Growing Cities that Work for All

A Capability-Based Approach to Regional Economic Competitiveness

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Executive summary

The United States has posted more than 100 consecutive months of net job gains since the economic recovery began in 2010, making this the longest expansion in seven decades. Yet, for many, wage growth has lagged, leaving many families economically insecure. Meanwhile, job and economic growth continue to accrue in select corners of the nation, leading to disparate economic and social outcomes across the country.

This uneven progress reflects, in part, a nation grappling with an accelerating pace of change. Powerful new technologies have enhanced people's and firms' ability to achieve unprecedented productivity and have made the global economy more interconnected than ever. At the same time, these forces are making some skills and knowledge obsolete. As demand for specific knowledge and skills rises, the people and places that can meet these demands thrive, while others lose ground.

Communities throughout the United States must find new solutions that address rapid transformation of industries and the labor force. Systems and institutions that helped foster inclusive economic growth and prosperity in the past century, like higher education, workforce development, and social policy, have struggled to adapt to today's circumstances. Work-based benefit and safety net programs are ill-equipped for a labor market in which people will have many careers, and where work is increasingly organized around short-term assignments rather than traditional jobs. Worker retraining and adjustment programs are often not linked to employment opportunities. Economic development plans often involve tax incentives for industries that may not be strategic. To pay for such incentives, metro or regional officials must often draw from funds that could otherwise be spent on public goods. Meanwhile, top-down federal programs are unable to respond to communities' unique challenges and opportunities.

To address this and help people adapt, local government and business leaders should pursue the following objectives:

1. **Grow their local economies.** Growth increases opportunities for work, ensures efficient labor market matching, and spurs wage growth. How local economies grow matters, as not all industries are equal. Fostering complex industries that take advantage of existing capabilities in a local economy, while upgrading them, can accelerate growth and industry diversification.

2. **Help workers adapt to the fast-changing demands of today's labor market.** Local employers and intermediaries should assess how displaced workers' skill sets differ from those required by in-demand occupations, fill the gaps, and seek to connect these workers to jobs. Making growth work for all will involve creating a lifelong learning infrastructure that is responsive to the new skills required and that meets workers where they are.

3. **Enable local systems and institutions to increase economic mobility and opportunity for all.** Increasing job quality and upward mobility for all requires firms paying higher wages and offering meaningful employment. But it also depends on access to affordable housing, efficient transportation, convenient childcare, and benefits—all factors that make workers more productive and firms more resilient. The task of creating a new institutional scaffolding to address these needs as low-skill work proliferates falls to regional policymakers, who can respond to specific challenges unique to each locale.

Introducing the Workforce of the Future initiative: Applying a complexity lens to U.S. cities

The Brookings Institution's Workforce of the Future initiative aims to inform cities as they pursue the above objectives. This report primarily focuses on the first objective: informing cities' growth agendas by identifying industries in each metropolitan area that offer viable and effective paths toward accelerated growth.

Our analysis uses the empirical insights of economic complexity, which focuses on the capabilities required for industries to emerge and on pathways to strategically diversify a city's industrial base. This approach provides a unique assessment of each city's capabilities to host new industries and each industry's propensity to spur growth. We find that our data-driven metrics of city and industry complexity, which have proven predictive at the country level,[1] also predict growth at the city level. Through our metrics, policymakers can anticipate the future needs of their city as they strive for more inclusive growth.

The report outlines four cities' industrial choices. These options are proposed in the context of transformational trends, such as the rise of automation and the proliferation of contract work—shifts that require a re-prioritization of policies to help people adapt. We emphasize industries that offer good jobs—those that provide living wages and benefits.

Policymakers around the country face similar challenges as they strive to lure expanding businesses or retain local industries, but they require tailored, location-specific solutions. Using an economic complexity lens, our methodology provides a map for investing in keystone industries that are both viable and foster future growth.

Guide to the report

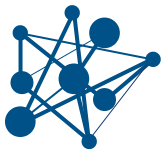
Our research aims to provide insights to local leaders on how the rapidly changing economy is reshaping communities' distinct advantages and opportunities. Because this plays out differently depending on the unique mix of industries in each city, and the implicit capabilities they depend on, each community needs to chart its own tailored strategies toward growth. We propose a framework for regions to grow good jobs through capability-based industrial development strategies where firms specify the inputs they need to be productive and cities become more resilient and attractive as they invest in those inputs.

The main objectives of this report are to:

1. Review the main underlying causes of structural change in the national labor market—from automation to digitalization to global competition—and the nature of the policy responses to date in addressing these challenges.
2. Propose a tailored approach to helping policymakers and companies bring economic growth to their regions by applying data-driven network analytics to reveal industry and city growth patterns within the U.S.
3. Demonstrate how the network analytics approach can inform local economic development strategies that foster growth and good jobs through four city-specific case studies: Nashville, TN; St. Louis, MO; South Bend, IN; and Boise, ID.

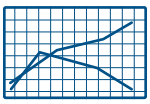
There are complementary resources to this report, including an online visualization found at: www.brookings.edu/product/future-of-the-workforce-initiative that will feature the results of this report and continued city level research. There is also a technical paper that describes the methodologies used in this report in more detail titled "Economic complexity and technological relatedness: Findings for American cities," which is available at the same site.

This work points to the following key policy insights:



Increase complexity of industrial composition. We find that economic complexity is correlated with urban success. *To grow and attract complex industries, focus on building capabilities.* Cities can chart a path to growth through strategic diversification of industry.

Identify industries that maximize feasibility and strategic gain. Often there is a tradeoff between industries that are feasible and those that offer the most potential growth. To chart a growth strategy, industrial development efforts should *consider both the ability of a city to host an industry, as well as the strategic value of that industry.*



Prepare for industrial growth and decline. Using our research to anticipate the growth and decline of industries, a city can *prepare for occupations that will be in demand by upskilling existing workers and attracting others* with existing skill sets. Understanding which industries are expected to contract will allow workers and cities to prepare.

Focus on capabilities in order to grow and attract industries. Although tax incentives may attract firms, they do not develop capabilities. Rather than engage in a race to the bottom, cities should *prioritize worker skills and infrastructure over tax incentives.* These efforts should be tailored to the specific requirements an industry needs to be successful.

Ensure growth industries fit local workforce skills and provide upward mobility. *Target industries that match a city's workforce skills, pay well, and offer worker benefits.* Foster entrepreneurial activity to enhance upward mobility by building a diverse economy with numerous complementary capabilities.

Develop institutional foundations for inclusive growth. *Offer affordable housing, lower commuting cost and time, and provide support and benefits that are linked to workers*, not just jobs. Support wage subsidies and other related policies which are good for both sides of the labor market.

State of the workforce

Sustained economic growth is a prerequisite for prosperous societies. Yet economic growth alone is not sufficient to deliver inclusive growth. By most measures, the U.S. economy has recovered from the Great Recession of 2007 to 2009 and experienced one of the longest job growth expansions in the nation's history, as shown in Figure 1. Major stock indices returned to their pre-recession levels in 2012 and coincided with the recovery of workers' median wage.[2] By 2017, the unemployment rate had reached 3.7 percent—its lowest level in the past few decades.[3] However, these aggregate trends mask distress in the U.S. labor market and the fact that many Americans are being left behind despite the current economic expansion.

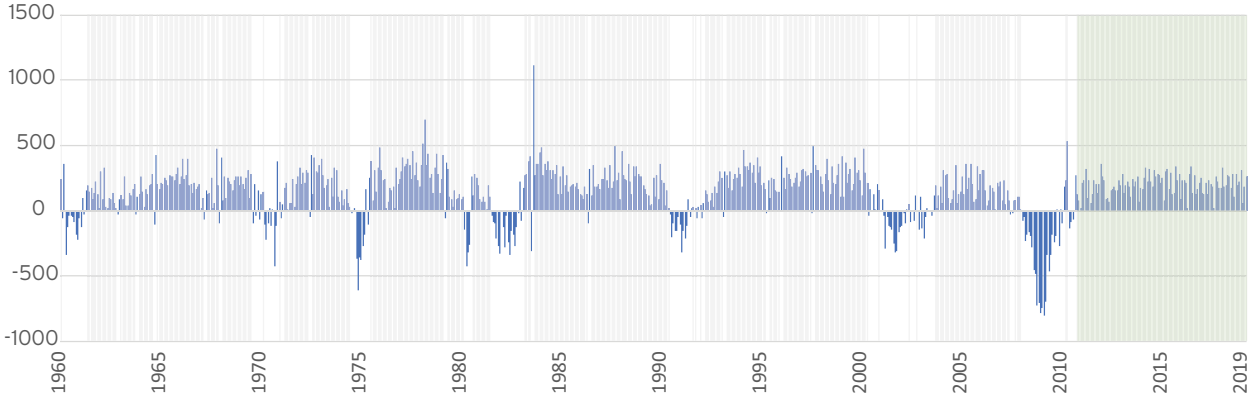
The nation's labor force participation rate—the share of the population over the age of 16 participating in the labor market—declined over the past 20 years. It stabilized recently but shows only marginal signs of recovery.[4] Fewer people are working, and for shorter time periods. For men, the decline in labor force participation started in the 1950s and was most precipitous among those without a high school diploma (see Figure 2). This points to structural changes in the economy, where people with fewer skills are increasingly discouraged from the labor market. There is also less entrepreneurial activity measured by new firm formation, and an overall drop in labor market fluidity.[5]

These trends are threatening one of the most potent mechanisms for sustaining economic growth: a thriving middle class. The ranks of the middle class have fallen in 203 of 229 metro areas since 2000.[6] According to Pew research, middle-income Americans make up a smaller fraction of households, and they also earn a smaller share of aggregate income.[7] Over the last decade job growth has been predominately in low-wage

FIGURE 1

Job change

Month to month, 1960-2019, in thousands

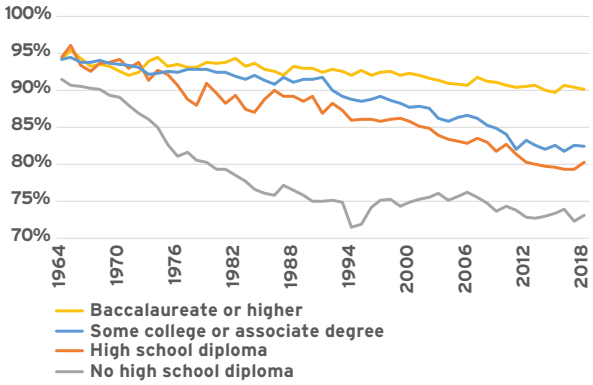


Note: Gray areas represent consecutive month-over-month job growth.
Source: U.S. Bureau of Labor Statistics

FIGURE 2

Labor force participation rate

Men aged 25-54, 1964-2018



Note: The labor force participation rate has been declining among working-age men since 1964. The drop has been most precipitous among those with little education.
Source: U.S. Census Bureau, Current Population Survey

industry sectors (see figure 3).[8] People with a bachelor's degree have seen their wages grow, but those without a four-year degree have seen their wages fall as compensation in many mid-skilled occupations have declined, even as the number of jobs has grown.

