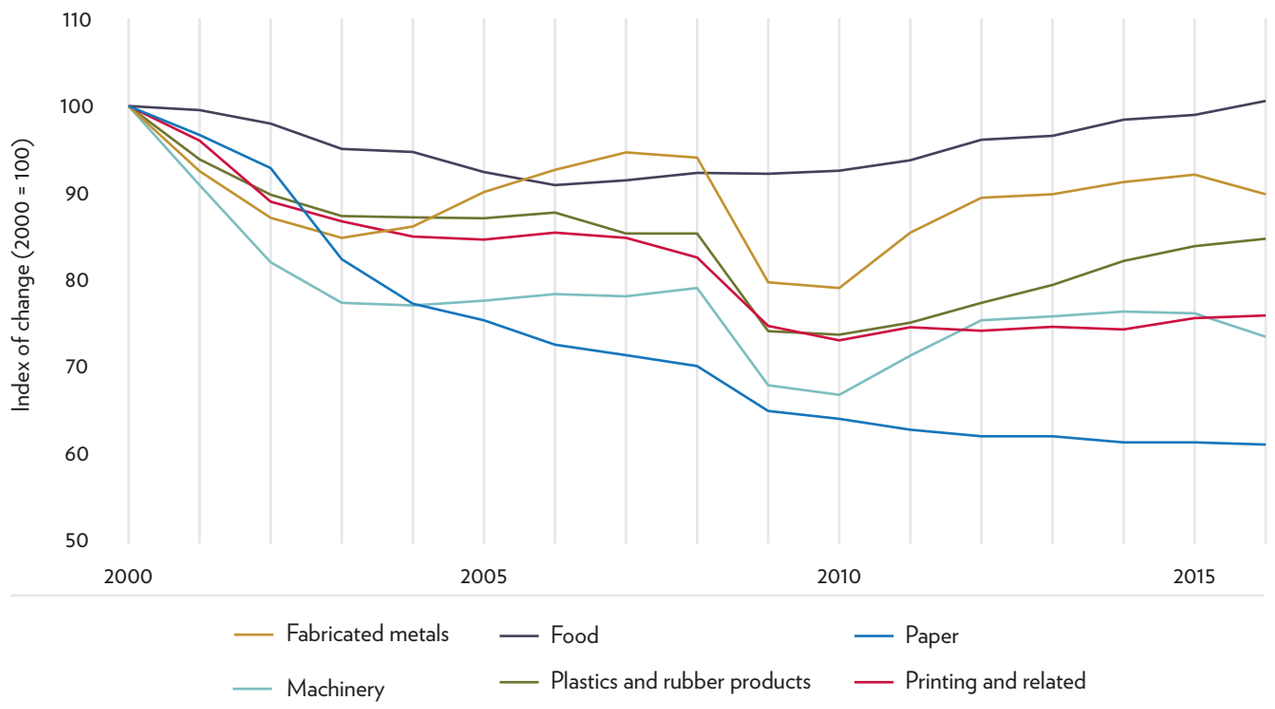
Arguably, focusing purely on job outcomes with policy is misguided to begin with (The Wall Street Journal). To focus policies on regaining the nearly six million manufacturing jobs that were lost in the 2000s, when less than one million have returned, is a heroic effort that has yielded modest success at best. Measuring success instead with a skilled workforce, wages, research, innovation, value-added, and increased exports may be far more effective. Focusing only on jobs can lead to ill-suited incentives that do not produce the desired outcome. For example, tying tax incentives to the number of jobs created may only serve to buoy uncompetitive industries and incentivize a firm to create a number of low-paying jobs that will only go away once the benefit has been collected. Investing in advancement, however, is more likely to have lasting economic effects.

ADVANCED MANUFACTURING

When considering industrial and occupational choices for targeted policy intervention, all sectors should be considered to identify the most promising opportunities. Manufacturing focused policy requires moving past broad, generic, or blanket strategies. For example, regardless of state and local policies, most printing and furniture industries will continue to lose jobs because of technological changes and global competition. The recent news of Kimberly Clark potentially closing plants in Neenah and Fox Crossing demonstrates this trend. Many of the largest manufacturers that are most directly affected by pro-manufacturing policies are international firms that are making location, expansion, and closure decisions based on global trends: state and local efforts are unlikely to outweigh these international economic forces. Yet there are subsectors within manufacturing that are doing well. For example, in Wisconsin, food processing continues to be stable, if not growing, as shown in Figure 6.

FIG 6

EMPLOYMENT CHANGE SINCE 2000 FOR THE SIX LARGEST MANUFACTURING SUBSECTORS IN WISCONSIN



Sectors in advanced manufacturing are also promising (Tassey, 2017). Advanced manufacturing is defined by the President's council of Advisors on Science and Technology as

"... a family of activities that (a) depend on the use and coordination of information, automation, computation, software, sensing, and networking, and/or (b) make use of cutting edge materials and emerging capabilities enabled by the physical and biological sciences, for example nanotechnology, chemistry, and biology. This involves new ways to manufacture existing products, and especially the manufacture of new products emerging from advanced technologies."

Going forward, strategically investing in advanced manufacturing could benefit Wisconsin both in terms of growing real output and generating high-paying jobs. From 2000 to 2009, the five major research and development oriented industries in manufacturing—namely semiconductors, communications equipment, computers, pharmaceuticals, and medical devices—grew their real output by 27 percent on average (Tassey 2017). Comparatively, in the five major traditional industries of chemicals, machinery, electrical equipment, plastics and rubber, and fabricated metals, real output declined by 23 percent.

The U.S. has seen its competitive advantage in these high-tech products diminish, as emerging economies have acquired and developed new manufacturing technologies and combined them with relatively low labor and capital costs (Tassey 2017). Comparatively, the U.S. has underinvested in the kind of productivity-enhancing measures necessary to maintain competitiveness.

