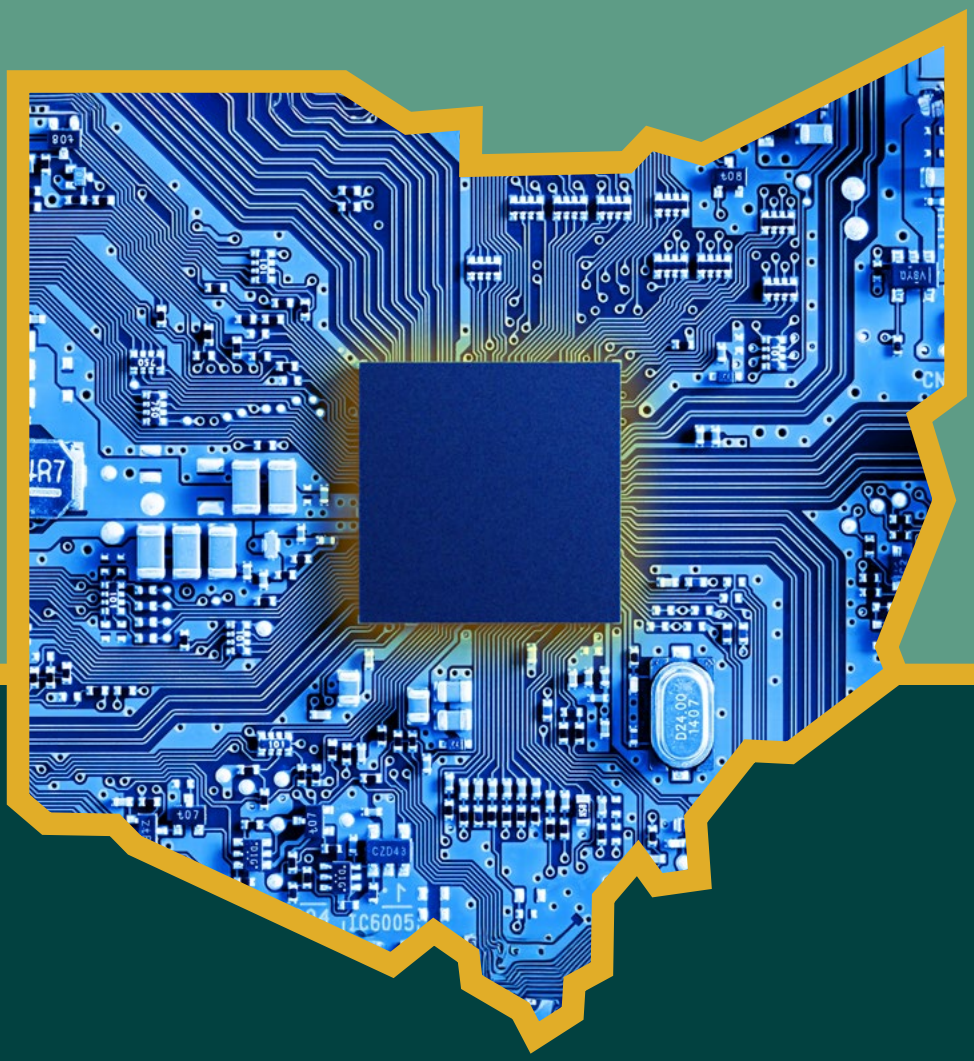
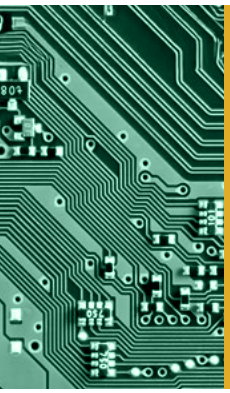


ECONOMIC INNOVATION GROUP

Silicon Heartland

The Evolution of Ohio's High-Tech Workforce



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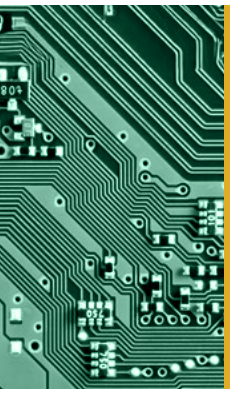

Introduction

For a broad coalition that stretches across both major political parties, sparking growth in the most distressed regions of the country has become a top economic priority.

This renewed embrace of place-based economic policy began in the aftermath of the Great Recession and its highly uneven economic recovery, and is now a motivating factor behind President Trump's drive to reindustrialize and reshore manufacturing.[1]

The revival of interest in place-based policy has been joined by the resurgence of another old idea: industrial policy. Policymakers are concerned that the United States is falling behind in the intensifying techno-industrial competition with China. They are right to worry: In a 2023 sampling of 45 key technology areas identified by the Australian Strategic Policy Institute, ranging from advanced manufacturing and energy to aerospace and artificial intelligence, China led the United States in 37.[2]

The United States has a long history of competing with adversaries in the frontiers of science and technology, particularly in areas with potential military or defense applications. Yet competition with China poses new challenges that the Cold War with the Soviet Union never did, namely the prospect of numerous economic "chokepoints," or dominance over key nodes in the supply chains of important physical goods like semiconductors or electric vehicles.

Recent legislation has tried to respond to these threats. The CHIPS and Science Act, which passed in August 2022 with bipartisan majorities in the House and Senate, included not only subsidies for leading-edge semiconductor manufacturers but also investments in "tech hubs" whose aim is to build new clusters of innovation across the country. Indeed, the decline of American industrial strength relative to China's has gone hand-in-hand with the decline of the regions that once powered it. The fall of manufacturing as a source of employment nationwide has hit these areas particularly hard. Manufacturing productivity, once resilient even as aggregate employment declined, has also been flat for roughly 20 years.

The state of Ohio is at the center of all these stories. Ohio is on the frontlines of economic competition with China, with a $137 billion manufacturing sector, the fifth-largest in the United States. Ohio also boasts the country's third-largest manufacturing workforce. The state is set to become a hub of advanced semiconductor manufacturing as Intel builds its $28 billion plant in New Albany. Ohio has furthermore been hit by sharp deindustrialization and demographic decline over the last three decades, especially in the state's small and mid-sized metro areas, albeit with some strong growth stories like the booming Columbus metro. While America's manufacturing sector has grown more than 60 percent in GDP terms since the late 1990s, Ohio's has hardly grown at all.

Ohio's manufacturing GDP growth has lagged behind

1997 manufacturing GDP level = 100

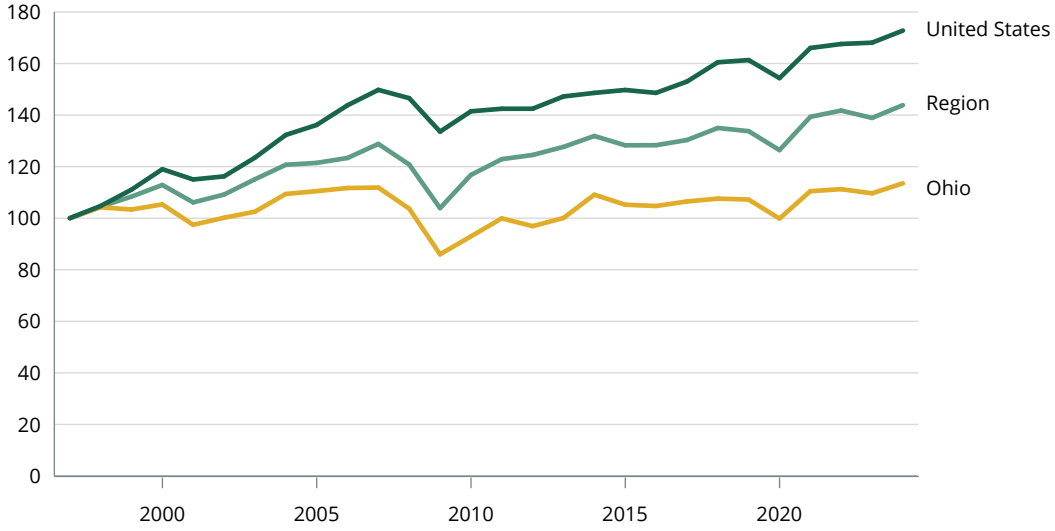

Chart: Economic Innovation Group. Source: Bureau of Economic Analysis

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But the painful flatlining in manufacturing in Ohio over the last few decades need not define its next few decades. The region's history as a hub of engineering and manufacturing excellence provides a basis for renewed growth, both in manufacturing itself and in adjacent industries critical to economic and national security. Ohio is well-positioned to take full advantage of national industrial and manufacturing policy if its institutions and leaders embrace economic dynamism, flexibility, and policy creativity.

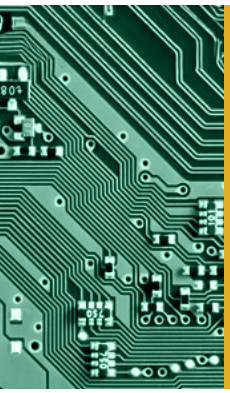
The report that follows will focus on one element of Ohio's efforts to grow its high-tech sectors and advanced manufacturing in particular: its workforce.

As manufacturing continues its shift towards more complex, capital-intensive forms of production, the need for states to adapt their workforce training ecosystems and efforts to retain skilled graduates—from community college to engineering PhD programs—will grow.

This report will take stock of the high-tech workforce in Ohio in addition to the state's ability to compete with states throughout the Midwest and the rest of the country for the next generation of investment in advanced manufacturing and other segments of the high-tech economy. It will analyze:

- How well the state is retaining high-tech college graduates and attracting them from other parts of the country;
- The growth of STEM talent at the sub-college, undergraduate, and graduate levels; and
- The competitiveness of Ohio's high-tech workforce against workers in other states.

Spiraling cost-of-living on the coasts, rising public support for reindustrialization, and renewed attention to place-based industrial policy provide an opportunity for heartland states like Ohio to reinvigorate their industrial base. Ohio has previously been a global engineering, scientific, and technical powerhouse—and it can be once again.



PART 1: History

The Midwest has a storied history of engineering and technical education.

The origin of the Midwest as a center for engineering and manufacturing excellence can be traced back to at least the mid-19th century.

The modern system of technical higher education in the United States emerged out of the Morrill Acts, the first of which passed Congress and was signed by President Lincoln in 1862. The Morrill Acts created what are today known as "land-grant universities." In contrast with the small, elite liberal arts colleges of the day, the emphasis of land-grant institutions from the outset was on producing graduates with technical skills useful to industry. The Morrill Act of 1862 prescribed for each state:

> "...at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."[3]

More than 160 years since the first Morrill Act became law, these sprawling land-grant universities in the Midwest—which remain some of the largest and most prominent public institutions of higher education in America today—have retained a core focus on training students in applied, technical fields in line with the needs of their local economies.

The region even pioneered new ways to integrate curricula with nearby manufacturers. Herman Schneider, who chaired the University of Cincinnati's engineering department and later served as president of the school, created the first modern "co-op" program in the United States. Students coupled classroom instruction with hands-on, apprenticeship-type jobs at local firms.[4] Starting with the city's existing machine tool firms run by German immigrants, Schneider's program was immediately successful and soon adopted by Georgia Tech, Northeastern, and other schools across the country. Hundreds of schools throughout the world boast such programs today.

Land-grant schools established by the first two Morrill Acts

Midwest

State	University	Morrill Act
Ohio	Ohio State University	1862
Ohio	Central State University	1890
Michigan	Michigan State University	1862
Indiana	Purdue University	1862
Illinois	University of Illinois	1862
Minnesota	University of Minnesota	1862
Wisconsin	University of Wisconsin	1862

Table: Economic Innovation Group

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But while the Midwest's universities trained workers to fill the top ranks of a booming manufacturing industry, the region also created new modes of vocational training.