Quality of work and opportunity

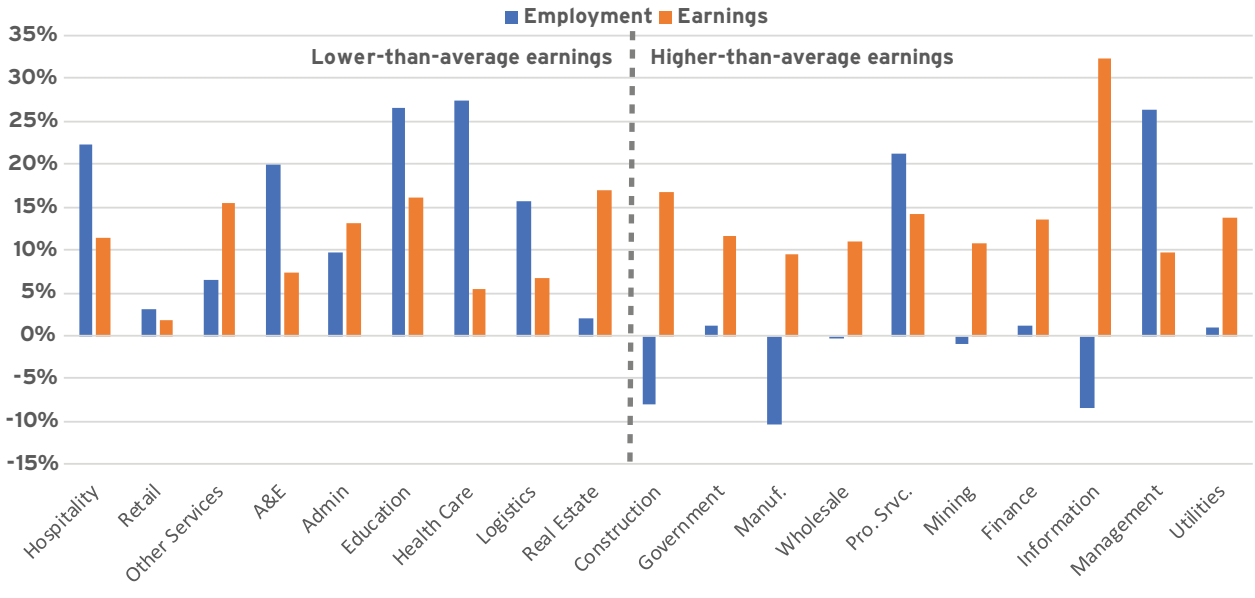
For many workers in low- or middle-paid occupations, wages, benefits, and hours have declined in recent years as their income volatility has risen. Employer-sponsored health insurance from 1999 to 2014, for example, became less common overall, and the drop has been most precipitous for those with low and modest income.[9] Low-wage jobs, such as those in retail or hospitality sectors, which are often the entry point for many young workers, provide fewer on-ramps to higher paid jobs.[10] Workers in these sectors often have unpredictable schedules and low chance of promotion.[11]

Contract work is also on the rise. While some workers may prefer the flexibility of contract

FIGURE 3

Percent change in employment and earnings by sector

United States, 2006-2017



Source: U.S. Bureau of Labor Statistics and Emsi estimates

work, for about 30 percent of contract workers, such work arrangements are a necessity, not a preference, according to the consultancy McKinsey and Company.[12] For many, contract work brings financial precariousness and a lack of benefits historically associated with work: health care, training, and a career path. Meanwhile, although "gig work" is difficult to define, there is no doubt it is growing.[13] By one definition that includes various types of alternative arrangements, 40 percent of employed workers in 2010 were involved in contingent work.[14]

Regional divergence

As the work and wages of people have diverged, so have the economic trajectories of the places where they live. Since the end of the Great Recession in 2009, the nation's more populous metropolitan regions have grown faster in terms of jobs, economic output (gross metropolitan product or GMP), labor productivity,[15] and population as compared to cities with smaller populations.[16] Bigger metro areas also experienced smaller declines in labor force participation rates.[17]

The roots of this economic divergence between places began in the 1980s, when the digital age reversed a long-running trend of economic convergence.[18] The digital age put a new premium on highly skilled, educated people and enterprises able to engage new technologies and ideas in skilled cities.[19] But rather than decreasing the costs of distance as expected, digital technologies increased the value of proximity. Skilled people flocked to cities with the industries and amenities that enabled them to be most productive, often driving up housing costs in many places and locking out lower paid workers.[20] The result for low-skilled workers was less economic opportunity in dense cities, places that had previously offered higher wages.[21]

Forces behind uneven growth

The present technological revolution, driven by innovative combinations of digital technologies, is notable for its rapid pace, creating both opportunity but also diverse sources of pressure for workers. The unprecedented pace matters to institutions and especially education systems, all which must acquire a new nimbleness to help people adapt.

A mix of more disaggregated supply chains and automation affect low-skilled occupations. Fierce global competition and improved logistical capabilities have led companies to optimize and disaggregate their supply chains, leading to the dislocation of factories and jobs. Some jobs and industries have been affected more than others, driving economic divergence among cities and workers.[22] The occupations that are most likely to be shipped abroad are those that are repetitive and routine. These same jobs have been susceptible to automation, as repetitive tasks are easier to code into algorithms.[23]

As automation transforms the nature of work, predictions abound regarding whether the phenomenon will result in a net increase or decrease of jobs. However, some trends are already clear: many jobs are becoming redundant, while for many more the composition of tasks are shifting. The jobs that are automating fastest are predominantly low-wage and typically require few skills; thus, their disappearance disproportionately affects less skilled workers. Research further relates the probability of automation to average education—more educated places face less risk.[24] Automation can help reimagine work, diminish repetitive, rote tasks, and dramatically improve the quality of jobs. But to do so in a way that minimizes social disruption, automation will need to be accompanied by massive retraining programs (see Box 1).

Trade, technology, and automation are all bringing unprecedented prosperity around the world. The real challenge is not these forces, but to help workers transition to the changing competitive landscape and to adapt our institutional scaffolding that has not evolved to respond. Addressing these forces requires targeted responses, many of which will be specific to place.

Box 1: The promise of automation

Automation covers a wide array of technological adoption—from robots in manufacturing assembly lines to Robotics Process Automation (RPA) coupled with smart analytics and artificial intelligence. Adoption in the RPA subsector pertains to the proliferation of bots. Bots serve as digital workers, taking on repetitive, process-oriented tasks through the use of programmable algorithms. The automation industry is growing by leaps and bounds, projected to grow from about $400 million in 2015 to $3.1 billion by 2025.[25] When workers hear their firm is considering an automation initiative, there is instant concern, particularly among frontline, customer-facing workers, that such initiatives will cost them their jobs. For early automation adopters, the main allure is the potential for savings. Yet the real promise of automation for human progress will come from firms that plan beyond cost-cutting. Automation will undoubtedly lead to redundancies—especially in the business process outsourcing (BPO) industry and with respect to call centers, legal secretaries, and other routine functions. Indeed, job losses in these areas have happened already.

Yet companies and workers that embrace automation as a key ingredient to creating better jobs are bound to benefit both their bottom line and society. What makes many jobs bad is not just a low wage, but the disempowerment of workers. They lack agency and have limited scope to apply uniquely human skills such as creativity, empathy, and complex problem solving. Today, only 4 percent of jobs require creativity as one of their required skills.[26] Robots can now monitor supermarket aisles for items that are misplaced, mispriced, or in need of restocking. Bots can enter data, send invoices, and reconcile payroll—tasks few people will miss undertaking. The promise of automation to liberate workers from menial, repetitive, soul-crushing tasks will only be possible if we invest in humans, so they can effectively work alongside bots in ways that make their jobs more productive and rewarding. Companies need to help workers make that transition. If automation initiatives are not coupled with resources to train workers to become programmers, process designers, algorithm architects, and so on, workers' resistance to automation may harden. By shortchanging training, companies will miss out on the potential for automation to transform their companies and the nature of work for the better.

Policy responses

Policymakers at all levels of government have sought to ameliorate the growing divergence between people and places by various means. At the federal level, the lackluster performance of worker-retraining and trade-adjustment assistance programs has given way to an array of far more ambitious policy proposals—from vast expansions of the social safety net to short-sighted limits on global flows of trade and talent. Federal policymakers are at odds over whether to enact such ambitious policies and how they might affect each place differently. Meanwhile, in the absence of progress or direction from federal policymakers, states and local government have advanced more incremental approaches.

Many jurisdictions have policies aimed at counteracting structural shifts in their labor markets, such as reforms to make low-wage and "gig" work more financially stable, as well as to increase worker mobility. For example, the state of Oregon, the District of Columbia, Chicago, New York City, San Francisco, and San Jose passed laws that make work and income more predictable for low-wage contingent workers. California, Illinois, New Hampshire, New Jersey, Utah, and Vermont have banned or curtailed the use of non-compete clauses that limit workers' job mobility. In the absence of a federal minimum wage law, some states and localities have raised minimum wages. In 2019 alone, 13 states and the District of Columbia will raise their minimum wage, and many others will adopt legally mandated cost-of-living

adjustments. Furthermore, the cities of Berkeley, Chicago, Flagstaff, Los Angeles, Minneapolis, St. Paul, San Diego, San Francisco, San Jose, Santa Fe, Seattle, and Tacoma will also adopt minimum wages that exceed state minimums.

States have also sought to help individuals gain the skills and abilities they need to adapt and thrive in today's labor market, taking meaningful steps to reform and expand access to education and training programs. Newly elected governors in several states have pledged to expand early childhood education, which can better prepare children for a lifetime of learning. Maryland has sought to improve on-ramps from high school to career and technical programs, giving students a range of options for post-secondary education. Arkansas, Minnesota, New York, Oregon, Rhode Island, South Dakota, and Tennessee have all made community college free for some, if not all, students.

These provisions around improving job quality, access, and the affordability and effectiveness of educational institutions have proven promising in the states and localities where they have been adopted.[27] Despite warnings about the tradeoffs involved in raising wage floors or other worker protection regulations, many jurisdictions that have enacted such provisions have not seen declines in job growth or employment rates.[28, 29]

Effectiveness of these policies, and others being considered, depends on the specific challenges faced by each city. As technology and globalization continue to reshape industries and occupations, and as the nation's baby boomers retire, local leaders need strategies to both increase the supply of talented workers and the jobs that demand them. Growth should remain a priority for most regional economies. State and local investments in human capital that support more resilient and inclusive labor markets must be paired with growth strategies that create more opportunity for individuals. This supply and demand for talent will interact differently depending on the nature of the workforce and industries present in a given location.

Yet, too often, leaders in states and localities still work from essentially the same race to the bottom playbook they have used for decades. States compete to attract business by offering low wages, weak unions, and scant regulation. In terms of local economic development strategies, business climate reforms and tax incentives continue to be the two most common tactics.

Though these tactics remain popular with key policymakers, decades of evidence suggest they are largely ineffective for spurring growth, let alone inclusive growth. Economists have shown that these tools are often used to lower the tax bill for companies that would have added or relocated jobs in the jurisdiction anyway.[30] Thus, governments pay for investment and jobs without receiving the revenue they need to service the associated growth. This often creates a backlash against growth, and a decreased capacity to invest in the capabilities that will attract additional complex industries. Though tax incentive provisions are getting stricter, in the past jurisdictions have also often subsidized low-quality jobs that do little to enhance opportunities for individuals.[31] Most of the economic value of incentives is instead captured by business owners and a few highly paid employees rather than lower-paid or out-of-work residents.[32] The use of taxes and incentives has also been reactive and indiscriminate, extolling job growth even when it occurs in industries that do little to enhance overall competitiveness of the local economy.[33] Economists have shown that lowering taxes or handing out incentives has among the smallest marginal effects on local job and wage growth compared to alternative uses of those monies, especially if they are paid for by cutting spending on education.[34]

Furthermore, recent controversies and economic development failures involving the use of tax incentives speak to the public's growing impatience with these tools during a time of increasing economic inequality and regional divergence:

- In Wisconsin, the state has committed to an unprecedented, multi-billion-dollar incentive package for a Foxconn plant that was to bring thousands of jobs for middle- and low-skilled workers. However, Foxconn's changing plans now envision far fewer jobs, and primarily for high-skilled engineers—a shift that economists estimate will make it impossible for the state to ever recoup these incentives.[35] The deal will likely turn out to be nonstrategic for both sides. Foxconn may have a hard time recruiting skilled engineers where few already exist, and the state will have paid dearly to create jobs that may be hard to sustain without parallel investments in building and attracting talent.