Technology-oriented occupations that are more common in advanced manufacturing industries also pay higher wages compared to the average for all other industries (Hecker 2005). These sectors generate significant value-added and offer relatively high-paying jobs, many of which are in research and development. These jobs, which have historically been middle class, can also be part of inclusive growth that is counter to increasing inequality. Finally, promoting advanced manufacturing, creates greater opportunities for expanding export markets which are, and will continue to be, a major source of economic growth.

RESEARCH AND DEVELOPMENT

As outlined in Deller and Conroy (2017), private firms often underinvest in research and development. That is to say, there are benefits that go unrealized because research and development is riddled with uncertainty. With unknown profitability, firms are often discouraged from spending on further research, especially on early stage or basic research that could be of great value. In addition to the uncertain profitability, firms may be discouraged by long development times. Firms may also be wary of advancements being shared with or leaked to competitors. In some cases, research may lead to advancements that are outside the firm's product line, so it is not in their interest to invest.

Given these obstacles for firms and the potential benefits for consumers, government has been an active supporter of R&D for decades. This support is demonstrated both financially in terms of grants to private companies (e.g., Department of Defense R&D contracts) and practically through the educational system (e.g., Colleges of Agriculture within land grant universities). Public support for more uncertain and early-stage research that may have widespread benefits has added to the efforts of private companies that take this basic research and, through additional private investment, commercialize the innovations. Some industries in manufacturing, however, may be good candidates for additional support given the unique nature of their research and development cycles.

In advanced manufacturing, research and development may include more than just basic and applied research that lays the foundation for later advancements into commercial products. Research and development also include developing technology platforms that demonstrate possible applications and infratechnologies that measure and facilitate the implementation of complex goods (Tassey 2017). These two additional phases can also have widespread public benefits sufficient to warrant additional government support. Even in later stage development, when companies are developing proprietary technologies that are profitable, there can be enough risk that firms underinvest.

Ultimately, fostering high-skill, high value-added industries through R&D is a key to wage growth and long-term competitiveness in Wisconsin. The National Association of Manufacturers (NAM) identified a range of policy options that Wisconsin can turn to for insights. They stated:

"A long-term manufacturing strategy for America will further investment in the research, ideas and people who produce innovation. R&D is, as the Commerce Department's Manufacturing Council phrased it, "the single most important source of technological advancement leading to higher productivity."

Further, they recommend that:

"The federal government has long fostered basic research and development that expands the knowledge base, spurring private-sector R&D as well as later commercial development. Innovation is served by robust funding for federal research agencies as well as financial support for public- and private-sector research."

While the National Association of Manufacturers are thinking at the national level, investments in R&D can play an important role at the state level. As noted above, manufacturing categories that tend to invest heavily in R&D and pursue innovation as a means to profitability are less common in Wisconsin. Nonetheless, bolstering all manufacturing industries with R&D support could be effective.

Increasing competition from around the globe not only creates the need for more R&D, but also a demand for greater efficiency (Tassey 2017). The resources necessary to revive the competitiveness of the sector will likely exceed the capacity of one firm or one local government acting alone (McKinsey 2017). Rather, regional clusters that coordinate and share resources at a larger scale are one way to improve the efficiency of R&D spending. Research and development is also closely linked to production. When production slows or moves elsewhere, it becomes more difficult to source new ideas and slows the creativity of the sector (McKinsey 2017). Geographic concentrations of research and development assets alongside the critical tiers of production can increase the speed of implementation and adjustment that are necessary for new technologies. Clusters should reflect the appropriate mix of participants (private, government, academic) and consider the distribution and relationship between activities across each phase of the research and development cycle.

Clusters may also benefit small and medium-sized manufacturers who otherwise miss out on benefits that come with larger size. These small and medium-sized firms are especially vulnerable to missing out on the benefits of research and development and falling further behind global competition (Tassey 2017). As research leads to new insights, it is vital that those insights be shared with manufacturers, particularly smaller and medium sized firms. The U.S. Department of Commerce's 2004 report entitled Manufacturing in America suggests that these R&D partnerships may be most strategic with small and medium size manufacturers. Specifically, public investments in R&D

"...should be matched with an equally vigorous effort to ensure that the technology developed is diffused broadly throughout the manufacturing sector, particularly to small and medium-sized manufacturers, which will benefit most because of their own limited capacity for independent research and development."

As noted in the companion study to this policy essay, Conroy, Kures, and Chen find that the majority of manufacturers in Wisconsin could be classified as small and medium (less than 50 employees) and may be in the best position to grow. Further, investing in small and medium size manufacturers makes sense as they are likely critical to the future supply chain of large manufacturers in the U.S. (McKinsey 2017).