The Henry Ford Trade School, founded in 1916, was one such example. This school trained thousands of young men in "woodworking, welding, electrical, engineering and repair," along with more traditional academic subjects. The Ford Trade School supplemented classroom content with shop work, including at Ford's massive River Rouge plant, where students would gradually learn the skills needed to repair machines.

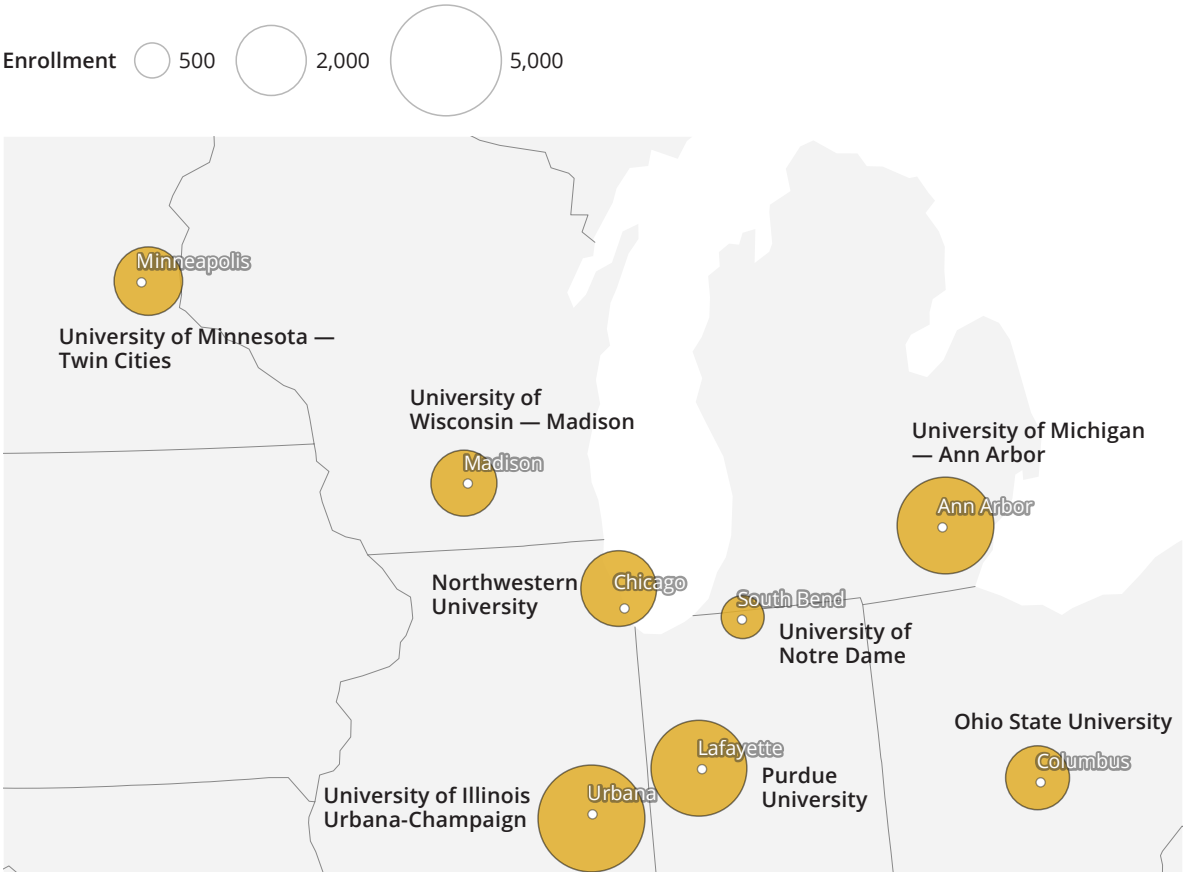
In nearby Flint, Michigan, what would soon become the General Motors Institute was founded in 1919 by Albert Sobey as an offshoot of a GM employee association.[5] GM itself soon took over and expanded the school, building on the co-op model pioneered in Cincinnati. By 1947, the General Motors Institute had developed formal undergraduate degree programs, and more than 20,000 students had enrolled in them. When domestic auto manufacturing slumped in the 1970s, GM cut ties with the school, which became Kettering University. Kettering retains strong undergraduate and master's programs in engineering and STEM fields, along with a nine-term co-op program. Median annual earnings for Kettering students ten years after matriculation are a full $40,000 higher than those of the average four-year university student.[6]

The Midwest today remains home to some of the strongest and largest engineering schools in the country. Every state in the region has at least one engineering department ranked in US News' top 50 programs. Alongside many of these departments are world-class research centers with deep links to top manufacturers, such as Ohio State's Center for Automotive Research.

Midwestern engineering schools ranked in US News' top 50

School	Rank
Purdue University	5
University of Illinois Urbana-Champaign	7
University of Michigan — Ann Arbor	11
Northwestern University	16

School	Rank
Ohio State University	27
University of Wisconsin — Madison	27
University of Minnesota — Twin Cities	36
University of Notre Dame	47



Map: Economic Innovation Group. Source: U.S. News and World Report

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The China Shock upended the region's manufacturing sector, particularly in Ohio.

The second half of the 20th century and the first decade of the 21st brought huge declines in manufacturing employment across the country. The number of American manufacturing jobs peaked at more than 19.5 million in June 1979, gradually declining by about two million over the next two decades before plummeting in the early 2000s.

The largest decline in raw employment totals occurred in apparel manufacturing, steel and iron mills, and printing. But employment also declined in manufacturing industries that many would consider "high-tech," such as aerospace manufacturing (down 37 percent since 1979), semiconductors (also down 37 percent), and engine and turbine manufacturing (down 53 percent).

Ohio was among the hardest-hit states by this era of deindustrialization. Between 1979 and 2022, the state lost more than 560,000 manufacturing jobs, or 45 percent of the state's jobs in the sector. That raw decline in manufacturing employment was the fifth-highest in the nation behind New York, Pennsylvania, California, and Illinois.

Within the Midwest, Ohio's manufacturing sector has been one of the poorest-performing in terms of employment growth since 1979. Only Illinois has fared worse.

Manufacturing employment, indexed to 1979 levels

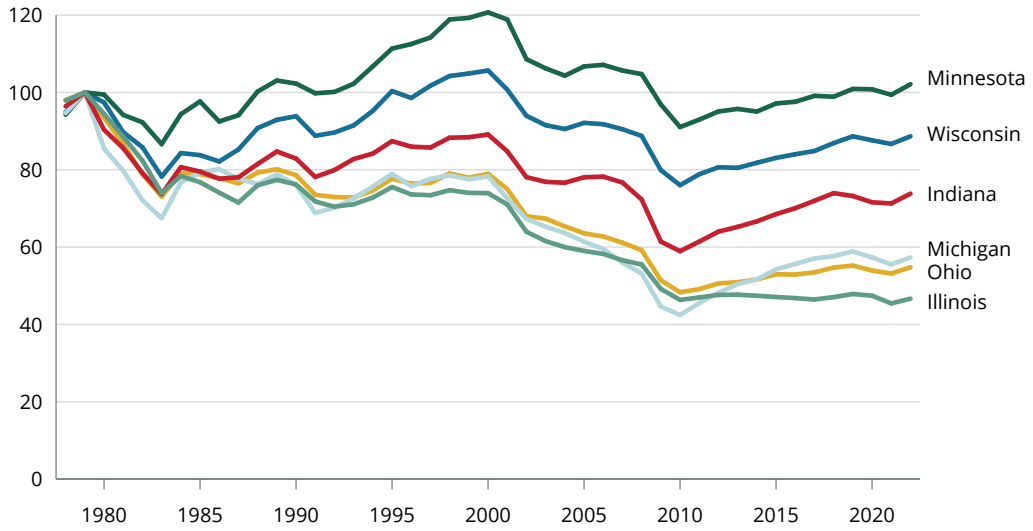

Chart: Economic Innovation Group. Source: Business Dynamics Statistics

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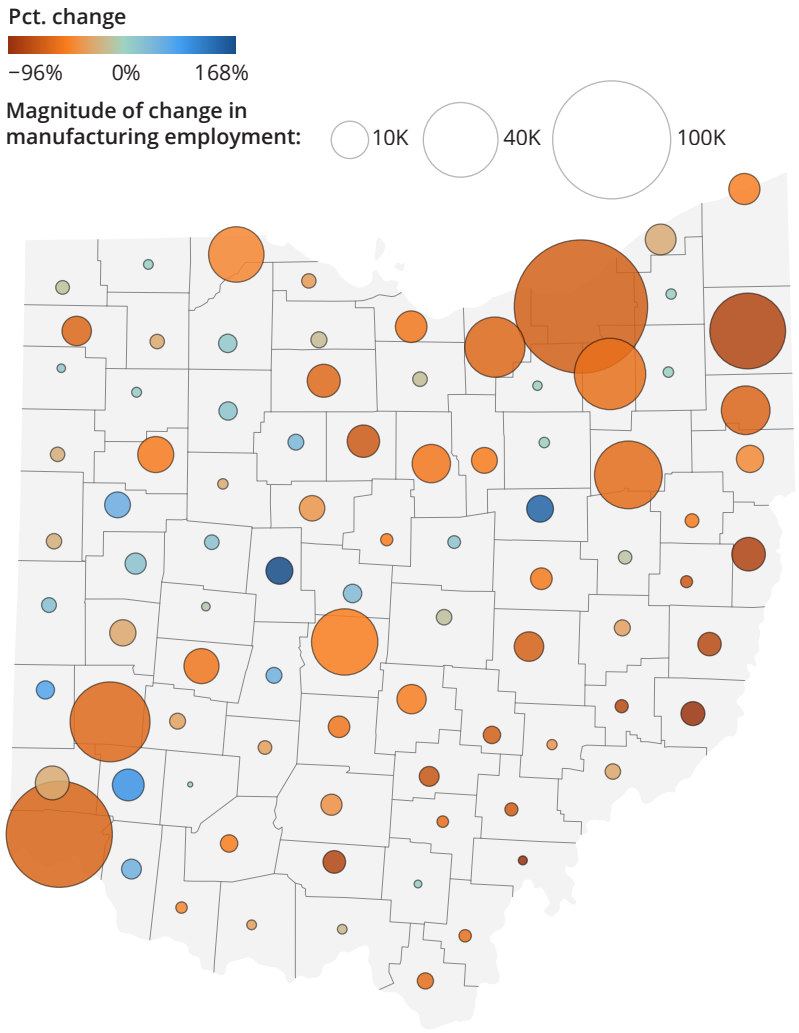
Within Ohio, the decline in manufacturing employment has been broad but not universal. Since 1979, counties centered around large cities—like Franklin County (-30,000, -48 percent), Cuyahoga County (-128,000, -67 percent), and Hamilton County (-80,000, -63 percent) have experienced large declines.

Change in manufacturing jobs by county in Ohio, 1979–2022



Map: Economic Innovation Group. Source: Business Dynamics Statistics

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A handful of counties have bucked this trend, though their growth in manufacturing jobs has been dwarfed by losses elsewhere in the state. Warren County, northeast of Cincinnati, has added 6,300 manufacturing jobs since 1979, nearly doubling its total.

Post-pandemic, manufacturing employment has continued to shift away from states like Ohio towards the Sun Belt and states with right-to-work laws. Nationally, the recovery from the pandemic was the first time since the 1970s that aggregate manufacturing employment recovered to its pre-recession levels, even as the sector continued to decline in its share of overall employment.