- Meanwhile, the contest for Amazon's second headquarters and the backlash against the company reveal corporations' shifting preferences in their location decisions and the public's skepticism surrounding them. After an 18-month search process, Amazon chose to locate in Northern Virginia and Long Island City despite better financial offers from communities around the country and even in each of these two regions. Amazon chose Northern Virginia, where officials offered tailored talent development packages to the company and menial tax incentives, over suburban Maryland, where officials had offered more than $8 billion in incentives. In Long Island City, the company accepted—before turning down—around $3 billion in incentives over a $6 billion package offered by the state of New Jersey for a location in Newark.

In Amazon's case, the company made its location decision based on the talent it could tap and the non-financial support it could receive from local government and institutions, which it wagered to be far more valuable than the billions more in incentives it could have garnered from communities just a stone's throw away.

Both examples show how the public is increasingly at odds with political leaders and decisionmakers on such deals. Despite securing an economic development deal with one of the largest technology manufacturers in the world, Wisconsin's governor lost his reelection bid in the fall of 2018 to an opponent who promised to reverse the Foxconn deal. In New York, Amazon pulled out of its deal with the city and state after community opposition to the governments' multi-billion dollar offer to the company.

Although these two high-profile examples may seem exceptional, many such deals are under increasing public scrutiny. Communities are therefore taking a far more serious look at how they can spur economic and job growth not through subsidy tactics, but through strategic investments in local technological capabilities, talent, and infrastructure.

New strategies for inclusive growth

State and local jurisdictions can hardly afford to continue the status quo. Although state and local policymakers prove time and again to be among the nation's most innovative but pragmatic leaders, they must often work with limited resources that do not match the scale of the challenges with which they must contend. Today, global economic forces and federal inaction are forcing leaders and the institutions that support them to not only put forward new, more effective policies that address the flagging trends in their communities, but policies that are mutually reinforcing: more strategic and targeted investments in transformative economic growth, human capital to support it, and policies to ensure that workers truly benefit.

Local government and business leaders generally must work toward achieving three broad objectives to help people more effectively adapt to the changing nature of work:

- **Grow their local economies.** Growth increases opportunities for work, ensures efficient labor market matching, and spurs wage growth. How local economies grow matters, as not all industries are equal. Fostering complex industries that take advantage of

existing capabilities in a local economy, while upgrading them, can accelerate growth and industry diversification.

- **Help workers adapt to the fast-changing demands of today's labor market**. Local employers and intermediaries should assess how displaced workers' skill sets differ from those required by in-demand occupations, fill the gaps, and seek to connect these workers to jobs. Making growth work for all will involve creating a lifelong learning infrastructure that is responsive to the new skills required and that meets workers where they are.

- **Enable local systems and institutions to increase economic mobility and opportunity for all**. Increasing job quality and upward mobility for all requires firms paying higher wages and offering meaningful employment. But it also depends on access to affordable housing, efficient transportation, convenient childcare, and benefits—all factors that make workers more productive and firms more resilient. The task of creating a new institutional scaffolding to address these needs as low-skill work proliferates falls to regional policymakers, who can respond to specific challenges unique to each locale.

This report uses the methods of economic complexity to address the first of these three boxes: helping cities grow and increase the share of good jobs.

As policymakers around the country face similar challenges as they strive to lure expanding businesses or retain local industries, they require tailored, location-specific solutions. To attract businesses or retain local industries, cities often offer incentives such as tax credits or workforce training. However, not every business or industry is right for these incentives. Considering the tradeoffs and opportunity costs that incentives impose, they are often not worth their benefit. Meanwhile, many recent economic development projects across the nation, including Amazon's search for a location for its second headquarters, have shown that firms value specific investments in talent and local capabilities more than direct financial benefits.

Our methodology provides a map for investing in keystone industries that are both viable

Three broad objectives to foster inclusive growth

and foster future growth. Equipped with an understanding of which industries are likely to grow or decline, our findings can help leaders make strategic decisions about their cities' growth and identify the gaps in skills and the required complementary inputs required to successfully host increasingly complex industries. Such a detailed understanding of local capabilities can help companies too. Choosing locations to set up new subsidiaries involves weighing many inputs, including access to local markets, availability of talent, and other capabilities that are hard to measure. Our methods can facilitate more efficient matching between firms and cities based on those specific inputs required for an industry to succeed.

Our work seeks to show the challenges that many cities and working-class families face as the nature of work has shifted, along with the choices that cities must make in the hopes of driving growth. The methodology frames and informs these choices based on a city's specific industries and worker composition. We answer questions such as:

- What industries are likely to grow and contract in my city?
- Which industries are most attractive in terms of accelerating growth and providing better jobs for my population?
- Which industries share complementary inputs (such as human capital and skills) that will strengthen a city's capacity to host new industries?

The goal of this work is to provide a map for city leaders, companies, and skill-building organizations as they navigate the shifting economic landscape to create better opportunities for workers. We do not intend for this report's findings to predict the future or provide an exact prescription for specific metropolitan areas. Rather, the findings offer a 21st century dashboard to help generate local and regional growth strategies for industries with the greatest promise to achieve inclusive growth: those that fit the capabilities of the city and its workforce, and those that provide good jobs.

Economic complexity

A society's ability to produce various goods and services drives economic development. Growth arises from the process of acquiring capabilities to produce new and better products and services. These capabilities come in different shapes and forms; they include increasing the specialized knowledge of workers, developing public goods and services, such as roads, ports, and efficient customs processes, and many other specific inputs depending on the industry. Societies, firms, and entrepreneurs organize these varied capabilities to make products and services. The more capabilities a society can host and combine, the greater the variety and complexity of the products and services it will be able to make, accelerating its economic growth.

Therefore, in contrast to the classical economic prediction that countries should specialize according to their comparative advantages, we observe that countries that diversify into increasingly complex categories of products and services enjoy higher incomes per capita. Diversification, which is the desirable outcome of an expanding set of societal capabilities, thus becomes a policy goal. Building new capabilities and spurring economic activity is a core task for policymakers and companies seeking to grow. Our research informs these goals and helps metro areas pursue a diversification strategy that accelerates growth while creating opportunities for workers.

Economic complexity is a way to describe and measure the growth process using the concept of capabilities. While some capabilities are general and positively influence the business environment, such as a well-educated workforce, functioning roads, reliable electric grids, or rule of law, others are specific to each business. Boeing's production of an airplane requires not only the raw materials, the labor, and the machinery to assemble aircraft, but also explicit knowledge at each stage of production as inputs combine along the value chain. Production requires both general and specific capabilities. The coordination behind the buildout of these capabilities—many of which include both private and public inputs—forms the foundation of successful diversification strategies.

The intuition that the accumulation of capabilities leads to growth is behind the economic complexity methodology and the implications for which industries cities should try to attract. A key contribution by Ricardo Hausmann and the research from Harvard's Center for International Development (CID) was defining a measure for each country's capability endowment as embedded in their observable exports.[36] The Economic Complexity Index (ECI) measures the unobserved stock of capabilities in an economy using the diversity and ubiquity of the products that a country exports (see Box 2). Capability-rich countries should be able to make many products and services, including those that are difficult for capability-poor countries to make. Harvard's CID found that their ECI "is a much stronger predictor of growth than other commonly used indicators that measure human capital, governance, or competitiveness."[37] At the national level, research on economic complexity showed that countries grow by both diversifying their industry mix and by moving into increasingly complex products.

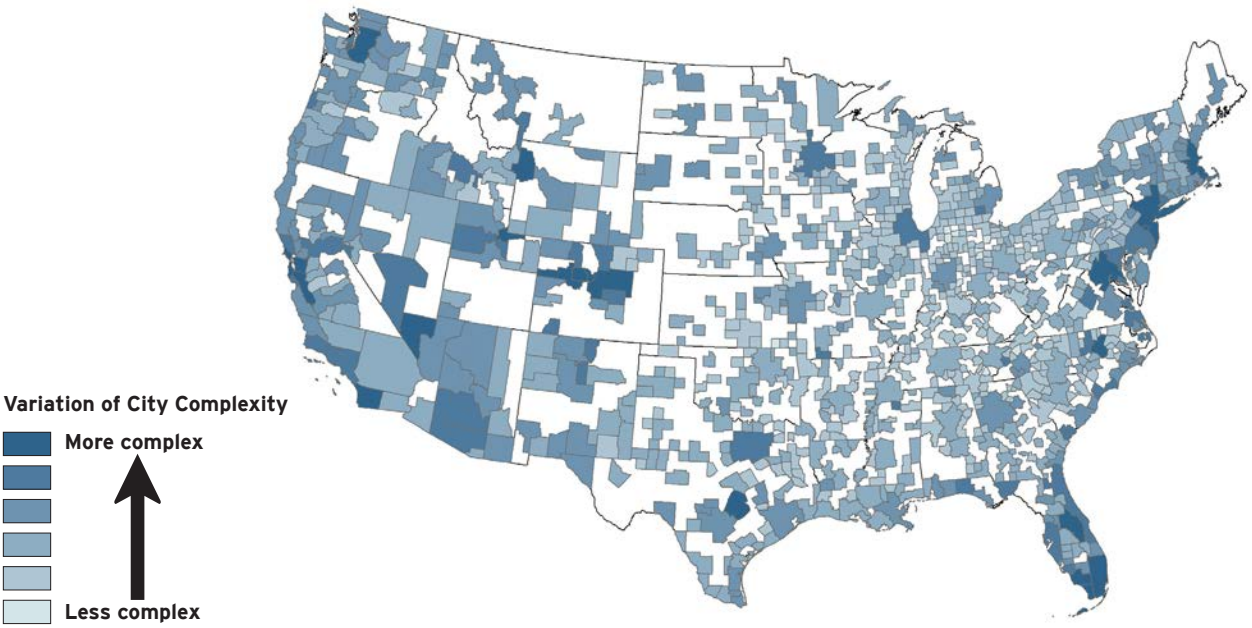
Findings

Complexity in metro areas

In this report, we build on the data-driven approach pioneered at Harvard in an international setting and apply it to the economic complexity of metro areas in the United States. The methodology and results are detailed in a related technical

FIGURE 4

Economic complexity of metro and micropolitan areas within the United States



Note: Figure 4 shows the variation in complexity across the country. More complex regions tend to be more prosperous and more populated. Controlling for relevant variables, complex regions also tend to grow faster.
Source: Authors' analysis

paper "Economic complexity and technological relatedness: Findings for American cities." Box 2 on the next page offers some basic complexity definitions.

Workers within the U.S. are geographically mobile and can relocate to seek new opportunities and do not face the same friction as workers moving between countries. Urban economists refer to the equalizing of real wages due to geographic labor mobility as "spatial equilibrium."

For our analysis, spatial equilibrium has two implications: 1) When predicting economic growth, we use population growth as a measure of metro area success instead of Gross Metropolitan Product (GMP) per capita, since workers will move to places where opportunity exists. Note spatial equilibrium does not imply policy should orient toward population growth, only that change in returns to productivity are often reflected in changes in population; 2) When testing the correlation between complexity and wealth, we control for population size, which removes the effects of past economic gains.[38]

Our first finding is that, as in the Harvard findings, economic complexity is positively correlated with median income, per capita GMP, labor productivity, and population. By any measure, more complex metro areas are more successful. This relationship is still robust when controlling for population, demography, education, income, and other factors.