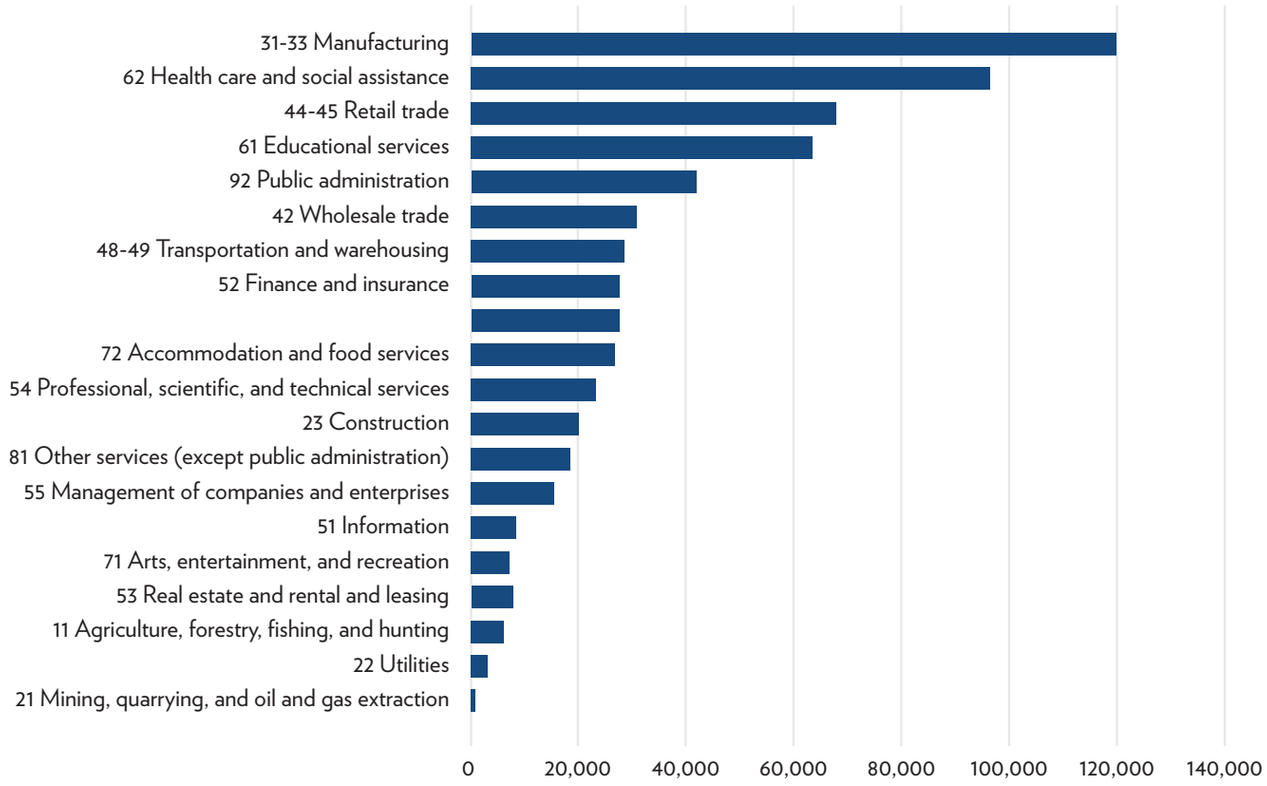
Technology transfer to small firms can take many forms such as customized training programs where companies partner with the technical colleges, focused one-day conferences, or one-on-one or on-site services. The Wisconsin Center for Manufacturing and Productivity, Wisconsin Manufacturing Extension Partnership, and Stout Manufacturing Outreach Center are examples of Wisconsin institutions that help facilitate technology transfer, professional development and continuing education, as well as firm-specific technical assistance. SMOC and WMEP also work together to capitalize on their distinctive competencies to provide specialized services to manufacturing clients statewide (i.e. WEDC heads up supply chain initiatives statewide, SMOC heads up technology acceleration and adaption initiatives statewide). While these organizations are exemplary, reductions in federal spending and continued calls for the discontinuation of MEP programs may mean that there is room for more state-level incentives for creating public-private research consortia, rewarding tech transfer at higher education institutions, and increasing research capacity.

Beyond technology transfer, support for small and medium sized businesses includes supporting new and young manufacturers. Often policy focuses on large employers, but small, new, locally grown businesses are critical to economic growth (Conroy and Deller, 2016). The capital barriers to manufacturing are diminishing as new technologies enter the sector, making it cheaper to startup and produce goods. Even Once started, new producers may also need assistance scaling up. As an example, in Pennsylvania, tech entrepreneurs who need manufacturers to produce and assemble their designs are being paired with growing manufacturers who can produce their new products. These two businesses can then grow together and develop a strong relationship between design and production over time.

WORKFORCE DEVELOPMENT

There are several examples of partnerships between manufacturing industries and community and technical colleges