Despite manufacturing's rapid recovery from the recent crisis, the geography of the sector is shifting. Between 2019 and 2024, Texas (+67,000 jobs), Florida (+44,000), Georgia (+23,000), Arizona (+17,000), and Utah (+16,000) led the nation in manufacturing job creation. California lost nearly 76,000 manufacturing jobs. Ohio was the fifth-worst, shedding 19,000 manufacturing jobs, ahead of Washington (-19,000), Michigan (-25,000), and New York (-26,000) and just behind Indiana and Wisconsin (both -18,000).

Both before the pandemic and after, manufacturing job growth in right-to-work states has outpaced that in states without right-to-work laws. Nationwide, unionized manufacturing jobs are down more than 15 percent since 2010, while non-union roles are up more than ten percent.

Growth in manufacturing employment has been faster for non-union jobs and in right-to-work states

2010 through 2024

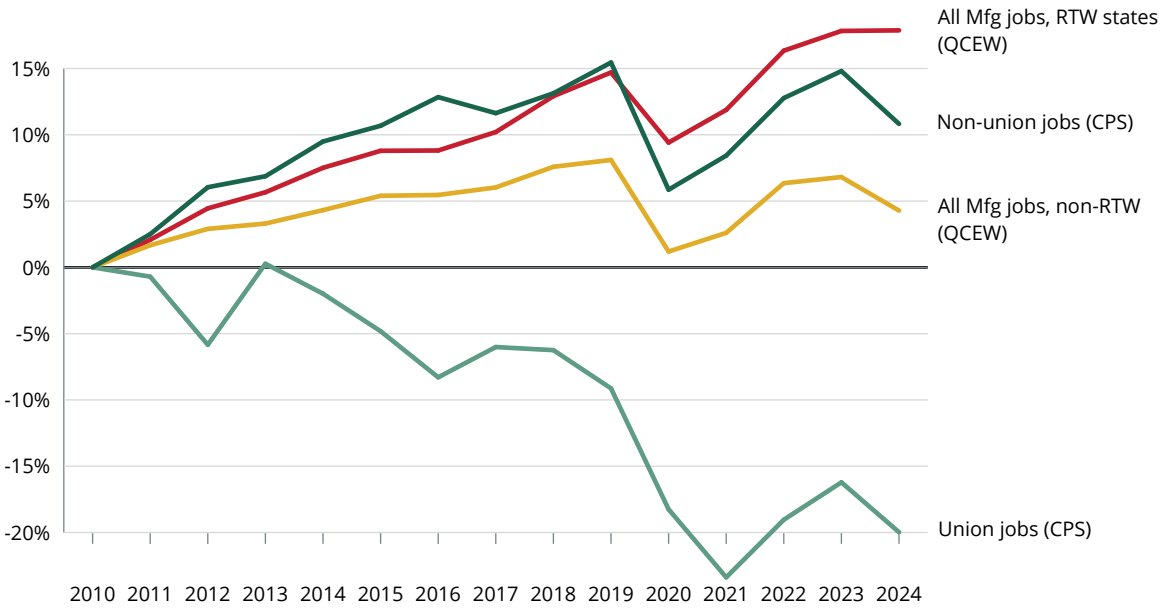

Chart: Economic Innovation Group. Source: CPS (union/non-union) and QCEW (state-level) data

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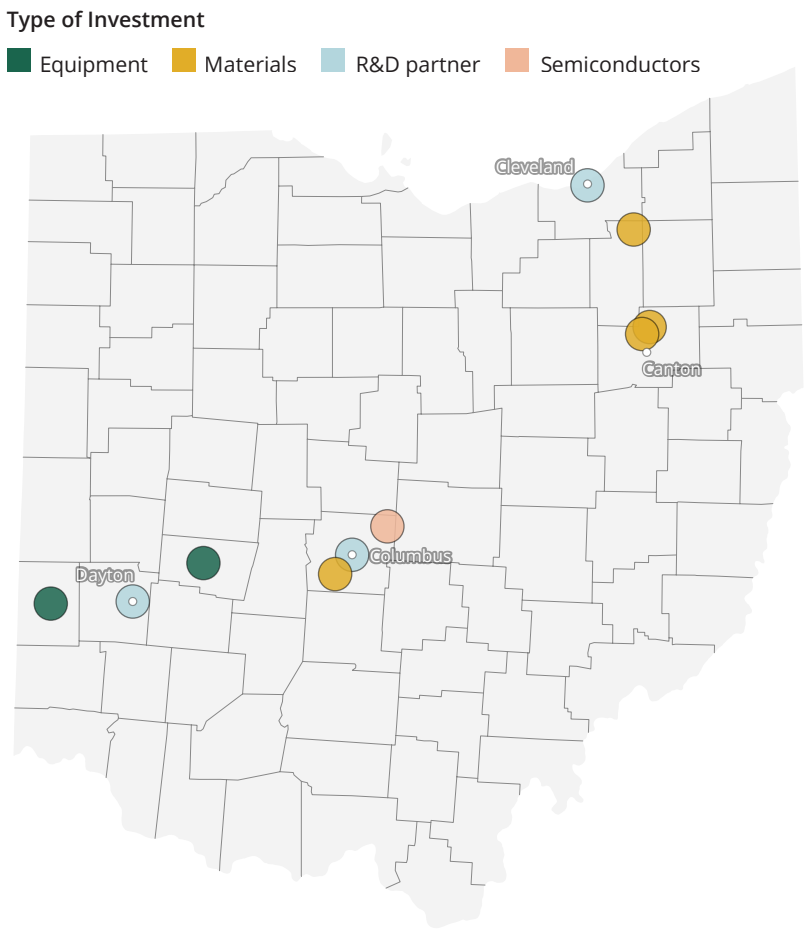
Meanwhile, the manufacturing recovery post-pandemic has not been kind to those parts of the country hit hardest by the "China Shock" of the 2000s. Indeed, the least-hit commuting zones have seen ten percent growth in manufacturing employment since 2019, while the two quintiles of commuting zones most exposed to the China Shock have seen no growth at all.[7] Notably, this is a change from pre-pandemic growth patterns, where manufacturing employment was growing (albeit modestly) across places regardless of their prior exposure to disruptions from Chinese competition. Ohio, home to industries and communities hit hard by the China Shock, was not spared.

High-profile investments from Intel, Honda, and others suggest a revival is possible.

Despite its recent manufacturing headwinds, Ohio has also received a series of massive, high-profile investments in its high-tech industries over the last few years.

In January 2022, Intel made one of the most historic investment announcements in the state's history, committing to spend $28 billion on at least two new semiconductor factories in New Albany, just outside Columbus. The sprawling complex is set to become one of the largest centers for leading-edge logic chip manufacturing in the United States, and a facility whose success has major geopolitical implications. Advanced logic chips power the latest consumer electronics like cell phones and laptops, but also have cutting-edge defense applications, making them critical to both economic and national security. At the moment, nearly all production of the most advanced logic chips takes place on Taiwan, which is under acute military threat from China.

Ohio's semiconductor ecosystem



Map: Economic Innovation Group. Source: Semiconductor Industry Association

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Ohio had many assets that made it competitive for major investments from Intel, including its water supply, relatively cheap industrial electricity prices, and stable geology, all of which matter to semiconductor manufacturers.

Ohio also has an existing ecosystem of firms further up the supply chain. Silfex, a leading producer of silicon components used in semiconductor manufacturing, has a major presence in both Eaton and Springfield, and it anticipates further expansion in the coming years as the Intel facility comes online.[8] Tosoh SMD, which produces chemicals used in the process of manufacturing chips, is located in Grove City.

In the area around Columbus, the workforce is already well prepared to accommodate a surge in new demand from the semiconductor industry. In fact, the area is home to a thriving set of programs at Lorain County Community College in microelectronic manufacturing (MEMS), which offer degrees—from certificates to four-year bachelor's—infused with hands-on training and deeply integrated with local industry partners. Students gain first-hand experience in labs and cleanrooms from early on in their degree programs.[9]

In interviews, local workforce development leaders and administrators describe Lorain's semiconductor and adjacent programming as key to both attracting investment from Intel and ensuring that the facility has a steady supply of highly skilled technicians. The Semiconductor Industry Association (SIA) estimates that more than 26,000 technician jobs risk going unfilled nationwide over the next decade.[10] Other regions should look to model Lorain County Community College, whose graduates are highly coveted by employers even before the Intel plant opens.

New programs at Ohio State's Electrical and Computer Engineering (ECE) department

Undergraduate minors	Undergraduate embedded certificates	Graduate embedded certificates	Stand-alone graduate certificates	Undergraduate certificates
Signal Processing	Semiconductor Devices	Semiconductor Optoelectronics	Semiconductor Optoelectronics	Tech-preneurship
Semiconductor Devices	Signal Processing	Semiconductor Devices	Semiconductor Devices	
		Semiconductor Fabrication Technology	Semiconductor Fabrication Technology	
		Machine Learning		

Table: Economic Innovation Group. Source: Ohio State ECE

Ohio State's Department of Electrical and Computer Engineering (ECE) has also proven highly adaptable. According to one faculty member at the school, the ECE department has nearly doubled in size over the last two years and added 12 new programs. That includes certificates at the undergraduate and graduate levels in areas like semiconductor fabrication technology, signal processing, and optoelectronics.

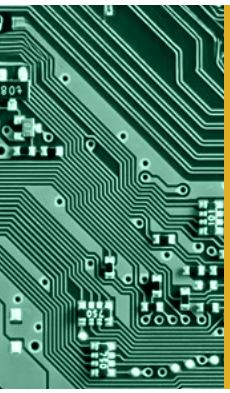
The expansion of such programs at Ohio State and other schools across the country will be essential if the United States is to meet the projected growth in demand for semiconductor engineers over the next decade.

But semiconductors are not the only industry in Ohio to receive big new investments. Honda, for whom Ohio has been a central node in the company's American presence, is investing $1 billion this year alone to equip its Marysville facility to make electric vehicles. These upgrades come on the heels of Honda's $4.4 billion joint venture to build a plant that manufactures batteries for EVs, also in Central Ohio.[11]

Marysville will be the first place in the world in which Honda manufactures electric vehicles, hybrids, and internal combustion engine-powered cars on the same, flexible assembly line.[12] This is not a trivial development for a firm that has traditionally developed new products and processes in Japan, later disseminating those innovations to American plants. Such a process is in many ways a mirror image of the deindustrialization and offshoring experienced by the United States in recent decades, where lower-value manufacturing firms gradually learn and climb up the value chain. With consumers continuing their shift towards electric vehicles, the "EV Hub" developing in Ohio has the potential to cement the state as a permanent force.

Finally, there are signs that the state's historic strength in aerospace is attracting a new generation of investment from that sector, too. In January, Anduril announced a nearly $1 billion investment to build a massive drone factory in Pickaway County next to Rickenbacker International Airport. The project will create an estimated 4,000 jobs and, critically, equip the Columbus area workforce with the skills needed to attract further investment in the next generation of defense manufacturing.

Ohio's comeback is far from finished, but green shoots are there. Parts of the workforce development system are meeting the moment, creating new programs and curricula to attract both workers and firms. If these lessons can be diffused across the state, training, retaining, and attracting top high-tech talent, there is no reason the state cannot become an undisputed manufacturing powerhouse again.



PART 2: Taking stock of Ohio's high-tech workforce

Attracting a steady stream of future, high-tech investments to Ohio will require building on the state's history as a center for engineering and technical excellence. Ohio must improve the state's ability to attract, train, and retain more high-tech workers, students, and researchers.

The skillset of a state's workforce remains a deeply underrated factor driving economic development success. Consider the Amazon HQ2 competition, in which cities fought to host the company's latest expansion of its white-collar workforce, offering tax breaks, subsidies, and other expensive amenities. Amazon settled on expanding its presence in New York and DC, two favorites from the outset. While the debate surrounding this competition largely centered on the incentives that local governments offered to Amazon, the company ultimately chose New York and DC because those two cities gave it access to workers with the skills it demanded.