Second, a metro area's ECI is a good predictor of growth, which we capture using population. In our most detailed analysis, which controls for baseline productivity, education, demography, population, population density, and income, we show that having high ECI is associated with higher subsequent population growth in U.S. metro areas. The measure's predictive power is robust to out-of-sample statistical tests.

Finally, we find that the effect of ECI is stronger among small metro areas. This finding suggests that smaller cities stand to gain more from developing complex industries, although further research is needed to confirm that this is the case.

Increasing complexity through strategic diversification

Despite meaningful differences between metropolitan and country growth processes, our finding that economic complexity predicts population growth suggests that, as in the case of countries, metro areas should try to diversify into complex economic sectors that can help lock in important productive capabilities. Pathways to growth are unique and specific to each metro area depending on the stock of existing industries and embedded capabilities. The policy implication is that the appearance of one industry is largely determined by the presence of another. This is referred to as "path dependence."

To some extent, all metro areas face a chicken-and-egg problem in the pursuit of industrial development and diversification: Metro areas cannot grow or attract advanced industries because they lack the necessary capabilities, but they have no incentive to build these capabilities because no local industry demands them. The key insight from Harvard's research, which we validate in the sub-national setting, is that countries diversify toward sectors that rely on similar capabilities and that are already locally available. This occurs because industries that can add new capabilities to an economy seek to maximize overlap with the available capabilities in a metro area. In doing so, they extend the metro area's capability set.

This raises an important question for policies to boost local productivity and growth: which industries add capabilities to a metro area's economy that are most valuable? The industries that pose the greatest potential for increasing local economic complexity are unique to each metro area. By analyzing the historical industrial diversification paths of all metro areas, we can determine how the presence of some industries determine the emergence of others.

To answer the question on which industries are most valuable in the international context, the Harvard CID team developed the "Product Space," a network that measures the distance between two products by the likelihood that they tend to be exports of the same country.[39] The tendency for two products to be exported by the same country is an implicit measure of the overlap in their capability requirements: if there is a high tendency to cluster between a pair of products, such as pants and shirts or computer

Box 2: Defining economic complexity

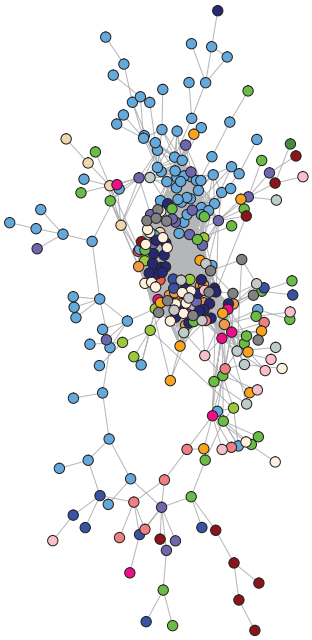
The **Industry Complexity Index** (ICI) is a metric that describes industries and their implicit capability requirements. The ICI is based on the industry's ubiquity and whether it is present in cities with a diverse composition of other industries. Complex industries, such as computer systems design, concentrate only in a few cities that possess all the required capabilities.

To mitigate distortions in our complexity measure caused by industries that are rare (not ubiquitous) but are not necessarily complex, such as metal ore mining, we measure not only the complexity of an industry using its ubiquity, but also the industrial diversity of the host cities. Thus, only industries that are rare and produced by cities that are industrially diverse will be complex.

The **Economic Complexity Index** (ECI) is a metric that describes cities and their implicit capabilities by the complexity of the industries it hosts. Cities with more capabilities are able to develop a more diversified set of products and services.

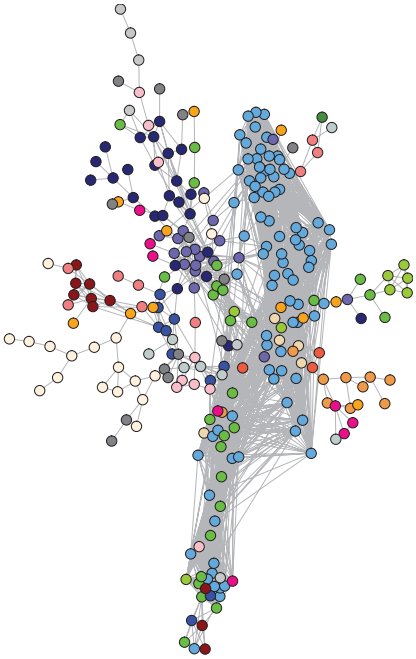
FIGURES 5 and 6

The Industry Space by industrial co-location



The Industry Space above shows the implicit relatedness of one industry to another. The distance between the nodes is determined by the tendency for any two industries to appear in the same city.

The Industry Space by occupational similarity



The Industry Space above shows the explicit relatedness of one industry to another. The distance between the nodes is determined by the tendency of different industries to employ the same composition of workers.

- Agriculture, Forestry, Fishing and Hunting
- Mining, Quarrying, and Oil and Gas Extraction
- Utilities
- Construction
- Manufacturing
- Wholesale Trade
- Retail Trade
- Transportation and Warehousing
- Information
- Finance and Insurance
- Real Estate and Rental and Leasing
- Professional, Scientific, and Technical Studies
- Management of Companies and Enterprises
- Educational Services
- Health Care and Social Assistance
- Arts, Entertainment, and Recreation
- Accommodation and Food Services
- Other Services (except Public Administration

Source: Authors' analysis of Emsi estimates

monitors and televisions, this suggests a country that exports one of the products will likely have the necessary inputs to concentrate in the other.

Similarly, to identify the industries that pose the most promising opportunities to increase local productivity and growth in the context of U.S. metro areas, we developed the "Industry Space" (Figure 5), a network that can be used to visualize the proximity between a given industry and every other industry. It reflects the capabilities shared by industries by measuring their tendency to cluster, or co-locate, in the same metro areas. We produced a second modified "Occupational Industry Space" (Figure 6) based on the tendency of different industries to rely on the same labor force. The distance between two industries in the Industry Space corresponds either to the industries' tendency to co-locate, or to the occupational overlap between industries.

Although both industry spaces can be used to understand the similarity between industries, the difference in their methodology results in different normative applications. The co-location space embeds a metro area's unobserved capabilities, which is what makes it an implicit measure of industrial similarity. This space is relevant when understanding institutional capacities, infrastructure, or other specific capabilities a nascent industry might require. Relatedly, we also know that some industries tend to hire similar workforces. In this sense, we can measure their explicit overlap of an input requirement, labor. The result is an industry space that provides information on the capabilities of

a metro area's existing workforce. Developing economic activities based on these explicit workforce capabilities offers a pathway for metro areas as they pursue strategic growth.

Analysis of the U.S. Industry Spaces yields a "density" measure that represents the implied capability overlap between a given industry and the industries already present in that metro area. The density measure allows us to identify the industries that are close by and thus feasible, given a metro area's existing industries and embedded capabilities.

These measures of density, also referred to as feasibility, lead to a key finding: economies tend to diversify toward sectors that rely on capabilities and occupations similar to the ones they already have (see Box 3 for more). Higher values for density metrics are positively associated with the future success of industries in different metro areas by three measures:

1. Higher growth rates

2. Higher likelihood that absent industries or those with low presence/competitiveness will grow

3. Lower likelihood that existing industries will disappear

These findings have forward-looking predictive power in out-of-sample statistical tests (that is, when observations use data from a different time period than the observations). Thus, our analysis can be used to form predictions on the rise and decline of industries, which can help metro areas understand how to encourage industries to appear and thrive in their environment.

Implications

In addition to "feasibility," it is important to consider how "strategic" an industry is to a metro area. While density indices capture the prospects of an industry's success in every metro area, the relative value of an industry for a given metro area depends on how much complexity that industry would add to the local economy. The amount of overall complexity an industry would add to the local economy corresponds to how well it improves the prospects of other nascent industries by filling capability gaps.

We can evaluate whether a metro area's industrial base is close to complex and well-connected nascent industries, and which of those industries would most improve connections to other such industries. To depict the quality of a metro area's position in the industry space we use a metric we call "strategic index" (SI). In describing the strategic value of different industries for every metro area, we use a metric called "strategic gain" (SG).

For a metro area looking to develop its industrial base, strategic index and strategic gain provide valuable information. To set development plans, policymakers should consider high-feasibility

Box 3: Defining feasibility

Feasibility captures the ability of a city to successfully host an industry. It is calculated using the industry co-location network. We also refer to feasibility as density because the measure can be understood as the concentration of capabilities shared by a given industry with all other industries present in a city.

An industry with high feasibility in a city implies that city possesses the capabilities typically required to successfully host that industry. We choose the implicit measure to calculate density, based on co-location of industries in the upcoming case studies for its theoretical appeal, since it captures the capabilities that are difficult to measure such as social capital or infrastructure that are shared by industries that tend to co-locate.

Box 4: Defining nascent industries, a measure of specialization and revealed comparative advantage

The complexity indices use revealed comparative advantage (RCA), a ratio that measures the competitiveness of an industry in a city relative to the overall size of the industry in the whole country. We call an industry **nascent** if its RCA in a city is less than one, which indicates the industry is underdeveloped in that city in comparison to the rest of the country. Although the word "nascent" conveys signs of future potential, in our analysis it refers specifically to industries with RCAs less than one, which could be either growing or contracting. We say a city has **specialized** in an industry when the RCA is greater than one. Although the threshold may seem somewhat arbitrary, the indices which build on RCA such as feasibility and strategic index, are robust to various specifications.

industries that are close in capabilities to the industrial base of that metro area, together with the strategic gain that would be added to the metro area by hosting that industry.

While some metro areas will have highly feasible, highly strategic industries, others will have no choice but to develop complexity by making long bets on less feasible industries. For metro areas with limited resources and few capabilities, a focused strategy is paramount. Long bets should entail concerted efforts to develop capabilities that give rise to increasingly complex industries. The analytic tools presented in this report allow the reader to assess what the most strategic nascent industries are for a given metro area at every level of feasibility (see Box 4).

To understand the way in which industrial policy should differ among metro areas, we plot in Figure 7 the SI of each metro area against its ECI. As Box 5 explains, the SI is a measure of the potential for a metro area to develop complex industries given existing capabilities. Since metro areas with a higher ECI possess more industries and more capabilities, they necessarily have less potential to add industry, and therefore they tend to have a smaller SI. But, as shown below, for a given level of complexity, metro areas show a variety of SIs. Figure 8 is useful for a first-pass approximation of the growth outlook for a metro area. The position in one of the four quadrants implies different policy prescriptions or approaches.

Box 5: Strategic index and strategic gain

The co-location Industry Space shown in Figure 5 captures implicit similarity in the capability requirements between different pairs of industries. While feasibility captures the similarity between an industry and the present industrial base of a city, the **strategic index** goes a step further by assessing the quality of a city's position in the Industry Space. The strategic index is higher when a city's nascent industries overlap the capabilities required by *other* nascent and complex industries. In a sense, it is a measure of a city's overall potential to grow by developing new industries.

To assess the potential of a particular industry to improve the diversification opportunities of a city, we calculate **strategic gain** of that industry. This captures the potential of a nascent industry to improve the capabilities of a city through that industry's relatedness to more complex industries.