FIG 7 | **AGE 55 AND OLDER (NUMBER)**



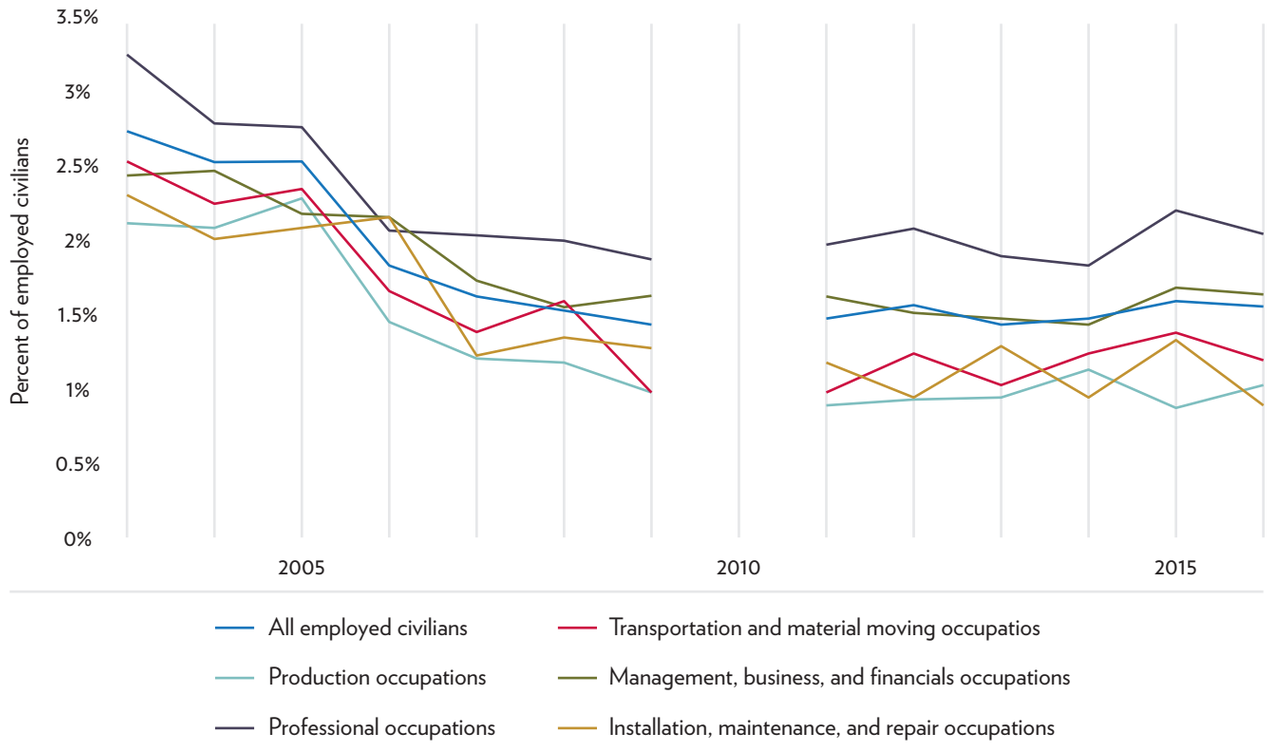
that are well established in Wisconsin. For example, Lakeshore Technical College's Advanced Manufacturing program trains students for the latest technology in manufacturing. Ashley Furniture has donated robots and other training equipment to the Western Technical College for their electromechanical technology program which prepares students for jobs at their company. Furthermore, the Northeast partnership for engineering education (Northeast Wisconsin Educational Resource Alliance) coordinates numerous institutions and colleges, including four technical colleges, five UW Colleges, UW-Extension, the College of Menominee Nation, UW-Green Bay and UW-Oshkosh, to address gaps in the local workforces.

Other options for employers include developing training programs, internships, apprentice programs, and mentorship programs that pair new employees with more experienced employees. Further, companies could pay tuition and offer flexible schedules for students pursuing additional education. Continued progress may be accomplished by making changes to high school education by expanding training in trades. The NEW Manufacturing Alliance, as well as other organizations in Wisconsin, are aware of the bias against manufacturing among young students and have partnered with local school districts to encourage students to consider manufacturing as a potential career path. They have hosted a yearly "draft" that matches students with businesses for internships and part-time employment. They also offer scholarships to encourage more interest from students (Herald Times).

The evidence of a skills gap is mixed, as described earlier in the report, but certainly there are still manufacturers that struggle to find workers in Wisconsin. This could be partly due the lack of competitiveness of manufacturing firms (Weaver and Osterman 2017). While often the narrative focuses on a short supply of workers as a constraint in manufacturing, it could be that firms are not competitive and therefore not able to offer attractive wages. This could be the result of internal practices, such as hiring and recruitment strategies, or even due to the quality of the product.

FIG 8

SHARE OF EMPLOYED CIVILIANS MOVING ACROSS STATE LINES BY OCCUPATION (2003–2015)



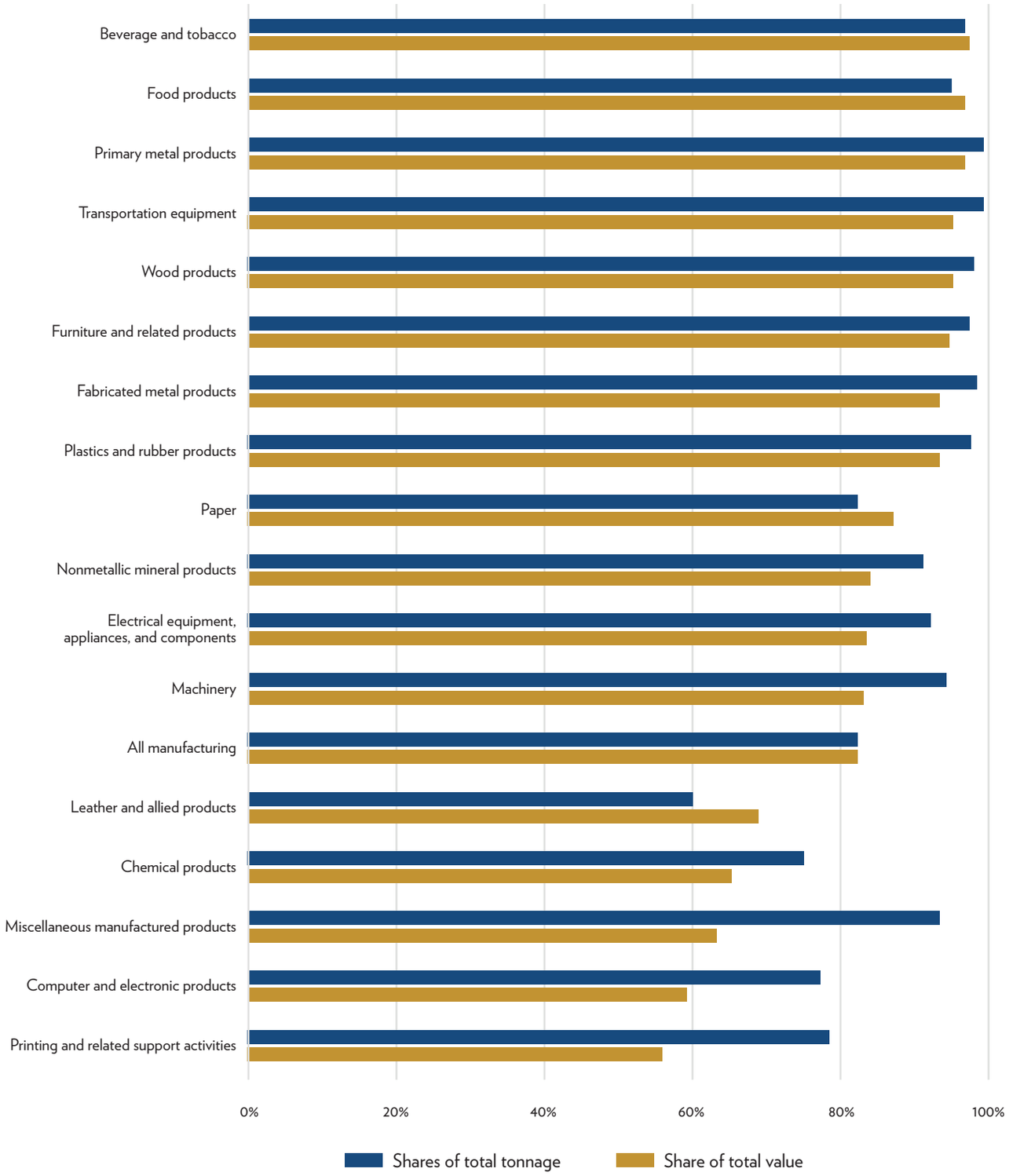
It can also be due to external pressures such as globalization. These external factors are more reasons to consider strategies that cultivate advanced manufacturing and nurture a more R&D intensive environment in the state.