Human capital ultimately makes local economies more resilient in the face of shocks, such as natural disasters or exposure to a sudden increase in import competition. One analysis of local economies in the United States, United Kingdom, Germany, Japan, Italy, and France demonstrates that across the developed world, those regions with higher rates of college education were much more likely to recover from deindustrialization than those home to fewer graduates[13]. Indeed, this is one reason why fewer regions recovered from deindustrialization in the United States than other peer countries.

Developing and attracting highly specialized talent will be particularly important if reindustrialization and reshoring of high-tech, strategic industries will succeed. At the center of industrial policy success stories across the world has been a highly complex process of transferring so-called "tacit knowledge."[14] This kind of intuition is hard to codify, as it comes from deep, first-hand experience, perhaps on a factory floor or a Research and Development (R&D) lab. As a longtime hub of manufacturing, albeit one that has struggled over the last few decades, Ohio already has plenty of workers who possess tacit knowledge. It represents an existing asset that the state can build on with a combination of workforce training emphasizing on-the-job experience and better policy to attract and retain high-tech talent.

This section will track Ohio's progress in developing its high-tech workforce, benchmark the state against its peers in the Midwest, and present a framework for high-tech workforce competitiveness.

Ohio's STEM graduate workforce has grown in line with its broader region.

One of the simplest ways to measure Ohio's high-tech workforce is to track the growth of workers with a STEM (Science, Technology, Engineering, and Mathematics) bachelor's degree, as defined by the Census Bureau.

Over the last decade and a half, the number of STEM graduates has grown markedly, both in Ohio and across the country. Nationally, the number of residents with a STEM bachelor's degree has risen 64 percent since 2009. That's well ahead of the Midwest—encompassing Ohio, Indiana, Michigan, Minnesota, Wisconsin, and Illinois—which combined have seen their STEM graduate population grow 53 percent.

Ohio's STEM graduate population has grown 60 percent since 2009, tied with Minnesota and behind Indiana, which has grown a touch slower than the country at large.

Growth in adults with a STEM bachelor's degree since 2009

By state and region

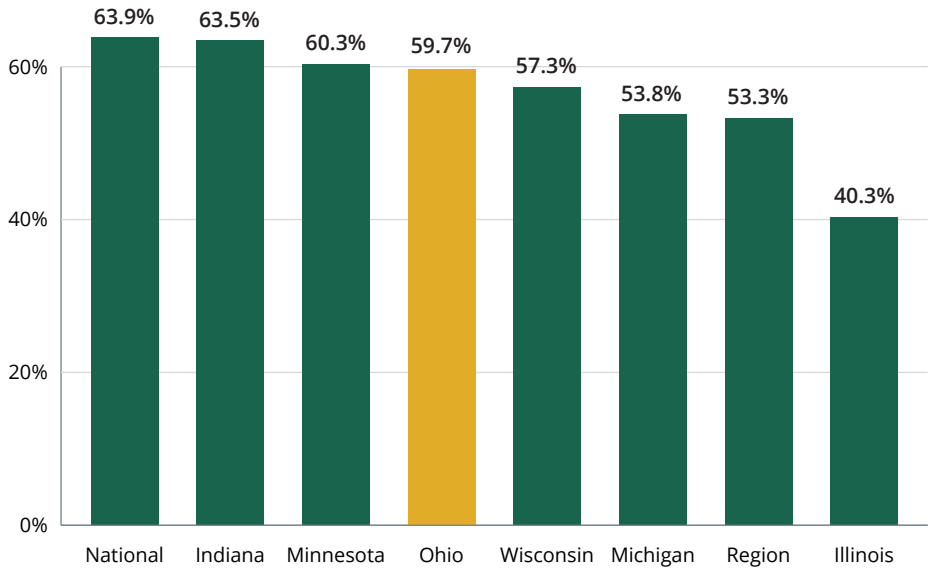


Chart: Economic Innovation Group. Source: American Community Survey

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The share of Ohio's graduates completing degrees in STEM and STEM-related fields has also risen over time. In 2009, Ohio's college-educated workforce had the lowest share of STEM degree attainment in the region at under 40 percent. By 2023, Ohio was in the middle of the pack, at nearly 45 percent.

Share of graduates with a STEM degree

State of college graduates

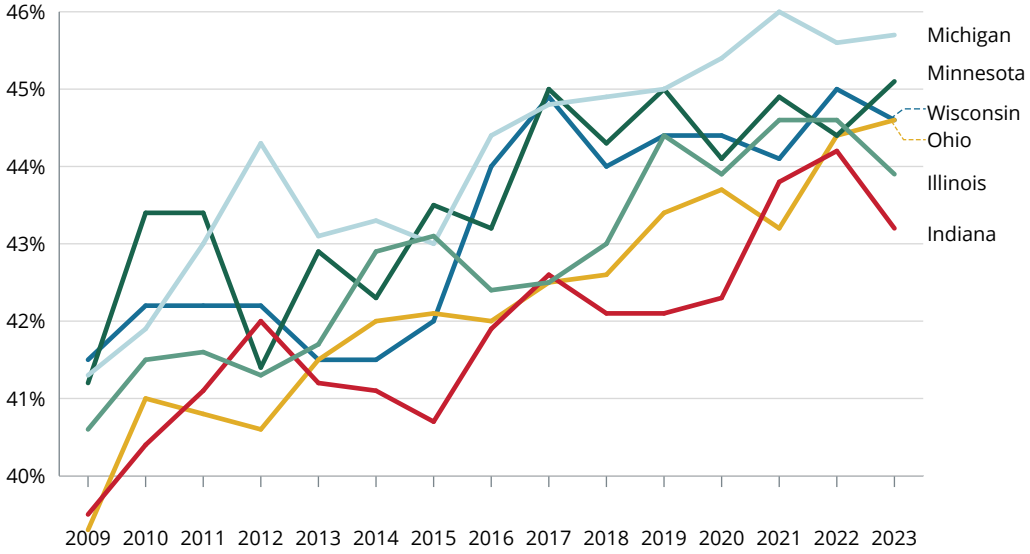

Chart: Economic Innovation Group. Source: American Community Survey

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The Workforce Competitiveness Index: A framework for understanding Ohio's high-tech workforce

With high-level data on STEM graduates in mind, it's important that we dive deeper into the kinds of degrees in demand from high-tech firms, and benchmark how Ohio's high-tech workforce compares to other states within its region and across the country. To do this, we constructed a Workforce Competitiveness Index that synthesizes three of the major workforce-related indicators that high-tech companies consider when making large-scale investments: the production of high-tech talent, the supply-demand balance of such talent, and the cost of living for the talent they demand.

We find that Ohio's high-tech workforce and ecosystem show potential to absorb major new investments in advanced manufacturing and emerging technologies, particularly when compared with the Southeast, a traditional competitor for manufacturing investment.

Identifying the high-tech workforce

First, we identify high-tech workers according to their undergraduate majors. To do this, we identify workers with degrees that are most in demand from employers in high-tech industries.

If a major is at least 50 percent more common in Business Dynamics Statistics-High Tech (BDS-HT) industries than the overall labor market, we consider the degree high-tech. BDS-HT is a cross-section of highly R&D and STEM-intensive industries, largely in manufacturing and information services, and is published by the Census Bureau.

Using this methodology, we identify 47 high-tech majors. Using microdata from the American Community Survey, we then calculate the number of workers with high-tech degrees in each state, which we then use for subsequent analysis.

The ten largest high-tech majors

Defined as: 50 percent more common in BDS High-Tech industries than the overall labor market

Major	Total Graduates defined by ACS, 2023
Computer Science	1,876K
Electrical Engineering	1,534K
Mechanical Engineering	1,340K
General Engineering	926K
Civil Engineering	752K
Computer And Information Systems-General	625K
Architecture	593K
Computer Engineering	504K
Chemical Engineering	499K
Physics	442K

Table: Economic Innovation Group. Source: American Community Survey

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The Workforce Competitiveness Index

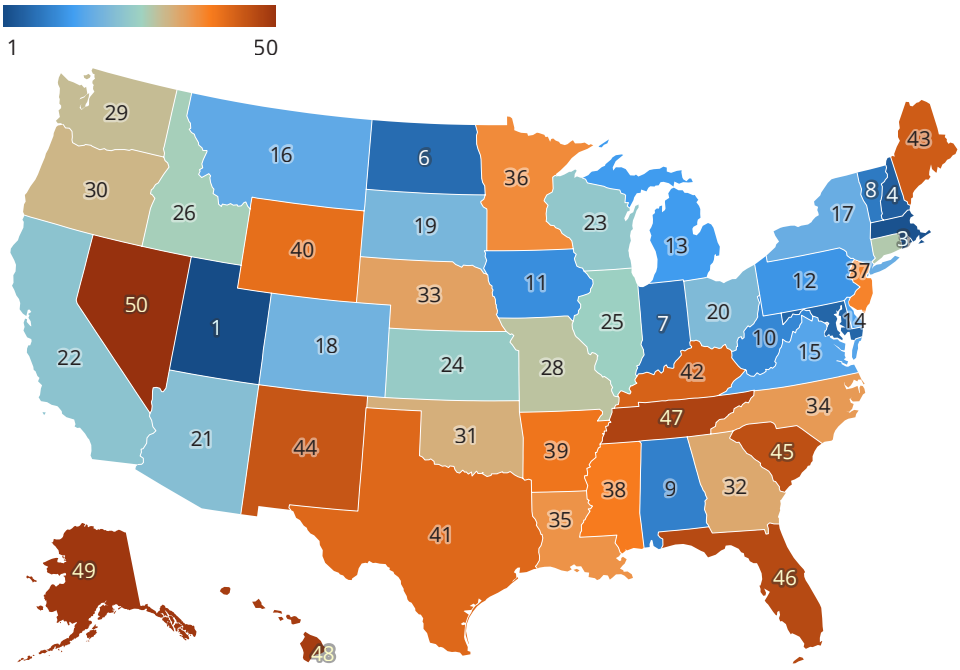
The WCI consists of three components, each of which is a factor for companies evaluating the attractiveness of the local workforce.

The first is the **production of high-tech graduates**. We calculate the ratio of recent high-tech degrees awarded by each state to the size of the overall labor force. All else equal, a state that is producing many high-tech graduates relative to the size of its labor market will be more attractive for outside high-tech investment. Specifically, we compare the number of high-tech degrees awarded between 2014 and 2023 in each state to the size of each state's labor force as of 2024.

Ohio and its broader region perform well on this measure, as its long tradition of engineering and technical education would suggest.

High-tech graduate production, by state

State rank, ratio of high-tech degrees produced 2014–23 to 2024 labor force size



Map: Economic Innovation Group. Source: BLS, IPEDS

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Nevertheless, Ohio's (and the region's) production of high-tech graduates has begun to wane. Between 2014 and 2019, the number of bachelor's degrees in high-tech fields awarded by Ohio's schools rose more than 35 percent. Since then, it has declined by seven percent, even as the number of bachelor's degrees in high-tech fields each year has continued to grow nationally.