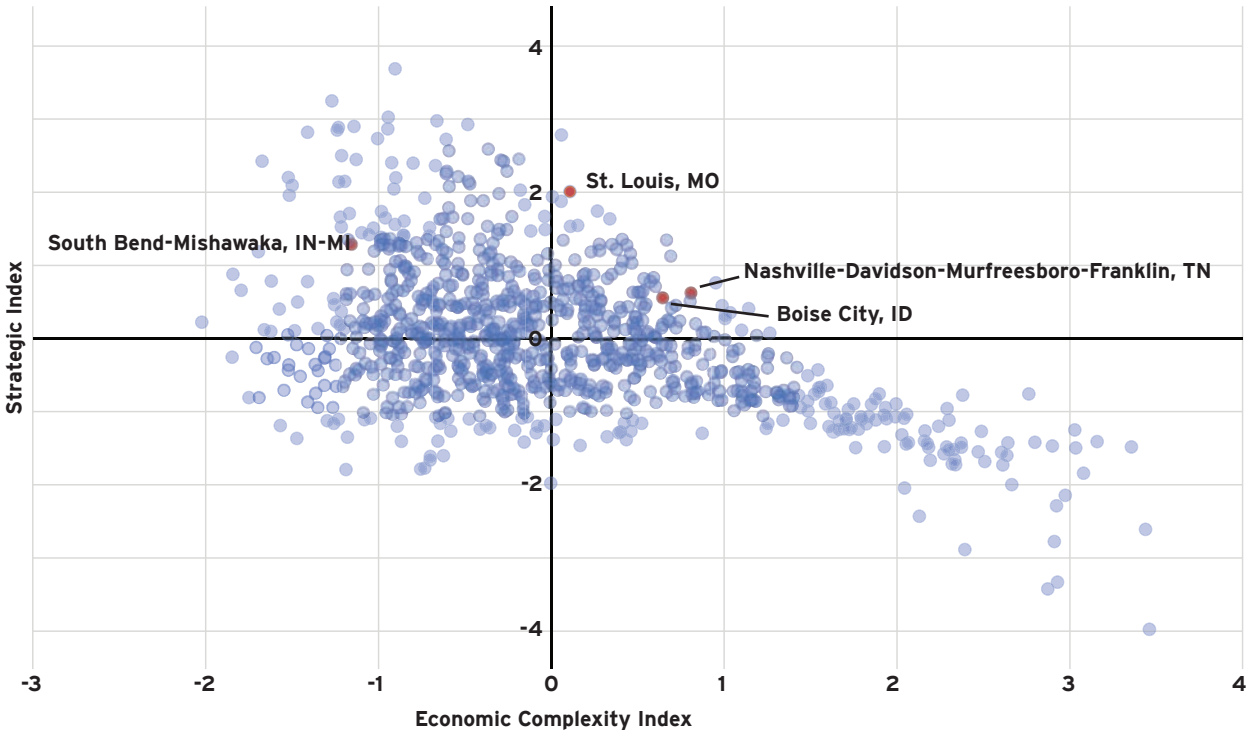
At the city level, strategic index is a measure of a city's overall potential to add attractive industries.

At the industry level, strategic gain is a measure of the potential of a particular industry to add valued capabilities that will be leveraged by *other* attractive industries

FIGURE 7

Complexity and strategy in metropolitan and micropolitan areas

Strategic index versus economic complexity index, 2016



Source: Authors' analysis of Emsi estimates

FIGURE 8

Policy Implications of SI and ECI

Strategic Index \ Economic Complexity Index	Low ECI	High ECI
High SI	Viable opportunities nearby. Although complexity is low, there is opportunity for strategic development into nearby industries.	The most desirable quadrant. These cities are primed for industrial growth and should think about how to prepare.
Low SI	These cities are in the toughest position. They need creative solutions and thoughtful intervention. For them, concerted effort towards strategic industries is paramount.	Complex cities with a low SI tend to be the most developed cities. Their future growth will likely come from growing existing industry or from creating entirely new industries.

Case studies

Decisionmakers in metropolitan areas can use economic complexity to understand local economic performance and design development strategies tailored to their metropolitan area's distinct opportunities and advantages. Here we examine the economic complexity metrics of four metropolitan areas—Boise, Idaho; Nashville, Tennessee; St. Louis, Missouri; and South Bend, Indiana—and what it reveals about each city's recent economic performance and opportunities. We first trace the cities' recent economic activity and industrial complexity. We illustrate the use of a policymaker's toolkit to diagnose and propose strategic diversification strategies. For Nashville, St. Louis, and South Bend, we directly apply the methodology and build a framework. In the final case study, Boise, we trace the industrial evolution through an economic complexity lens and pull wider statistics to develop a more holistic and qualitative panorama of a city at a crossroads.

Our hope is that insights revealed through an analysis of local economic capabilities, threats, and opportunities can help leaders in U.S. communities undertake both incremental and fundamental changes in how they approach inclusive economic growth. For decades, states and localities have competed with one another for investment and jobs rather than investing in policies that yield lasting economic advantages that benefit residents and attract new industries. The analysis presented here can reveal threats to existing advantages and surface where opportunities exist to create new ones through more strategic, targeted deployment of economic development funds. We also aim to show how communities can leverage existing capabilities, including the talents of their workers, to foster new economic activity in ways that benefit firms, workers, and the broader economy.

Economic trajectory

Although the four metro areas share some similar economic features, they have seen distinct economic trajectories in recent years. On the one hand, Boise and Nashville grew especially fast from 2007 to 2017, as shown in Table 1, thanks in part to historical diversification in complex sectors that paid dividends. Their economic dynamism, as well as their cultural and natural assets, continue to attract young millennials and older retirees alike. On the other hand, St. Louis and South Bend grew more slowly as legacy manufacturing industries shrank and select advanced service industries grew.

There is one salient pattern shared by all four metro areas: Despite job growth, middle-class earnings declined from 2007 to 2017 in each location. This trend of growth that leaves many people behind is a hallmark of this period and an urgent concern across the nation. As shown in Table 1, Boise grew its job base more than 10 percent, productivity by more than 4 percent, and average wages by nearly 4 percent. Yet median earnings in Boise declined more than 6 percent. This gap between Boise's average and median earnings growth implies that the metro area's economic growth is disproportionately benefiting high-wage workers, even as it disproportionately generates low-wage jobs. The other three metro areas saw a similar but less pronounced pattern.

Complexity trajectory

These four metro areas also experienced distinct complexity trajectories. The growth or decline of certain industries relative to others led to changes in each metro area's economic complexity and the nature of future growth opportunities available to them. These changes suggest that some metro

TABLE 1

These four metro areas saw uneven economic progress in recent years

	United States	Boise	Nashville	St. Louis	South Bend
Change in jobs, 2007-17	6.1%	10.7%	17.2%	1.3%	0.4%
Jobs, 2017	150,582,031	318,194	969,495	1,392,810	143,115
Change in gross product, 2007-17	13.6%	15.5%	31.9%	4.7%	-3.2%
Gross product, 2017	$19,095B	$33,370M	$127,518M	$162,675M	$14,201M
Change in productivity, 2007-17	7.0%	4.4%	12.6%	3.3%	-3.6%
Productivity, 2017	$126,807	$104,873	$131,530	$116,796	$99,292
Change in average earnings, 2007-17	6.8%	3.9%	9.0%	4.3%	2.2%
Average earnings, 2017	$58,973	$44,708	$52,968	$51,258	$41,616
Change in median earnings, 2007-17	1.50%	-6.30%	-0.40%	-2.70%	-0.12%
Median earnings, 2017	$34,041	$29,863	$34,493	$35,041	$29,981

Source: Brookings Metro Monitor, 2019

areas capitalized on the growth opportunities they enjoyed in 2007, while others did not.

Among the four metropolitan areas, Nashville boasted the greatest strategic index in 2007 and appears to have made the most of the opportunities available to it. As shown in Figure 9, Nashville was about as economically complex as St. Louis in 2007, but the industrial specializations Nashville started with at that time were complementary to other complex industries Nashville did not specialize in. Such complementarity gave Nashville a slightly higher strategic index than St. Louis. Nashville leveraged its existing capabilities to gain new specializations in certain highly complex industries, including consulting services, security services, real estate and leasing services, insurance, and corporate headquarters. These highly productive industries helped fuel the region's better-than-average productivity and average wage growth and led to an increase in the region's overall economic complexity. A natural consequence of Nashville's increasing complexity, however, is that there are now fewer opportunities and less to gain from adding new specializations in the future. For this reason, the metro area's SI fell from 2007 to 2017.

Boise boasted the greatest economic complexity in 2007 among the four metro areas by far, but the lowest SI, as shown in Figure 9. Boise started with especially strong specializations in advanced manufacturing industries and corporate headquarters, such as the semiconductor manufacturer Micron and the headquarters of the grocery chain Albertson's. The metro area lost more than one-third of its headquarters employment from 2007 to 2017 and sustained

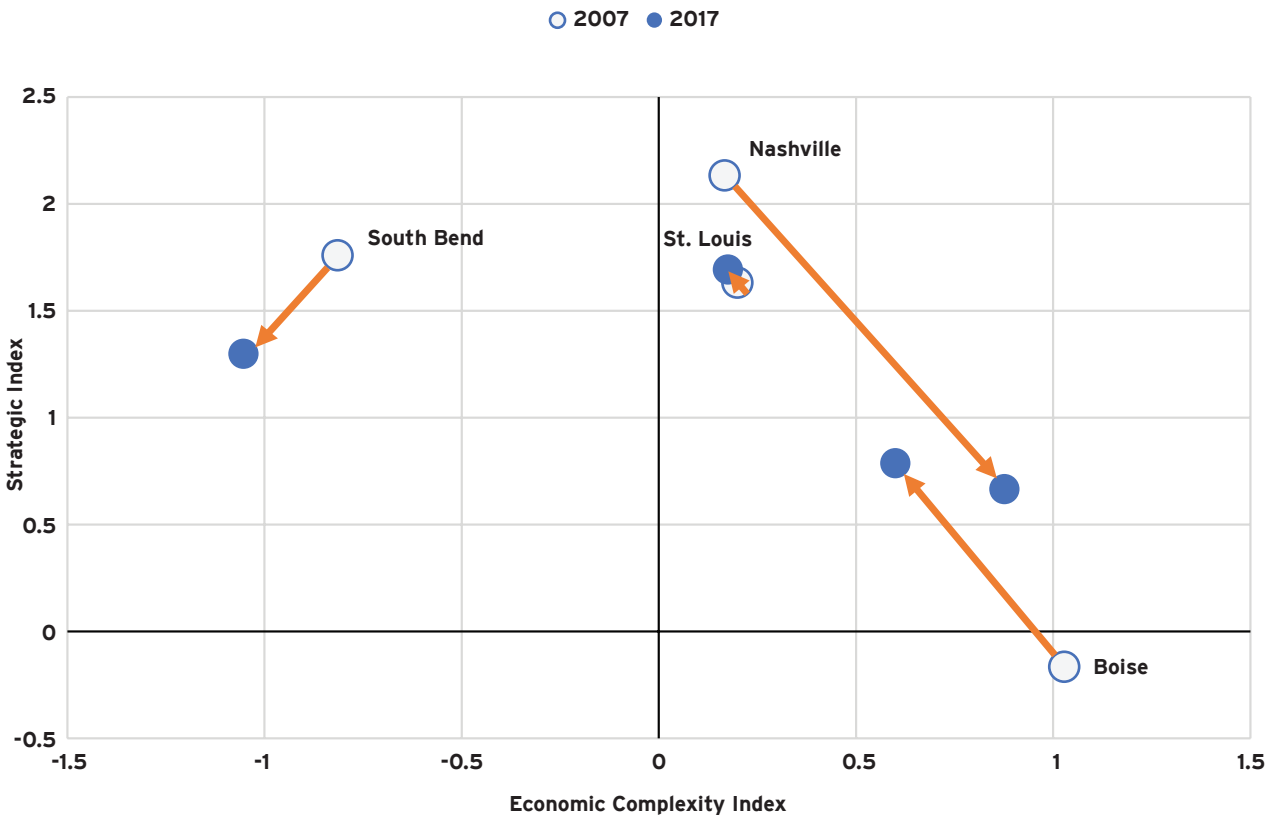
losses in related industries, as well as key logistics industries, which cost Boise its specializations in these complex industries. Meanwhile, industries in which Boise gained specialization, including administrative services, amusement and nature parks, nursing homes, home health care, and gas stations, were less strategic and less complex than the industries in which the region lost specialization. This growth pattern enabled Boise to add more jobs during this period and to make modest gains in its productivity, but it also gave up much of its economic complexity.