Despite the lack of competitiveness, Wisconsin manufacturers may struggle to find workers due to a number of issues. Even with strategic initiatives to directly and indirectly address workforce readiness, the supply of labor will continue to be a challenge due to our state's demographic structure (Figure 7). While attraction efforts may help to fill professional or technical occupations, production workers are among the least mobile occupational category (Figure 8) . While highly skilled occupations in manufacturing may be willing to relocate or commute great distances for work, the lower and middle skilled occupations are less likely to relocate or commit to longer commutes. In a purely economic sense, the willingness to relocate or commute hinges greatly on wages: higher wage occupations are more willing to relocate or commute than lower wage occupations and this appears to be particularly true within manufacturing.

Furthermore, state level attraction efforts will do little to address the spatial issues presented by the rural/urban distribution of manufacturing in Wisconsin. As a result, it is likely that automation will increasingly need to be part of the solution rather than a concern. In most Wisconsin counties, the increase in robotics has been at or below average (Bloomberg) which at face value may be viewed as a positive for employment opportunities. While the potential displacement effects are a concern, the cost of not integrating automation in U.S. manufacturing is likely far greater. The technology and productivity gains, particularly in the face of a shortage, are critical to remaining competitive. Automation can improve production with consistency and quality and, over time, reduce costs. Firms that are automating more slowly or attempting to keep costs down in the short-run by not adopting new technologies are more likely to lose market share as their customers turn elsewhere. Some argue that automation and robotics can actually be good for expanding the need for

FIG 9

SHARE OF MANUFACTURING SHIPMENTS MADE BY TRUCKS ALONE



MANUFACTURING AND INDUSTRY 4.0

While "Industry 4.0" has become a somewhat generic term applied to the integration of digital technologies to the production process, the concept was first developed by Germany Trade and Invest (GTAI). GTAI notes that Industry 4.0 "… connects innovative embedded system production technologies and smart production processes to pave the way to a new industrial age which will radically transform industry and production value chains and business models in tomorrow's smart factories." Specifically, the simultaneous integration of technologies such as robotics, additive manufacturing, the Internet of Things (IoT), artificial intelligence, and augmented reality provides new opportunities for manufacturing firms to improve their operations and grow their businesses.

Several examples of Industry 4.0 technology integration include:

- Adding sensors, network connections, machine learning and data analytics to the production process that allow robotics and other manufacturing equipment to provide instantaneous feedback to employees. This feedback can improve product quality, monitor machine performance and mechanical issues that can lead to downtime, create higher levels of product quality assurance, and increase employee safety and productivity;
- Incorporating new additive manufacturing and augmented reality technologies that allow products to be quickly prototyped and/or customized, which in turn reduces time-to-market and allows for customer needs to be rapidly met;
- Connecting the production facility to final products being used by customers through cloud computing. These connections allow products to communicate their performance and maintenance needs back to product designers and developers. Doing so provides opportunities for constant analysis of product performance that can be rapidly incorporated into quality improvement and design processes. Connecting final products to the production facility also allows manufacturers to develop algorithms that predict demand for their goods and foresee the maintenance needs of the products they produce.

Ultimately, the incorporation of Industry 4.0 concepts to the manufacturing industry can help firms improve their production processes, anticipate consumer demand, create new supply chain efficiencies, improve worker satisfaction and increase revenues. However, Industry 4.0 will also require investment in equipment, research, information technology, and cybersecurity. Industry 4.0 will also require the development and training of a workforce that is further skilled in engineering, data science and security, robotics, computer programming and database development. The educational system and government agencies both have opportunities to foster these necessary investments in technology and labor.

additional workers (Toness, 2017). Consider a long assembly line. When one task is automated and increases production, the demand for surrounding tasks increases as well thus creating the need for additional workers. At the very least, the implementation of robotics may increase the need for engineers and technical experts to service and refigure machines.

Supporting the development of automation could include increased training for the skills needed by robotics/computerization, re-training for individuals who may be displaced by automation, financial support for purchases of equipment, and greater partnerships between Wisconsin firms who produce the sensors, robotics, actuators, software, etc. used in automation.