High-tech bachelor's degrees awarded by year

2014 Total = 100

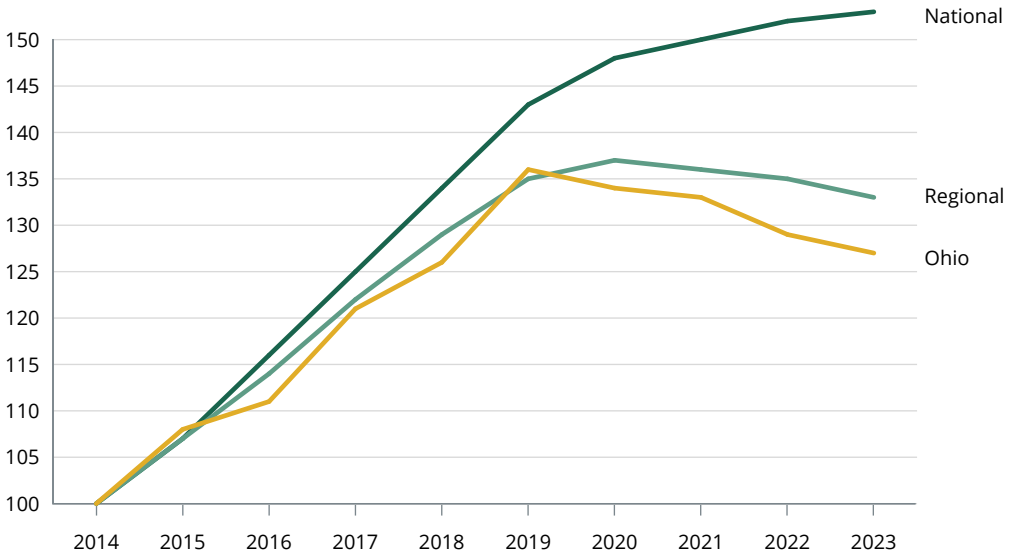


Chart: Economic Innovation Group. Source: IPEDS

ECONOMIC INNOVATION GROUP

The second component is the **high-tech worker supply and demand balance**. This is a proxy for graduate retention and attraction, relative to how effectively a state's college and university system produces new, high-tech graduates.

The supply and demand balance is measured as a ratio of high-tech majors graduating between 2014 and 2023 to high-tech graduates under 35 years old living in each state today. A ratio well above one suggests the state is producing more high-tech graduates than it is using, while a ratio below one suggests a state is relying much more on external graduates.

States that are training many high-tech graduates but losing them to other states will, all else equal, have an easier time growing their high-tech workforce than states attempting to draw in workers with no local connections. States like Ohio (ranked 23rd on supply-demand balance) have more room to improve retention, recruiting graduates who already have established social or economic ties to the state. They rank higher on this portion of the index, as their supply-demand balance reflects room for improving retention.

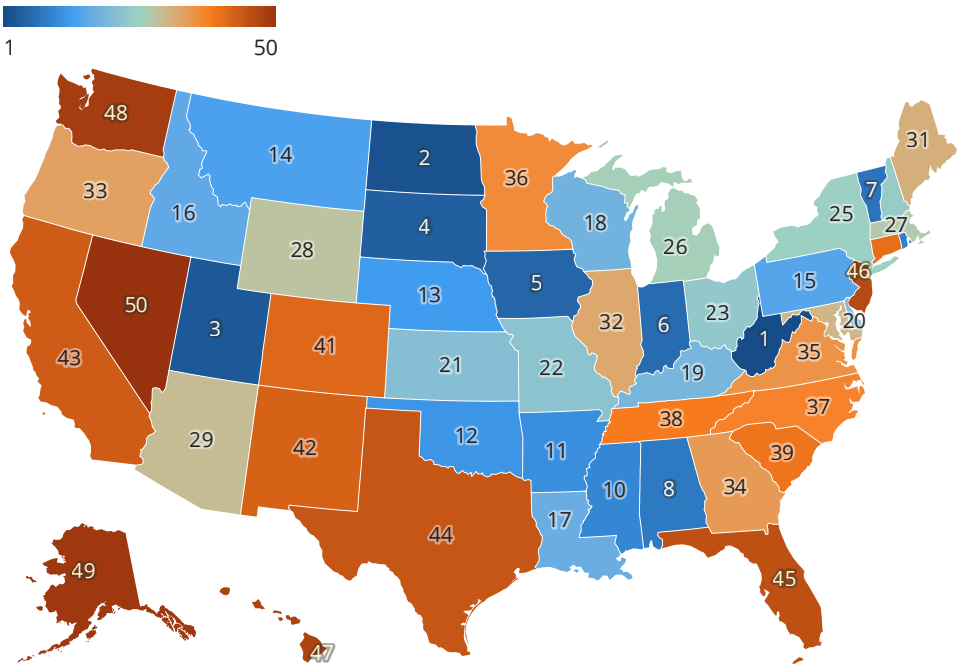
A stark supply-demand balance in favor of demand—meaning a state is employing far more high-tech graduates than its schools can produce—is an indicator of past high-tech success. States like California, for example, employ far more high-tech graduates than the state produces, even though it is no longer a hub of investment in high-tech manufacturing, for example.

A better balance of supply and demand is a forward-looking indicator of potential.

There are qualitative indicators that some high-tech employers seek out locales with this kind of "slack" at times, rather than always investing in existing, crowded clusters of competitors.[15] Notably, Intel chose to invest in New Albany, Ohio rather than expand at its existing plants in other sites or the large, emerging semiconductor manufacturing hub in Arizona, home to TSMC's new fabs. The market for engineers in Arizona might be too tight and its relevant workforce pipelines already fully tapped.

High-tech supply-demand balance

State rank, high-tech degrees produced from 2014–2023/Residents with high-tech degrees in 2023



Map: Economic Innovation Group. Source: IPEDS and ACS

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The final component is **cost of living**, as measured by the Center for Community and Economic Research's (C2ER) Cost of Living Index. C2ER's index is the longest-running measure of the relative cost of living across the country.

On this measure, Ohio is highly competitive, along with other peers in the region. Ohio ranks sixth-best in cost-of-living on C2ER's index, just behind its neighbor Michigan (fourth) and tied with Kentucky directly to its south.

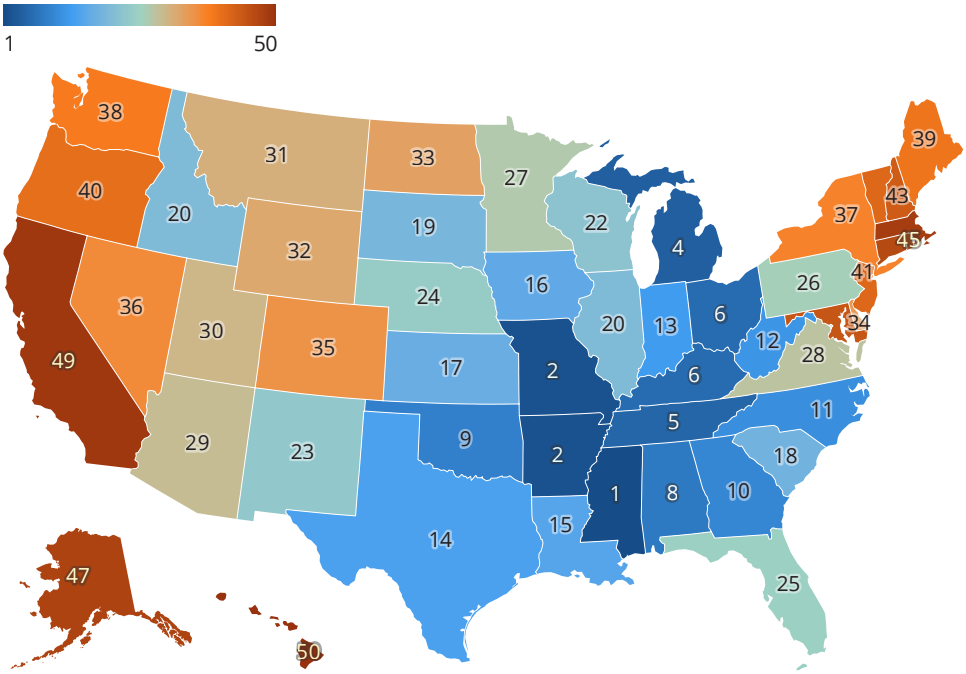
C2ER's index is different from standard measures of the cost of living, such as Regional Price Parities produced by the Bureau of Economic Analysis, in that it specifically attempts to estimate relative differences in costs faced by college-educated, professional households

with top-quintile incomes. In other words, it is a better proxy for the relative attractiveness of a particular area to the kinds of high-tech engineers and technical talent that Ohio should attract than broader measures that would include less relevant demographic groups like retirees. While an imperfect measure, C2ER's index is well-targeted to the question at hand: which states are most attractive to the kinds of workers sought out by high-tech companies like Intel, Honda, and Anduril, from a cost-of-living perspective?

For tradeable, high-tech industries, C2ER's index is not simply a measure of cost-of-living for the kinds of professional workers such industries demand. It is also a proxy for labor costs. Companies investing in regions with dysfunctional, over-regulated housing markets, for example, will have to pay more for the same talent than they would in states with more elastic housing supply. Ohio is highly competitive on this measure, a win for high-skilled workers who can take advantage of the state's low cost of living and the companies that can save on labor costs.

C2ER Cost of Living Index

State rank, May 2025



Map: Economic Innovation Group. Source: C2ER

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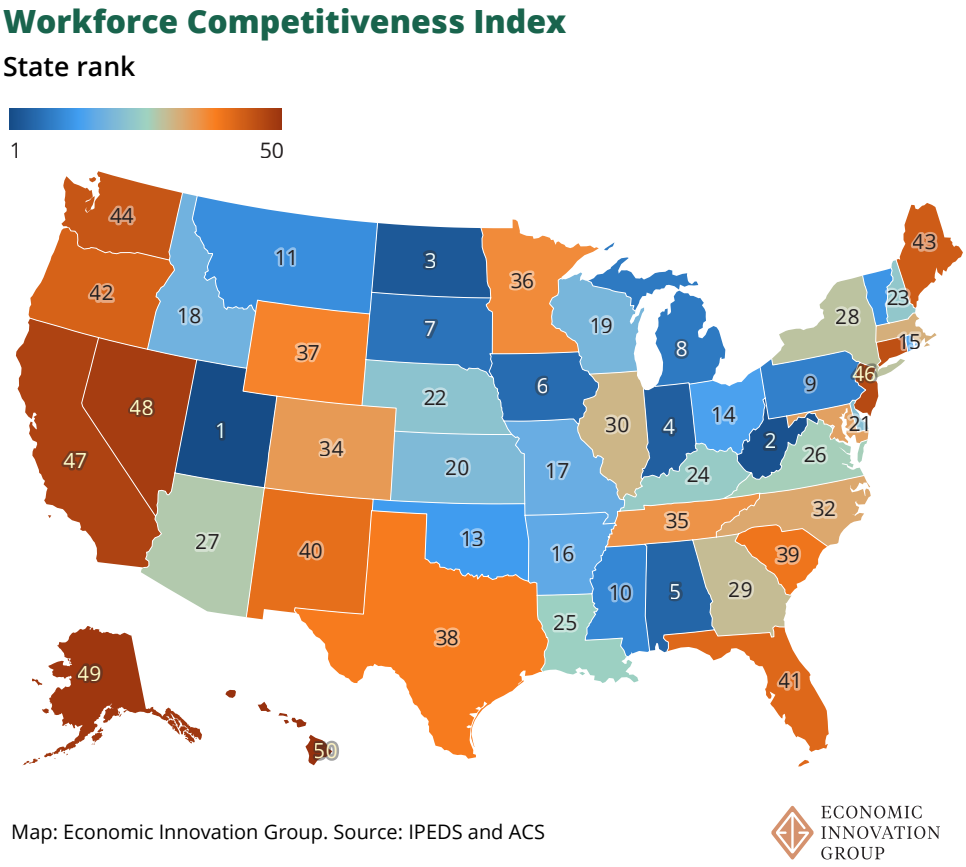
Putting together the Workforce Competitiveness Index

Together, these three measures make up the Workforce Competitiveness Index (WCI), a forward-looking measure of each state workforce's attractiveness for new high-tech investment and capacity to absorb it. Each of the three components is converted to Z-scores and summed together, creating one unified index.