These contrasting cases reveal how difficult it can be to maintain or increase economic complexity in today's highly dynamic global economy. Both metro areas achieved job and economic growth that exceeded the national average from 2007 to 2017, yet their growth led to different outcomes. Nashville managed to leverage the opportunities it had in 2007 to grow far more productive and complex by 2017. It must now maintain its competitiveness to host these highly complex, productivity-enhancing industries, or risk following Boise's path toward less-complex, less-inclusive growth. Meanwhile, as Boise lost complexity, it increased its potential, as shown by the increase in SI. For both metro areas, increasing economic complexity going forward will require social, institutional, and infrastructure investments that will make growth inclusive and self-sustaining.

FIGURE 9

Metro areas saw distinct changes in their economic complexity and strategic index

Changes in four metropolitan areas' economic complexity and strategic index, 2007-2017



Source: Authors' analysis of Emsi estimates

Economic complexity and SI tend to move in opposite directions: As one increases, the other tends to decline, and vice versa. This occurs because as an economy grows more complex, as Nashville's did from 2007 to 2017, there are fewer industries that provide strategic opportunities to further increase its complexity. Similarly, as an economy grows less complex, it will find more industries that provide strategic opportunities to increase complexity, which increases its SI. However, the industry specializations that are gained and lost along the way do matter: South Bend lost specializations in its most complex and strategic industries, causing it to lose complexity and strategic position.

For older industrial cities, small changes in economic complexity and SI can mask the dramatic restructuring of their economies and the scale of the challenges they have managed to overcome. In St. Louis and South Bend, economic progress has been punctuated by losses. Job and economic growth lagged the nation's in both metro areas. Yet by making major investments in industries that offer larger strategic gains, these two metro areas have managed to either maintain their complexity or stave off worse outcomes.

St. Louis continues to grapple with an industrial restructuring that has only moderately altered its economic complexity but has dramatically altered the nature of its opportunities. Steep job losses cost St. Louis its specializations in some highly complex industries, such as travel services, scientific research and development services, and medical equipment manufacturing. At the same time, however, the region gained jobs and new specializations in other highly complex industries, including securities brokerages, design services, advertising, cable programing, professional and scientific services, and drug wholesaling. This restructuring allowed St. Louis to mostly counterbalance its losses in some complex industries with gains in others, contributing to only a small decline in its overall economic complexity. Though this led to more modest progress on growth, productivity, and wages, the metro area emerged with slightly better SI as a result.

South Bend has gone through an even more dramatic economic restructuring in recent years. South Bend lost about one-sixth of its jobs from 2007 to 2017 but gained as many jobs in other parts of its economy. (By comparison, St. Louis's losses and gains were equivalent to less than one-tenth of its job base.) Job losses cost South Bend its specialization in more than two dozen industries, mostly in the manufacturing, retail, and wholesale sectors. The city gained specializations in fewer industries than it lost, however. Furthermore, the specializations South Bend gained, which were also mostly in the manufacturing and wholesale sectors, were in less complex and less strategic industries than those it lost, on average. South Bend's productivity, economic complexity, and SI all declined as a result of these shifts. Yet without its targeted efforts to reinvent itself, the metro area could have fared worse. Job losses in many of South Bend's manufacturing and logistics industries were less severe than in other parts of the nation during this period, and the city managed to add jobs in industries that were shrinking nationwide. Although South Bend emerged with fewer industrial specializations overall, it gained more specializations in industries that tend to fuel trade with the world and are therefore crucial to sustaining its economic growth.

Strategic and feasible industries

The distinct economic trajectories of each metro area in recent years contributes to a unique pattern of opportunities through which to grow more complex and productive. Though each opportunity merits further exploration, the pattern of opportunities provides a useful indication of how well a metro area is suited to diversify into more complex industries in the future.

Figure 10 displays the industrial diversification opportunities of each of the four metro areas.

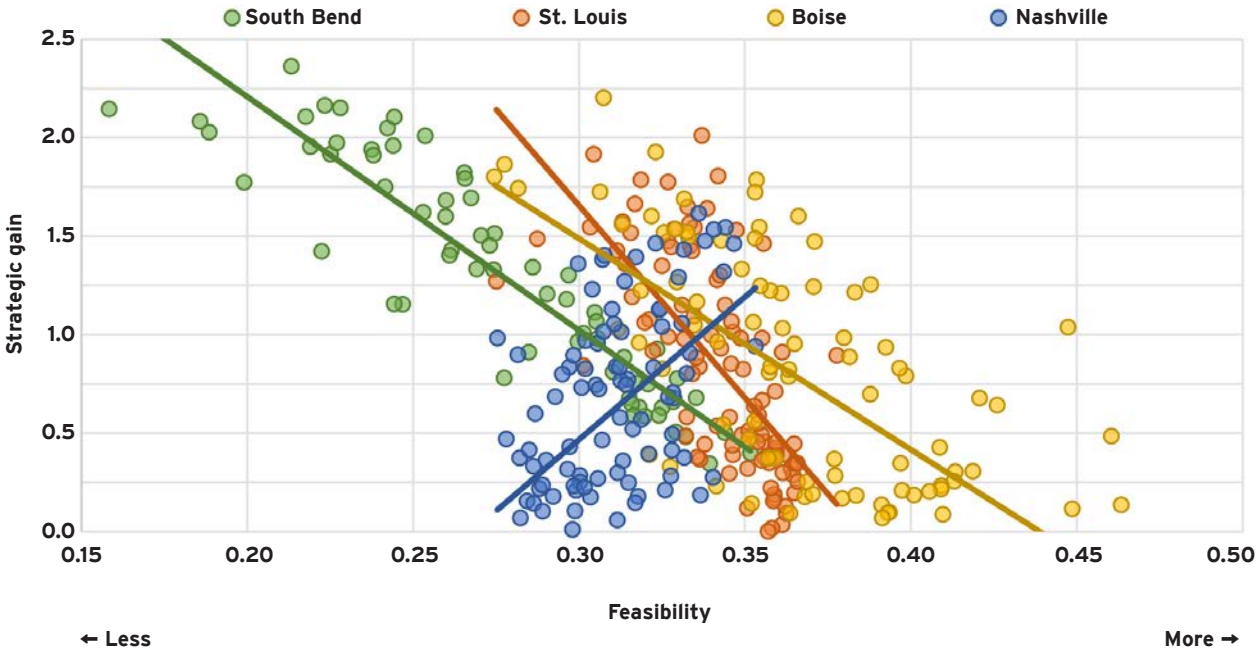
Each dot represents a nascent industry—one that a metro area neither currently specializes nor hosts but one that could develop or strengthen in the future. Only those nascent industries that are tradable are displayed. (Tradable industries are those that produce products or services which can be sold to customers outside the metro area and are key to sustaining economic growth.)[40] Examples of tradable industries include manufacturing or consulting, while non-tradables include schools or retail services. Nascent industries are arrayed from bottom to top by how strategic they are and from left to right by how feasible it is for the metro area to gain specialization in that industry. This means that industries in the upper right of the chart are more strategic and more feasible.

The opportunity patterns for these four metro areas suggest they face quite different outlooks for improving their complexity in years to come. For example, many of Boise's nascent industries—in yellow—are highly feasible for it to gain specialization, given its existing, complementary industries. For instance, beverage manufacturing, a nascent industry for Boise, shares required capabilities with dairy product manufacturing, a thriving industry in Boise. However, Boise's most feasible nascent industries are also its least strategic, on average, as indicated by its downward-sloping trend line—also in yellow. Like Boise, South Bend's most strategic nascent industries—in green—also tend to be less feasible to gain specialization. By contrast, Nashville's most strategic nascent industries tend to be those in which it is most feasible to gain specialization, as indicated by the city's upward-sloping blue trend line.

FIGURE 10

Metro areas' strategic and feasible industries suggest some are better positioned to diversify than others

Four metropolitan areas' strategic and feasible tradable industries in 2017



Source: Authors' analysis

By revealing how a metro area is poised for economic growth and diversification, strategic gain and feasibility of nascent industries can equip decisionmakers with potential strategies required to meet economic development objectives. Diversification into more complex industries may be relatively easy for St. Louis, on the one hand, since it has highly strategic opportunities that are moderately feasible. On the other, South Bend's diversification into more complex industries could be more difficult, since none of its opportunities are highly feasible, and even its moderately feasible opportunities are not very strategic. South Bend may therefore require a strategy to develop those industries in which it is most feasible to gain specialization, even if they are not very strategic as the city moves up the complexity scale. This analysis also points to the importance of learning which are the capabilities required by the most complex and feasible industries and investing in them. Decisionmakers can focus resources on selected opportunities that may involve greater investment and risk to create the capabilities, such as skills and infrastructure, that will help nascent industries thrive until complementary industries emerge.

Opportunities for inclusive growth

As decisionmakers in each metro area consider the industrial outlook for their economy, they can use additional metrics to assess which opportunities are most suited to enhance competitiveness and support inclusive growth. Decisionmakers should also focus on creating opportunities for workers and families to share in the benefits of growth by increasing the proportion of jobs that provide family-sustaining wages and benefits (see Box 6).

In addition to the feasibility and strategic gain of available opportunities, decisionmakers should consider other industry dimensions, job quality, tradability, and industry complexity, to ensure economic development strategies help create growth and opportunity. Not all nascent industries offer the same benefits in this regard. For example, some nascent industries may be highly feasible and strategic, but offer few jobs that pay family-sustaining wages (or few jobs, period). Some may be strategic but less complex than the metro area's economy.

By assessing the following dimensions of nascent industries, metro leaders can identify opportunities that most effectively promote a metro area's economic competitiveness and inclusion:

1. **Tradability**: Metro areas' economic development strategies should primarily focus on nascent industries that sell most of their products and services to customers outside the metro area, which brings new income into the region that drives local economic growth.

2. **Job quality:** The share of a priority industry's jobs that qualify as good should exceed the metro area average, ensuring an industry's growth will increase overall job quality.

3. **Complexity:** Priority industries should be more complex than the metro area's overall economy, ensuring that gaining a specialization in that industry will increase the metro area's overall economic complexity.

Screening each metro area's set of industries with these dimensions can reduce the dizzying array of potential targets from hundreds of nascent industries to less than two dozen. Further, the nascent industries that are identified after screening often fall into a few clear and coherent industry groupings, as we see in the four metro areas studied here. These groupings help decision makers design and implement strategies to develop industries that rely on similar capabilities.

When it comes to developing a more competitive, resilient economy, focusing on opportunities to grow tradable industries is crucial. To promote inclusive growth, however, decisionmakers in metro areas also need strategies that go beyond tradable industries. After all, in most metro areas about two-thirds of jobs are in non-tradable,

local-serving industries, such as retail, hospitality, and health care. Therefore, improving job quality as these sectors grow is a necessary pillar of economic inclusion.