Arguably, the current conversation around the skills gap in manufacturing does little to effectively match workers to modern manufacturing positions. With the long-term downward trend in manufacturing employment, few students are encouraged to pursue a career in manufacturing. Mark Kaiser, CEO and president of Lindquist Machine Corp. in Green Bay said, "It can be a challenge to convince parents that careers in manufacturing are good for their kids" (Herald Times). Rather, students are persistently encouraged to earn a four-year college degree. Yet, the new wave of manufacturing workers does not always need a degree, but experience and/or a certificate. These more affordable and flexible education options are an often ignored but promising path. There are many programs that encourage the next generation of employees already occurring such as INSPIRE and CEO in the Classroom. However, these are probably not as widely known as they should be. The Northeast Wisconsin Educational Resource Alliance is an example of new investments in education and training that directly meets the needs of Wisconsin manufacturers.

In some smaller school districts, the revenue caps placed on property taxes coupled with stagnant and declining state aids have forced many schools to greatly curtail program offerings that focus on the trades. Many of these programs require expensive equipment and specialized classrooms that are simply beyond the means of a growing number of schools. The result is that many schools across Wisconsin have elected to reduce their investments in these expensive programs and focus on college preparation courses. While this movement is appropriate for college bound students, it has the unintended consequence of discouraging students from considering the trades as a profession and possible careers in manufacturing. Attempts to partner with the technical colleges to fill this growing gap in many high schools have been less than satisfactory. However, growing support for fabrication laboratories, or "fab labs", from the Wisconsin Economic Development Corporation and other organizations helps to fill these gaps.

Furthermore, manufacturers may struggle to find workers due to broader issues throughout the state. In the upper-Midwest, up to half of applicants in the manufacturing sector fail their drug tests (The New York Times). Consequently, addressing drug use could be one way to enhance the pool of workers for manufacturers. Further strengthening transition and employment programs for those with a criminal record could also alleviate a worker shortage. In Wisconsin, 22 percent of adults have a criminal record. Simply educating employers on how to use information from a criminal record in employment decisions could facilitate hiring. A broader implementation of risk-need-responsivity principles can further reduce risk of recidivism and enhance employment outcomes. These methods are focused on people who have the greatest need for services and not on people who are likely to succeed with little or no intervention (Pelka, 2018)

INFRASTRUCTURE

U.S. investment in infrastructure has long been declining, but the effect on roads is especially important for manufacturers. The manufacturing industry is highly dependent on the road system for full or partial transportation of their inputs and/or final products. Wisconsin manufacturers ship approximately 82 percent of their product tonnage and value by truck alone (Figure 9). Smaller shares are also made in multi-modal combinations of trucks and air, rail or ships. In fact, manufacturers depend on trucking more than any other mode of transportation (McKinsey 2017). Transportation funding remains a significant issue in the state. For Wisconsin to truly support manufacturing statewide, the road funding debate needs to be resolved. The discussion of funding must also extend beyond the expansion or improvement of freeways. Last mile and local roads are important to many firms in urban and rural areas.

In addition, while most manufacturers rely on trucking, rail services within the state are also a concern. In a study of rail freight users in southern Wisconsin, Deller (2013) found nearly one-in-three survey respondents stated that without access to reliable rail service, it would be difficult to remain in operation. While many stated that without rail they could shift to trucking, some expressed concern that their current location would make the transition difficult. Somewhat interestingly, the study by Halstead and Deller (1997) found that smaller rural manufacturers expressed greater concern about access to air freight than either rail or trucking. Because a growing number of these smaller

manufacturers focus on custom manufacturing as inputs to other firms, the ability to meet "just-in-time" inventory demands places greater needs on air freight over long-distance trucking and rail.

Many manufacturers across Wisconsin also rely on public water and wastewater treatment infrastructure in their production processes. The high volumes of water Foxconn will require from Lake Michigan is a case in point. In a study of non-farming water dependent industries in central Wisconsin, Stewart, Deller and Schroeder (2010) found that many industries, particularly food processing businesses, drew directly from public water systems and returned the waste water to those same public systems. In one particular community, the revenues from one water intensive manufacturer accounted for almost three quarters of the operating budget of the municipal water system. Indeed, public infrastructure that supports manufacturing in Wisconsin is more than just roads and highways, and a systems approach to infrastructure is required requiring a systems approach to infrastructure. This includes multiple means of transportation, water infrastructure as well as the electrical grid.

TRADE

Manufacturing produces close to 50 percent of U.S. exports (Tassey 2017). Undoubtedly, trade has affected manufacturing significantly. In industries that have moved overseas, the domestic employment losses can be devastating for families and communities. These losses, though, often come alongside gains in other industries in the form of increased demand from a larger market. Indeed, Canada and Mexico have been important trade partners for the U.S. In a study released last year, the Center for Automotive Research, highlighted how the North American Free Trade Agreement (NAFTA) has benefited the automotive industry (Reuters 2017). In Wisconsin, the food and beverage manufacturing is an important manufacturing sector—representing close to 15 percent of all manufacturing jobs—that is also impacted by NAFTA. Processed food exports to NAFTA trade partners have grown by 400 percent since NAFTA was implemented (Farm Bureau).

Despite the potential gains, according to a survey by the National Small Business Association, 37 percent of firms cite a lack of knowledge of international markets as their reason for not exporting (McKinsey 2017). Small companies are especially disadvantaged. Increasing trade for smaller manufacturers may require access to trade finance alongside adjustments to customs procedures and requirements which were likely established to primarily accommodate much larger companies (ibid). At the state-level, Wisconsin can continue to educate manufacturing firms (especially SMEs) on the importance of global markets and provide additional technical assistance to support exports. WEDC and DATCP currently provide export assistance, as do several regional economic development organizations.