The Midwest scores very well on the WCI. Ohio ranks 14th, Indiana fourth, and Michigan eighth.



Map: Economic Innovation Group. Source: IPEDS and ACS

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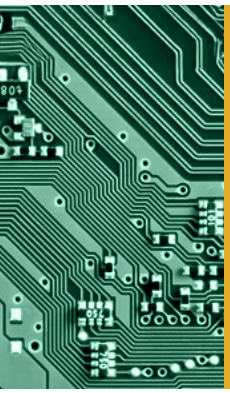
It's worth noting how the Midwest outperforms two sets of states. The first is the set of high-cost, coastal states like California, Washington, Oregon, New York, and New Jersey. While California firms and inventors in particular were at the forefront of so much advanced manufacturing in the 20th century, that is no longer the case. High-profile advanced manufacturers may still spend on R&D in these states, but it is simply too expensive to manufacture at scale relative to competing regions.

The second set of states the Midwest outperforms on the WCI is the Southeast. Only Alabama, ranked fifth, and Mississippi, tenth, beat Ohio in the index. Georgia, still an emerging hub of battery manufacturing, ranks 29th, while North Carolina (32nd), Tennessee (35th), and South Carolina (39th) are further behind.

To be sure, the Southeast—and the Sun Belt more broadly—is still the center of gravity for manufacturing investment in the United States today.[16] But our measure suggests that Ohio and the Midwest are perhaps being underrated or overlooked for certain kinds of high-tech investment. Ohio and the Midwest still punch well above their weight in terms of engineering and technical expertise. Talent remains an asset for the region. Paired with other smart policies to build a more dynamic economy, Ohio and its neighbors can emerge as leaders in the next generation of high-tech industry and place-based industrial policy.



PART 3: Policy to Accelerate Ohio's High-Tech Workforce Transformation

Despite the challenges Ohio has faced over the last few decades, the state retains key building blocks for a renewed, thriving ecosystem in high-tech manufacturing and other emerging technologies.

Its public universities continue to produce top technical talent. The state's long history as an engineering powerhouse is still yielding benefits. And Ohio ranks very favorably on the cost of living, particularly outside its capital of Columbus.

Ohio can, and should, pair these assets with additional policies to further boost its high-tech workforce, accelerate investments tied to state and federal industrial policy, and create a more dynamic labor market. This final section offers suggestions for state and federal policymakers on these fronts, grouped into three pillars.

Pillar 1: ***Roll out more flexible workforce development tools and provide a landing pad for high-tech entrepreneurs.***

The next generation of advanced manufacturing will bring with it a surge in demand for new blue-collar technicians to operate and service high-tech factories on a day-to-day basis. Anecdotally, many employers in high-tech manufacturing industries are at least as concerned about their access to such technicians as they are about their ability to find and hire the highest-paid engineers and managers.

To meet the rapidly evolving needs of these employers, Ohio should experiment with flexible workforce training programs that are more closely tailored to employers' specific requirements than traditional programs. One promising idea from the DC-based think tank American Compass is a portable grant of $10,000 for on-the-job training, overseen by the federal Department of Labor.[17] Such a program would defray the costs of training new technicians, who might not be net-positive contributors on the factory floor in the initial weeks or months on the job. Bypassing traditional gatekeepers and bottlenecks in the existing workforce development ecosystem, a pilot program of this model at the state level could more quickly and effectively align training pipelines with the skills demanded by high-tech employers.

Pillar 2: Attract more high-tech talent with smart, targeted immigration policy.

Improving Ohio's workforce training pipelines is just the start. The state can also improve its retention of international students, thousands of whom graduate from local universities each academic year. In this section, we propose three new policy tools to do that, the first of which Ohio can adopt on its own, the latter two requiring action from Congress.

As we have shown, a large majority of PhD recipients trained at Ohio's universities leave the state within a decade, particularly those in STEM fields. Such talent already has deep ties to the state, having spent five years or more in the state for school. Many of these graduates are international students, who struggle to remain in the country after school. For those who can remain, starting a business risks violating the terms of their visa.[18]

While immigration policy is squarely in the domain of the federal government, state and local authorities do have tools to retain more foreign-born entrepreneurs. States and universities across the country are building so-called "Global Entrepreneur-in-Residence" (Global EIR) programs that provide cap-exempt H-1B visas to local startup founders, typically graduates of local universities[19]. One of the newest Global EIR programs, funded by the State of New Jersey, will provide visas to local graduates starting AI-focused companies in the area.[20] Ohio should establish a statewide Global EIR program to provide a pathway for more promising entrepreneurs to stay in the state after graduating from undergraduate or graduate programs, particularly in fields that align with the state's economic development goals. Policymakers at the state and even local levels have the authority to start Global EIR programs on their own.

Congress should also take up bipartisan reforms to improve the nation's high-skilled immigration system, with a particular focus on helping reindustrializing places like Ohio attract and retain talent.

First, Congress should establish a "Chipmaker's Visa" tailored directly to the urgent challenge of rebuilding the semiconductor supply chain in the United States.[21] As an emerging chipmaking hub, Ohio has much at stake. A Chipmaker's Visa would guarantee that companies investing in Ohio would have access to the highly specialized talent they need while generating revenue that gets redirected to further expanding workforce training programs for American workers. The program would offer a flexible visa usable by firms and workers up and down the chipmaking supply chain for ten years, giving time for firms investing in the United States to scale up production immediately. Visas would be auctioned off for firms, with revenues recycled to a domestic training fund, such that every visa offered to a skilled engineer means an additional American worker gets trained for another job in the industry.

More ambitious than the Chipmaker's Visa is EIG's Heartland Visa proposal, a place-based, high-skilled visa program specifically designed for communities struggling with economic or demographic stagnation. Unlike the Chipmaker's Visa, the Heartland Visa would be industry-agnostic, instead ruthlessly focused on attracting the highest-paid workers and entrepreneurs to cities like Cleveland, Akron, or Youngstown. Introduced in the Senate on a

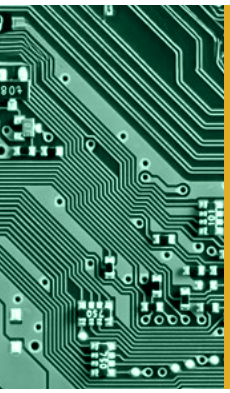
bipartisan basis in 2024, Heartland Visas would be a game-changer for economic development and talent attraction across the state of Ohio.[22]

Pillar 3: ***Break down barriers to worker mobility.***

One of the most critical ingredients to a booming, high-tech ecosystem is mobility. When workers change firms, they bring with them new ideas, new insights, and new relationships, all of which can catalyze innovation at the firm level. Also critical is the ability for workers to strike out on their own to start new firms, armed with what they have learned earlier in their careers.

But the proliferation of noncompete agreements impedes this critical process across the country, including in Ohio. The best evidence finds that noncompete agreements reduce innovation, stifle new business formation, and suppress wages.[23] Ohio is one of the only states left with no restrictions whatsoever on this coercive, innovation-killing practice.

The state should move quickly to end, or at least severely limit, the use of noncompetes in employment contracts. Ohio's economy, struggling with a long-running decline in economic dynamism, sorely needs the boosts to startup formation, innovation, and worker mobility that such a ban would spark.[24]



Conclusion

Ohio has historically been at the center of American manufacturing and high-tech industry. It has pioneered new models in technical education, working closely with the private sector to forge new industries and companies. The region still boasts some of the strongest engineering programs in the country, churning out sought-after graduates across a wide range of technical fields from semiconductors to auto manufacturing.

As we enter a new era of industrial policy, place-based federal investments, and advanced manufacturing, Ohio is well-positioned to take advantage. With the addition of smart, flexible policy tools, the state can continue to build its high-tech workforce and regain its place as a national leader in advanced manufacturing and high-tech investment.

Appendices

Appendix 1: Data shows manufacturing apprenticeships are stagnant in Ohio.

Healthy growth in STEM and high-tech graduates from Ohio's colleges and universities is a positive sign for future high-tech investment prospects. Another segment of the state's workforce development ecosystem, however, has not given indications that the state is ready for a revival of high-tech manufacturing: apprenticeships.

Over the last two decades, the share of the state's apprenticeship programs devoted to training workers for manufacturing occupations has fallen by nearly two-thirds, from 15 to 6 percent. Indeed, the number of manufacturing apprentices has fallen outright even as the number of apprentices overall has grown.

Active apprenticeship programs in Ohio, by industry

Since 2004

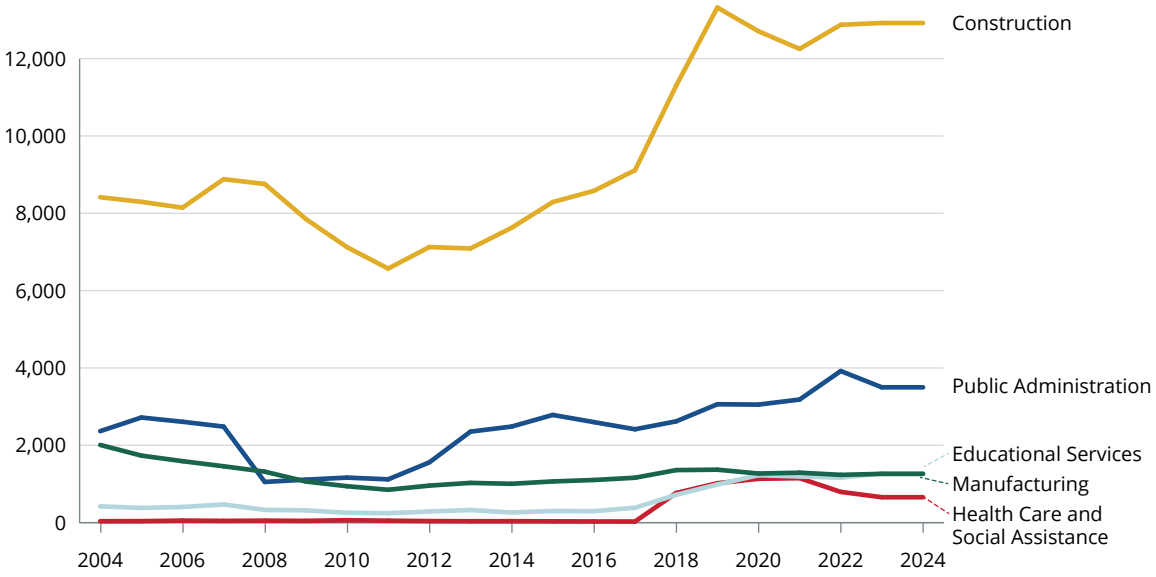


Chart: Economic Innovation Group. Source: Ohio Department of Job and Family Services

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Appendix 2: Analyzing graduate retention throughout the workforce ecosystem.

Producing desirable graduates in high-tech fields is just one part of Ohio's workforce development equation. It also needs to keep them from leaving the state for better job prospects in other states. Improving the *retention* of high-tech graduates is one of the lowest-hanging fruits available to Ohio in its drive to become a more competitive destination for high-tech investment.

A state's ability to retain its graduates—whether from associate's degree programs, traditional four-year programs, or graduate schools—is influenced by a variety of factors. First is the local labor market's potential to absorb and productively employ graduates nearby. A university with a top-flight engineering school will not grow the area's stock of human capital without major employers ready to put graduates to work with attractive offers. Other factors within a state's control like taxes, housing supply, and cost-of-living will also affect a state's ability to keep the students it trains.