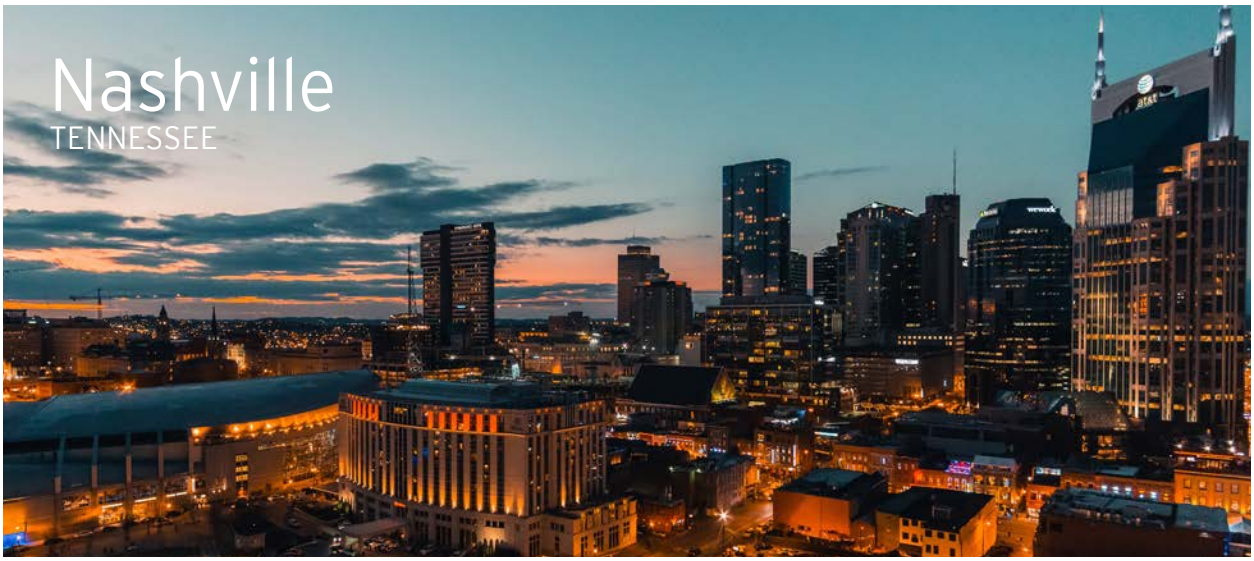
The tools described above are not meant to provide a pre-specified, prescriptive, narrow path for each city's growth. This data-driven approach can provide decisionmakers with a better toolkit, so they can prioritize economic development investments and target them where they are more likely to achieve the greatest benefits.

The following case studies illustrate how decisionmakers can interpret insights from economic complexity metrics. The first three—Nashville, St. Louis, and South Bend—directly apply the metrics to identify promising target industries. In the final case study of Boise, we elucidate the connection between growth and investment in capabilities.[41]

Box 6: Defining good jobs

As policymakers in cities and regions consider which industries make promising targets for economic growth and diversification strategies, they should also consider how those industries can promote labor market opportunities for individuals. This analysis incorporates a final metric on the share of jobs within an industry that are considered "good jobs" that provide family-sustaining wages and benefits.

This job quality metric comes from a 2018 Brookings study[41] which looked at how industries and industry growth in a region facilitate local workers' upward economic mobility toward middle class jobs. In that study, the authors define "good jobs" as those that pay at least the local median annual earnings for full-time workers and provide employer-sponsored health insurance—a proxy for other types of employment benefits.



Nashville possesses advantages in developing many nascent industries that also have high strategic gain. It is the only one of the four case-study metro areas that has a positive (upward-sloping) relationship between the feasibility of nascent industries and the strategic gain they offer, putting it in the enviable position of having several promising strategies to increase its economic complexity. How should Nashville's decisionmakers sort through all these potential opportunities to understand which offer the greatest overall benefit? The factors outlined below are helpful:

- **Tradability and job quality:** Nashville has 84 tradable nascent industries as shown in Figure 11. Of these, 64 contain a disproportionate share of the region's good jobs. In the figure, the size of a nascent industry's bubble indicates the share of its jobs that are good: the larger the bubble, the greater the concentration of jobs that offer benefits and pay a living wage.

- **Complexity:** Though all of Nashville's nascent industries offer capabilities that could make it easier for Nashville to grow more complex in the future, not all offer positive impact on Nashville's average economic complexity. Of Nashville's tradable nascent industries that boast above-average job quality, 21 are more complex than the metro area's current economy, meaning that specializing in these industries would directly increase Nashville's economic complexity. These industries are shown in blue in Figure 11.

Screening Nashville's universe of nascent industries using each of these dimensions yields a set of tradable industries that would directly increase job quality in the metro area and increase the metro area's economic complexity. These 21 industries are shown as blue bubbles in Figure 11. Interestingly, all lie above the upward-sloping gray best-fit line that reflects the average relationship between the feasibility and strategic gain among Nashville's nascent industries. This means these industries offer a greater dividend in terms of strategic gain than their feasibility would suggest, on average, making them especially promising targets for economic development efforts that aim to increase the metro area's complexity. Generally, these priority industries fall into four discrete industry groupings:

- **Computer and communications equipment manufacturing:** manufacturing of computer equipment; semiconductors; communications, audio, and video equipment

- **Precision manufacturing:** manufacturing of aerospace products and parts; and electromedical, control, and precision instruments

- **Financial services:** banking, securities brokerage, alternative investment managers (e.g., private equity firms or hedge funds), and fintech

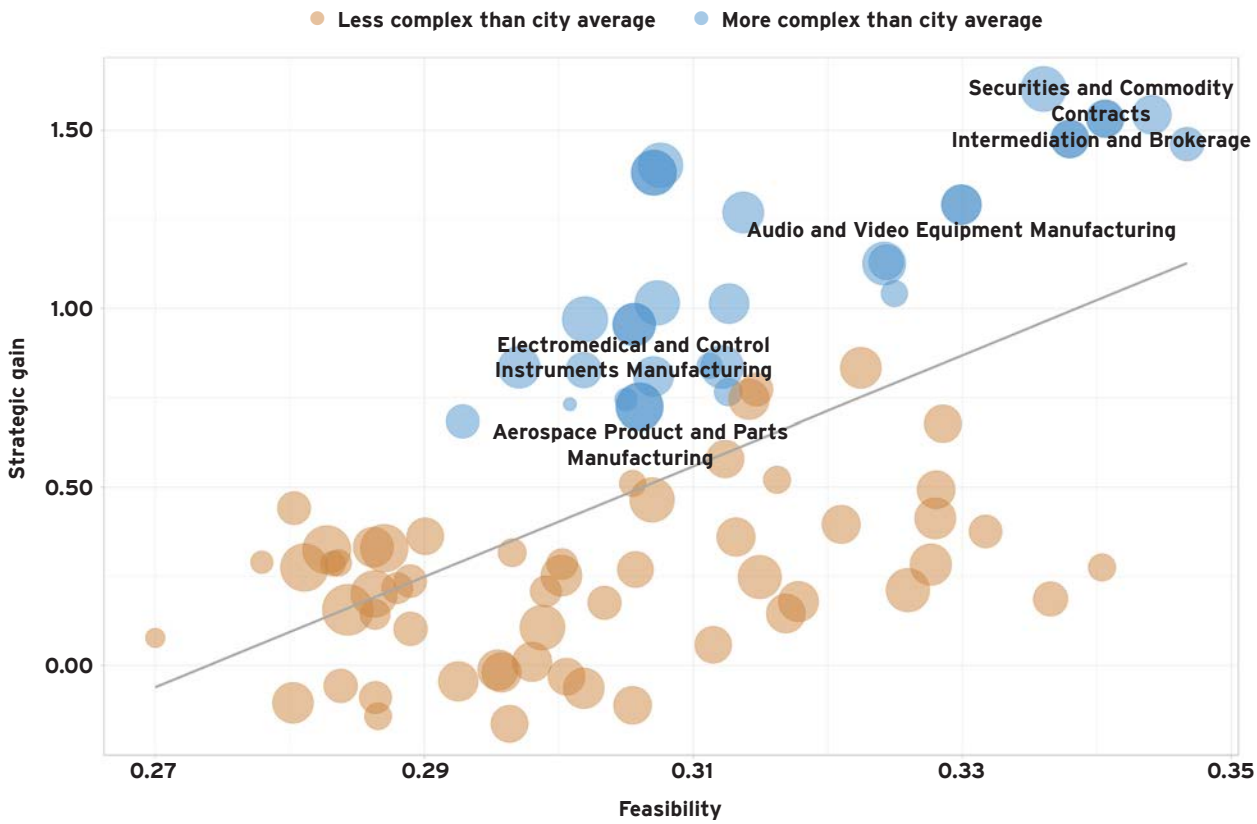
- **Professional/technical services:** computer systems design, software publishing, scientific research and development, advertising and information services, and telecommunications services

Notably, these select groups of industries provide capabilities that either build on or complement several of Nashville's existing industry specializations and capabilities. Nashville is one of the nation's leading metro areas for automotive manufacturing, and as automobiles become more information-enabled, communications equipment will become an integral part of these products and their manufacturing. Such equipment and services would also complement Nashville's music recording industry. Information and communication technologies and services also help unlock important new insights in clinical health, where Nashville is a leader. Business and financial services would further cement Nashville's attractiveness for corporate headquarters, and information technologies and services are increasingly crucial enablers of business and financial services.

FIGURE 11

Industries that offer Nashville the biggest strategic gain are also more feasible to develop

Nashville's industry outlook, 2017



Note: Bubble size indicates industries' relative concentration of good jobs.
Source: Authors' analysis

St. Louis's industry outlook suggests that its best way forward may be through its past. St. Louis's nascent industries are similarly feasible for it to develop specializations, which means there are fewer tradeoffs to consider as it chooses its target industries. Still, some industries offer more benefits than others. St. Louis is fortunate that the nascent industries that are most tractable and that offer the greatest benefit closely resemble those in which St. Louis has long boasted advantages, as the following dimensions reveal:

- **Tradability and job quality:** St. Louis has 87 tradable, nascent industries, 56 of which contain a disproportionate share of the region's good jobs.

- **Relative complexity:** Of St. Louis's 56 tradable nascent industries that boast above-average job quality, 19 are more complex than the metro area's current economy, meaning that specializing in these industries would directly increase St. Louis's economic complexity.