In those sectors that are displaced by trade, enhancing government training programs may help workers get the necessary skills to go back to work. For example, Trade Adjustment Assistance, which was established in in the 1960s, provides laid off workers who meet certain requirements—often including enrollment in a job training program—with relocation assistance, subsidized health insurance, and extended unemployment benefits. Though the program has been criticized, it hasn't been thoroughly revisited since 1994 alongside the North American Free Trade Agreement. As it is, workers laid off from a car factory facing direct import competition from abroad qualify for benefits, but workers at the related tire factory to do not. Further, a shift in production to an overseas location does not meet the requirements. Instead, imports have to increase, which takes longer. Possible changes to the program include expanding it to workers in secondary industries and considering shifts in production so that more workers can gain access to benefits faster. At the community level, these programs could also be better utilized so that retraining matches the needs of employers in the region of the workers who are re-educating.

CONCLUSION

Manufacturing remains, and will continue to remain, a large component of Wisconsin's economy. The sector employs almost 500,000 workers, offers favorable wages, and contributes almost 19 percent of Wisconsin's Gross State Product. The contributions of manufacturing have declined over the past several decades as other industrial sectors have grown at faster rates. Since 2000, the state of Wisconsin has added 239,000 non-farm jobs while employment in the state's manufacturing sector declined by 120,000 workers. Furthermore, Wisconsin's overall Gross State Product increased by 22.7 percent (inflation adj.) between 2000 and 2016 while manufacturing GSP increased by just 2.6 percent.

Despite a recent increase in manufacturing employment, it is unlikely that Wisconsin's manufacturing sector will return to its peak employment levels. In fact, the Bureau of Labor Statistics projects a loss of over 800,000 manufacturing jobs between 2014 and 2024 (Henderson, 2015). While Wisconsin's manufacturing sector may not follow the projected national trend, it will not be immune to technological changes and automation influences that continue to reduce the long-term demand for labor. Wisconsin's aging labor force and geographic mismatches in labor supply and demand also create constraints on significant future employment growth.

Given past and projected employment trends, blanket policies that seek to maintain the status quo by simply tying incentives to jobs are unlikely to have lasting economic effects. Instead of focusing solely on job creation as a metric of success, policies to support Wisconsin's manufacturing sector should take a long-term approach of increasing productivity and innovation. While manufacturing is responsible for a majority of the nation's private-sector research and development, recent spending on R&D has slowed in the United States. In contrast, R&D efforts are increasing in competing nations such as China. Helping Wisconsin firms strategically move from ordinary competition to quality competition through innovation will not only help to increase wages and productivity, but also better insulate Wisconsin firms from competing against nations with a low cost of production. State and local investments in nurturing early stage research; developing new technology platforms; and supporting later stage commercialization can help firms innovate. These investments may be particularly important for the significant number of small-to-medium sized manufacturing firms in Wisconsin that may not have the resources to heavily invest in R&D.

With an aging workforce and historically low unemployment rates, Wisconsin's manufacturing firms are facing growing challenges to finding labor. Current programs that encourage individuals to pursue manufacturing careers are positive steps, as are Wisconsin's efforts to coordinate regional workforce development initiatives across public and private-sector partners. It will be likely, and perhaps necessary, however, that automation technologies become part of the solution to future labor demands. The low mobility of individuals in production occupations and rural-urban mismatches in labor availability suggest that many firms will increasingly need to rely on technology. While increases in automation will create disruptions in some occupations and change the skill requirements of others, job loss is not necessarily a natural consequence of increasing automation. Instead, automation may help to create new long-term economic opportunities and enhance the competitiveness of the sector.

Policies aimed at growing international trade should continue. Wisconsin manufacturers currently export a large volume of products to international markets, with Canada and Mexico being notable trading partners. Wisconsin's large pool of small-to-medium sized manufacturers could mean that many firms are unaware of international market opportunities. With potential changes to NAFTA, Wisconsin manufacturers also could face significant challenges to accessing two of their key foreign markets. Accordingly, efforts from WEDC, DATCP, and other organizations to support exports will continue to be vital to the growth of Wisconsin's manufacturing sector.

Finally, transportation funding remains a significant issue in the state. Wisconsin manufacturers ship approximately 82 percent of their product tonnage and value by truck alone. For Wisconsin to support its manufacturing sector, a long-term solution to road funding must be determined. Importantly, any discussion for funding must also extend beyond the expansion or improvement of freeways. Last mile connections and local roads are important to many firms in urban and rural areas.

REFERENCES

------August 23, 2010. Maybe it Isn't China: A long-term look at manufacturing employment. The Economist. https://www.economist.com/blogs/freeexchange/2010/08/manufacturing

------September 29, 2005. Manufacturing Employment: Industrial Metamorphis. The Economist. https://www.economist.com/blogs/freeexchange/2010/08/manufacturing

Acemoglu, Daron, and Pascual Restrepo. (March 2017) Robots and Jobs: Evidence from US Labor Markets. National Bureau of Economic Research. Working Paper 23285.

Autor, D. H. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation †. Journal of Economic Perspectives, 29(3), 3–30. http://doi.org/10.1257/jep.29.3.3

Bailey, Martin Neil.(2015). How the U.S. Gets Manufacturing Policy All Wrong. The Wall Street Journal. https://www.wsj.com/articles/how-the-u-s-gets-manufacturing-policy-all-wrong-1433301281

Conroy, Tessa, Deller, Steven C. and Tsvethova, Alexendra. 2016. "Regional Business Climate and Interstate Manufacturing Relocation Decisions." Regional Science and Urban Economics. 60:155-168.

Conroy, Tessa, Deller, Steven C. and Tsvethova, Alexendra. 2017. "Interstate Relocation of Manufacturers and Business Climate." Review of Urban and Regional Development Studies. 29(1):18-45.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? Technological Forecasting and Social Change, 114, 254–280. http://doi.org/10.1016/j.techfore.2016.08.019

Halstead, J. M., & Deller, S. C. (1997). Public Infrastructure In Economic Development And Growth: Evidence from Rural Manufacturers. Journal of the Community Development Society, 28(2), 149–169.