The Census Bureau's Post-Secondary Employment Outcomes (PSEO) data tracks graduates by school and degree program over time, allowing us to analyze how retention varies across different types of programs and fields. Participation varies between states, leaving some states with a high share of graduates covered by the data and others with few or no graduates tracked over time. This makes comparisons across states difficult. The data does, however, reveal three interesting trends for colleges and universities within the state of Ohio.

1. Graduates from lower-level degree programs are the likeliest to remain in Ohio after school.

In Ohio, graduates of associate's degree and certificate programs are significantly less likely to leave the state after their studies. After one year, 86 percent of associate's degree recipients from schools in the PSEO dataset who were employed were working in Ohio, compared with 75 percent of bachelor's degree recipients.

For higher degree levels, retention is even lower. About 70 percent of master's degree recipients remain in Ohio after graduation, while the one-year retention rate for those with a professional doctorate is just over 60 percent. For traditional research doctorates, retention is far lower. Slightly more than 40 percent of such graduates are employed in-state a year after their program ends. After a decade, just one-third remain.

The gap between the retention of graduates of lower-level programs and traditional undergraduate and graduate programs persists long after graduation. While 73 percent of graduates from short (less than a year) certificate programs and 69 percent of those finishing 1–2-year certificates remain in Ohio a decade later, just 65 percent of bachelor's degree graduates do.

Ohio's in-state retention rate, by degree level

Degree levels with at least 1,000 tracked graduates

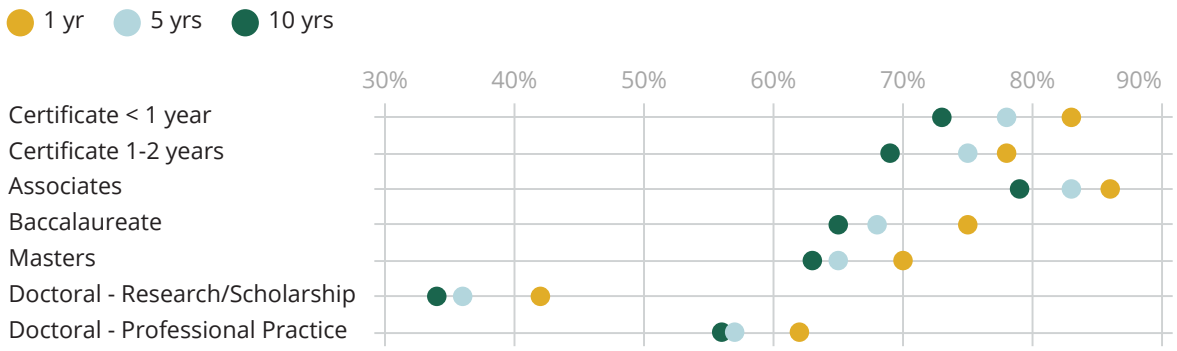

Chart: Economic Innovation Group. Source: PSEO

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2. Regional colleges and universities outperform flagship schools on post-grad retention.

Similarly, it is Ohio's regional colleges and universities, not its flagship schools, which produce the graduates most likely to stick around after graduation.

Nearly 90 percent of bachelor's graduates from Cleveland State are still in Ohio after one year, the highest of any school with at least 1,000 graduates tracked by PSEO data. A little over 70 percent of graduates from the University of Cincinnati, Ohio State, and Ohio University remain in-state after one year. Miami University has a substantially lower retention rate; fewer than half of its undergraduates remain in-state after a decade.

Differences in retention are strongly correlated with a college's share of out-of-state students. The majority of the entering class of Central State University, an HBCU east of Dayton, came from outside Ohio.[25] It also has the lowest retention rate 10 years after graduation. Miami University, not far behind Central State in retention, attracted 38 percent of its 2022 entering class from out-of-state.[26]

This phenomenon is not unique to Ohio. Research shows that flagship universities have lower retention rates than regional schools across the country. According to one estimate, spending at "selective regional colleges" results in 70 percent more graduates who ultimately stay in-state than an equivalent level of spending at flagship schools.[27]

Ohio's in-state bachelor's graduate retention rate, by school

Schools with at least 1,000 tracked graduates

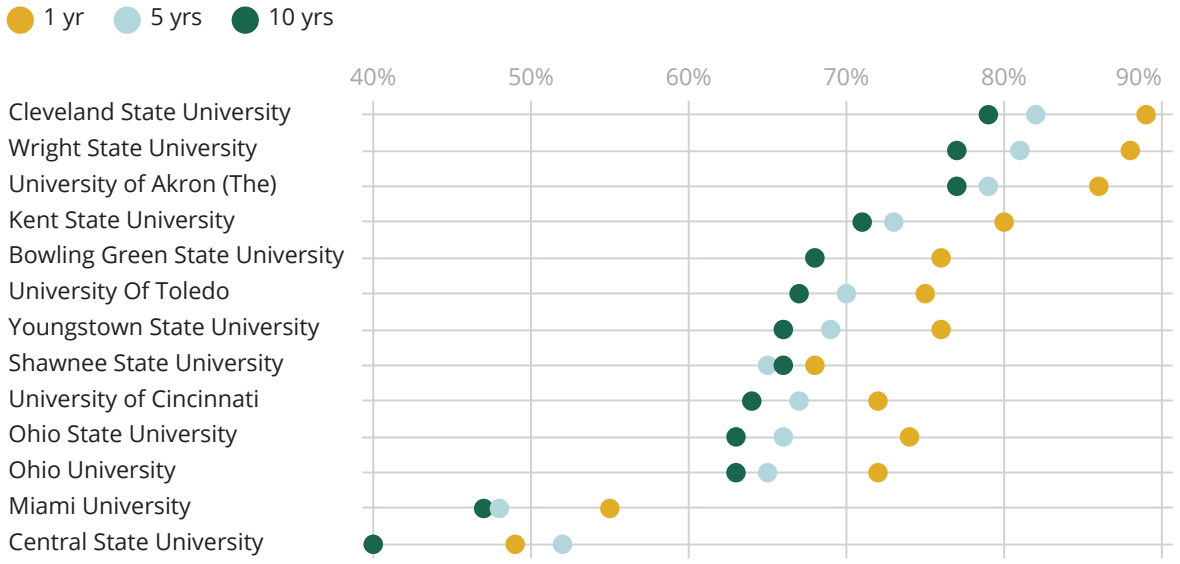

Chart: Economic Innovation Group. Source: PSEO

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3. Ohio has room for improvement in retaining high-tech graduates.

Ohio's retention rate varies by degree field, in some cases quite dramatically. Nearly 80 percent of those receiving a four-year degree in education, for example, remain in Ohio a decade after graduation, the highest of any field. Perhaps unsurprisingly, other majors tied to state and local public services, like law enforcement and public administration, also have among the highest retention rates.

In STEM degree fields, Ohio's retention record is not nearly as positive. Less than half—45 percent—of graduates in physical sciences remain in-state after a decade. In mathematics and statistics, architecture, and biology, more than two out of every five graduates leave the state after ten years. The state's ten-year retention rate of engineering majors is only marginally better, at 62 percent.

At higher degree levels, retention rates are even lower. Education is the only PhD field for which a majority of Ohio's graduates remain in-state after a decade. Retention in STEM fields is much worse. Fewer than one-quarter of engineering PhDs trained in Ohio are still there a decade after graduation; in computer and information science, 26 percent remain. Given that a majority of STEM PhDs in the United States each year are awarded to international students, it should not be surprising that Ohio's STEM retention rate for graduate students is much lower than in other fields, but such low retention rates do present the state with a clear area to improve.

In-state retention rates in Ohio, by major

Majors with at least 1,000 tracked graduates

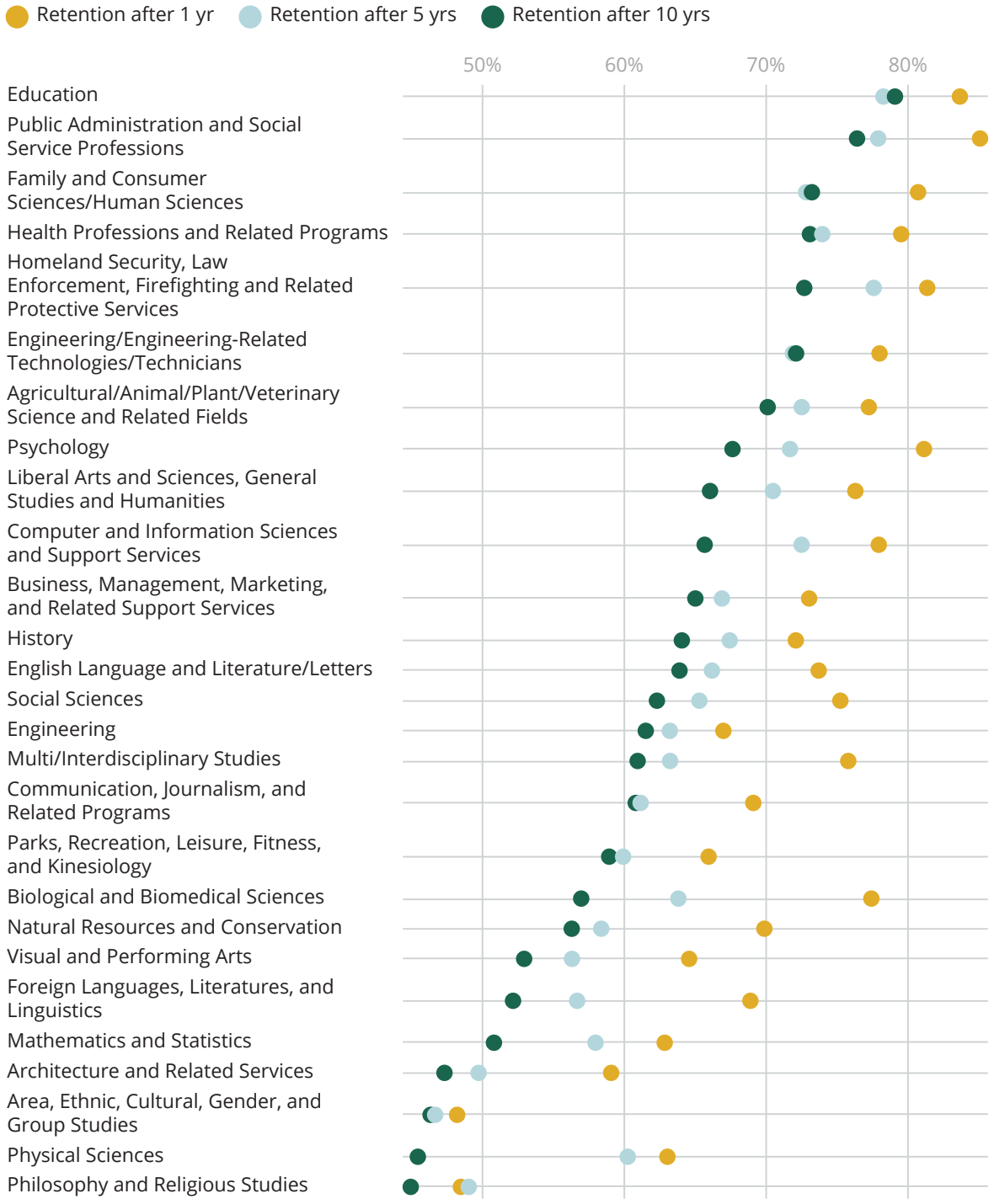

Chart: Economic Innovation Group. Source: PSEO

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At the associate's degree level, Ohio's retention rate in technical fields is generally better, though still lower in STEM fields than in others. Notably, 78 percent of engineering technician graduates remain in-state ten years after earning their associate's degree.

In-state retention rates in Ohio, by PhD (research) field

Fields with at least 100 trackd graduates

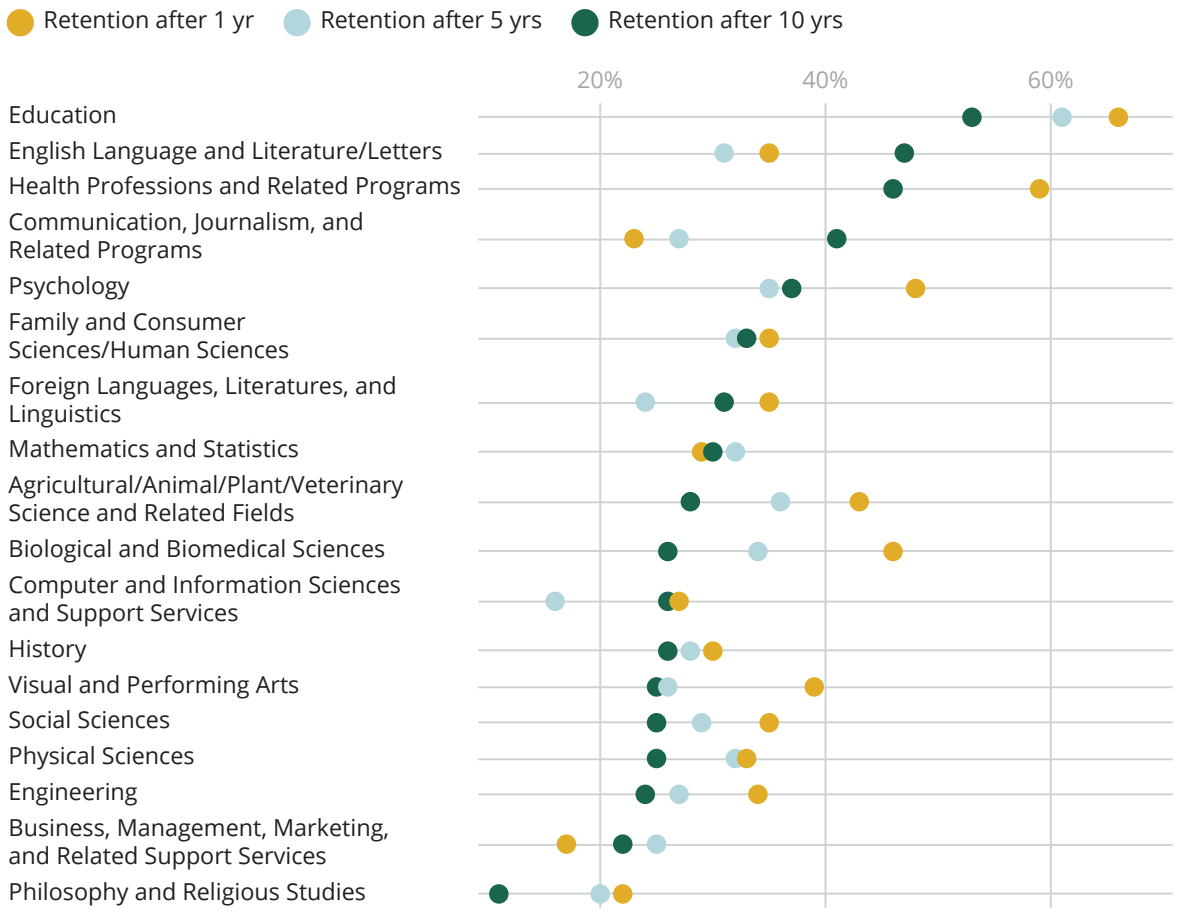

Chart: Economic Innovation Group. Source: PSEO

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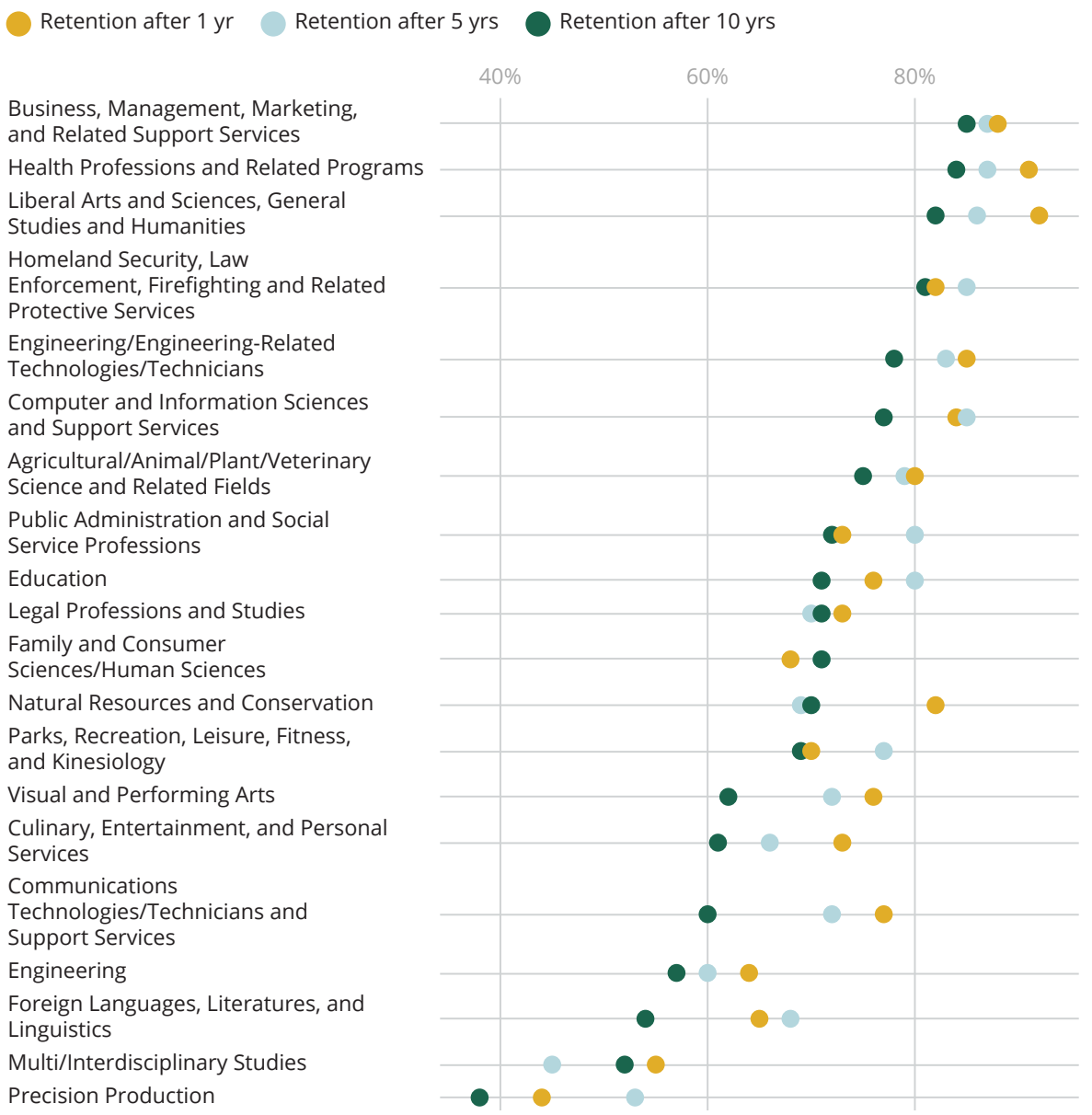
In-state retention rates in Ohio, by associates degree field

Majors with at least 500 tracked graduates



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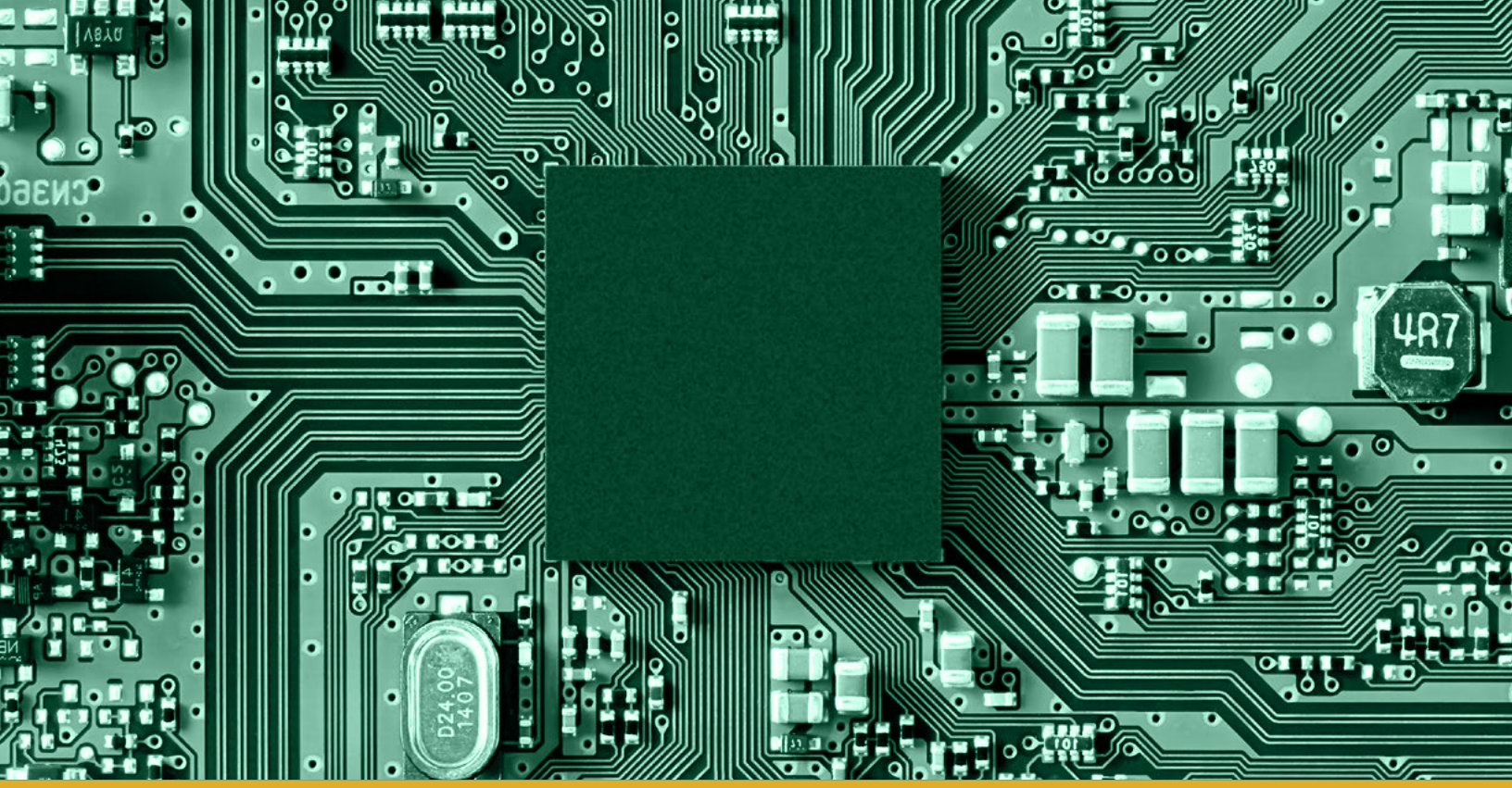

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The Economic Innovation Group (EIG) is a bipartisan public policy organization dedicated to forging a more dynamic and inclusive American economy. Headquartered in Washington, DC, EIG produces nationally-recognized research and works with policymakers to develop ideas that empower workers, entrepreneurs, and communities.

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