Helper, S., Krueger, T., & Wial, H. (2012). Why Does Manufacturing Matter? Which Manufacturing Matters? Metropolitan Policy Program Paper, (February), 1–53. https://www.brookings.edu/wp-content/uploads/2016/06/0222_manufacturing_helper_krueger_wial.pdf

Henderson, R. (Dec 2015) "Industry employment and output projections to 2024," Monthly Labor Review, U.S. Bureau of Labor Statistics, https://doi.org/10.21916/mlr.2015.47.

Hicks, M. J., & Devaraj, S. (2017). The Myth and the Reality of Manufacturing in America, Ball State University. (April), 1–7. https://conexus.cberdata.org/files/MfgReality.pdf

Levinson, M. (2017 2018). U.S. Manufacturing in International Perspective. https://fas.org/sgp/crs/misc/R42135.pdf/

Levinson, M. (2017). U.S. Manufacturing in International Perspective. https://fas.org/sgp/crs/misc/R42135.pdf/

Mckinsey Global Institute. (2017). Making it in America: Revitalizing US Manufacturing. McKinsey & Company, (November).

Nicholson, Jessica R., and Ryan Noonan. (2014). Manufacturing Since the Great Recession. U.S. Department of Commerce, Economics and Statistics Administration. http://www.esa.doc.gov/sites/default/files/manufacturingsincethegreatrecession2014-06-10final.pdf

Nordhaus, W. (2005). The Sources of the Productivity Rebound and the Manufacturing Employment Puzzle. National Bureau of Economic Research. Working Paper 11354.

Pelka, Mark. (2018). Strategies to Improve Employment Outcomes For People with Criminal Histories in Opportunities for Strengthening Wisconsin's Workforce. Wisconsin Family Impact Seminars. Robert M. La Follette School of Public Affairs, University of Wisconsin Madison.

Rojanasakul, Mira, and Peter Coy. (May 8, 2017) More Robots, Fewer Jobs. Bloomberg. https://www.bloomberg.com/graphics/2017-more-robots-fewer-jobs/

Toness, Bianca Vazquez. Five Question for David Autor. Undark. April 24, 2017.

https://undark.org/article/five-questions-for-david-autor/

Tassey, G. (2014). Competing in Advanced Manufacturing: The Need for Improved Growth Models and Policies. Journal of Economic Perspectives, 28(1), 27–48. http://doi.org/10.1257/jep.28.1.27

Weaver, A., & Osterman, P. (2017). Skill demands and mismatch in U.S. Manufacturing. Industrial and Labor Relations Review, 70(2), 275–307. http://doi.org/10.1177/0019793916660067

METHODS

FIGURES

1 calculated from the Bureau of Economic Analysis data. The change in Wisconsin jobs is equal to the net job creation from 2000-2015 in different industries. The percentage of total growth is the ratio of total gross job creation to the total employment in base year by industry.

2 calculated from Bureau of Economic Analysis data. The denominator is equal to the real GDP in all industries by state. The manufacturing's contribution to State GDP is the ratio of real GDP in manufacturing to the state total real GDP (adjusted for inflation, in 2009$).

3 calculated from Bureau of Economic Analysis data. The share of total nonfarm employment is the ratio of total manufacturing employment to total non-farm employment by states and U.S. total.

4 calculated from Bureau of Economic Analysis data. The denominator is state total manufacturing employment. The gross state product per worker (or productivity) reflects the value of real manufacturing GDP divided by total manufacturing employment by state.

5 calculated from the ratio of employment in each industry to total employment in Wisconsin and the ratio R&D spending in each industry to total at the national level.

6 calculated from the Bureau of Labor Statistics and Bureau of Economic Analysis data. The employment change is the ratio of all employment in each of six manufacturing subsectors from base year to year t to the level in base year.

7 calculated from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) Quarterly Workforce Indicators. Total employment by workers age 55 or older at the beginning of Q2 2016.

8 calculated from the U.S. Census Bureau/U.S. Bureau of Labor Statistics (BLS) Current Population Survey. The share of employed civilians who moved across state lines is based on the percent of employed civilians who: 1) moved from a different state in the same Census division, 2) moved from a different Census division in the same Census region and 3) moved from a different Census region.

9 calculated from the U.S. Census Bureau/Bureau of Transportation Statistics Commodity Flow Survey. The share of tonnage and share of total value is based on the total values transported by truck alone as a percent of the total values transported by all modes.

ABOUT THE WISCONSIN ECONOMY SERIES

The Wisconsin Economy Series is a publication of the University of Wisconsin-Madison Economic Development Administration (EDA) University Center, which is housed at the Center for Community Economic Development.

This series, along with other publications by the EDA University Center at UW Madison, are designed to provide the economic development community in Wisconsin and the Upper Midwest with data specific to issues related to the current economy in this part of the United States. Additional publications, including our WIndicator series and the results of our most recent public opinion survey on the economy of Wisconsin, can be found at https://cced.ces.uwex.edu/eda-university-center/.

For additional information about the Wisconsin Economy Series or the Economic Development Administration University Center at the University of Wisconsin-Madison please contact:

Kristin Runge, Ph.D,
Community Development Specialist
EDA University Center
Center for Community Economic Development
kristin.runge@wisc.edu

Tessa Conroy, Ph.D
Economic Development Specialist
EDA University Center
Center for Community Economic Development
tessa.conroy@wisc.edu

Steven Deller, Ph.D.
EDA University Center Advisory Board
Department of Agricultural & Applied Economics
scdeller@wisc.edu

Matt Kures
Community Development Specialist
EDA University Center
Center for Community Economic Development
matthew.kures@wisc.edu