Altogether, the application of these criteria narrows St. Louis's universe of nascent industries from 87 to 19. These 19 nascent industries are shown as blue bubbles in Figure 12. Twelve of these industries lie above the downward-sloping gray trend line that reflects the average relationship between the feasibility and strategic gain among St. Louis's nascent industries. This means these 12 industries offer a greater dividend in terms of strategic gain than their feasibility would suggest, making them especially promising targets for economic development efforts. Generally, these 19 industries fall into four discrete industry groupings:

- **Financial services:** banking and alternative investment managers and funds, intellectual property lessors

- **Professional/technical services:** management, scientific, and technical services, including computer system design, scientific research and development, and engineering; software publishing

- **Precision manufacturing:** manufacturing of medical equipment, electronic components, measuring and control precision instruments, communications equipment, computer and peripheral equipment

- **Logistics:** scheduled and non-scheduled air transportation services, other logistics arrangement services

Not surprisingly, these groupings leverage many of St. Louis's existing or legacy capabilities. Today, the metro area hosts the headquarters or major operations of several financial firms,

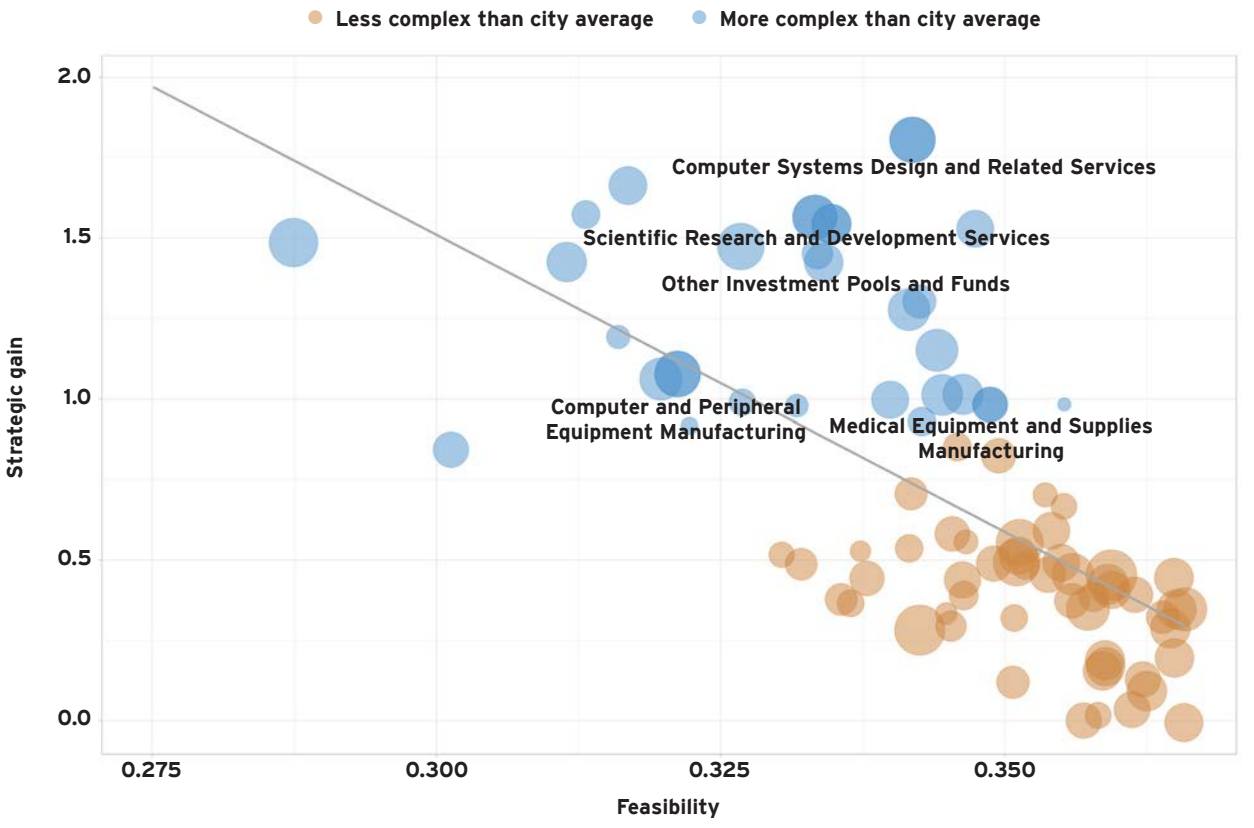
including Mastercard, Citi, Edward Jones, AG Edwards, Scottrade, Stifel, Wells Fargo, Thomson Reuters, and Reinsurance Group of America. St. Louis also boasts research and design capabilities: Monsanto, Pfizer, and other firms represent the region's capacities in plant and animal sciences. Boeing continues to operate former McDonald Douglas operations devoted to researching and producing defense technologies. Relatedly, the region has legacy specializations in medical equipment manufacturing, automotive manufacturing, aerospace and defense manufacturing, and contract manufacturing.

Further, as the "gateway to the west," St. Louis has long been a leading venue for multi-modal logistics services and activities. Therefore, the industries that are most feasible and offer the region the greatest strategic gain for St. Louis are not necessarily new. Rather, they represent waning specializations in sectors where St. Louis has lost market share as other regions have excelled at developing (or are doing a better job at retaining). For St. Louis, prioritizing these former specialties in economic development efforts could help it reclaim leadership in these industries.

FIGURE 12

Industries that are most feasible for St. Louis offer the least strategic gain

St. Louis' industry outlook, 2017



Note: Bubble size indicates industries' relative concentration of good jobs.
Source: Authors' analysis

South Bend is among the many American cities forced to reinvent itself after a dramatic shift in industrial makeup. It can be difficult to recuperate from these shifts, particularly for small homogeneous cities. South Bend has managed to redeploy some of its manufacturing capabilities in advanced industries, evidenced by the growth of Lippert Components, a manufacturer of recreational vehicle components. The city's strategic investments in industrial zones and entrepreneurial ecosystems, in partnership with local research institutions, intend to drive a new critical mass of tradable industries. While development will continue to be an upward battle, a capability-based approach can be most useful for cities such as South Bend. These types of cities are forced to make more precise bets and gradually move upward in complexity to open opportunity in new industries, all while leveraging legacy capabilities and worker skill sets.

- **Tradability and job quality:** South Bend has 43 tradable, nascent industries, 29 of which contain a disproportionate share of the region's good jobs.

- **Relative complexity:** Of South Bend's tradable nascent industries that boast above-average job quality, 18 are more complex than the metro area's current economy, meaning that specializing in these industries would directly increase South Bend's economic complexity.

Applying these criteria to South Bend's universe of tradable, nascent industries leads to the identification of only a limited number of industries that are both tractable to develop and would provide requisite benefits. This suggests that, in South Bend's case, relaxing some of these criteria may be necessary to identify promising opportunities. The nascent industries that are most feasible for South Bend to develop are not the most strategic nor would all of them have a positive direct effect on the metro area's overall economic complexity. However, they can increase the likelihood that South Bend could more feasibly develop other more complex industries in the future. South Bend may need to invest heavily in resources that are able to spur growth or recruit firms in these complex industries. The nascent industries that are most tractable for South Bend to develop include:

- **Production:** manufacturing of commercial and service industry machinery, gas and electric power distribution, and cement and concrete manufacturing

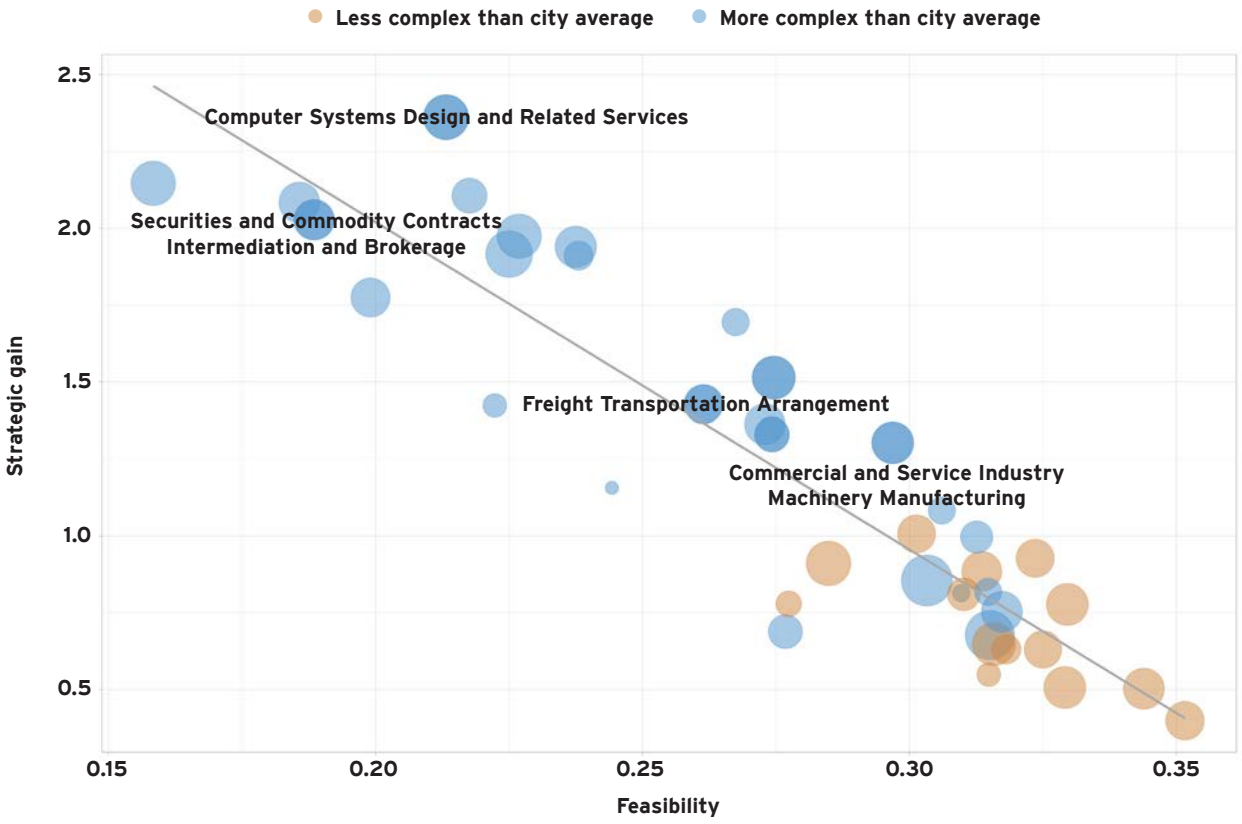
- **Financial services:** credit, securities, and commodities intermediation and brokerage; other financial investment activities

- **Professional/technical services:** computer systems design, software publishing, and data hosting; scientific research and development and advertising, design, and related services; other telecommunications and information services
- **Logistics:** scheduled air transportation and freight transportation arrangement

FIGURE 13

South Bend's industries with the greatest strategic gain are hardest to host

South Bend's industry outlook, 2017



Note: Bubble size indicates industries' relative concentration of good jobs.
Source: Authors' analysis

Boise: charting a path

IDAHO

No wonder people are flocking to Boise. Its welcoming disposition is upstaged only by the mountains and rivers that surround the place with natural beauty. The city's safety and low tax rate make it an appealing place to retire. Tech opportunity, hospitable culture, and sense of community make it a great place to launch a career or a start a family. [42]

But the city Forbes magazine called "the fastest growing in America" is also a city at a crossroads. Both Boise and Idaho will require bold action not only to maintain growth, but to grow in an inclusive way that benefits all citizens. The complexity metrics suggest an unsupported tradable sector and a dearth of industries that normally complement high-tech firms. The complexity of industry has decreased in recent years as high-tech companies struggle to find talent. Recent economic growth has primarily come from non-tradable service sectors rather than from growth-sustaining, export-driven sectors. Population growth resulted in part from retirees who drive housing prices, but who have less incentive to fund public goods such as education and workforce development.

City and state leaders, Boise's tight-knit business community, and local organizers, all of whom aspire to build a resilient region and to develop globally competitive industries, will need to invest recent windfalls into capabilities, talent, and infrastructure. Doing so will help the region maintain high-complexity growth by leveraging existing advantages. Boise's history, punctuated by a can-do, self-reliant attitude, shows how the entire state can use its identity to chart a path into the future.

An early bet on complex industries

In the 1970s, Hewlett Packard (HP) moved to Boise, bringing with it a critical mass of technical know-how and a robust demand for productive inputs. HP didn't choose Boise because of lucrative tax incentives or preferential treatment. Though the city did offer a healthy business environment, ultimately visionary leadership from former Governor Cecil Andrus, plus a little luck, attracted the blossoming company. In his autobiography, the former Governor recalled rebuffing David Packard after being asked to offer tax concessions. Instead Andrus replied, "We don't believe in existing business subsidizing new business. When you come to Idaho you become a citizen, and we all play by the same rules. A few years down the line and you'll be an old-timer. Do you want to subsidize the next guy who comes along?"[43]

They sealed the deal with a handshake and in doing so planted the seeds for decades of growth. HP made early investments into local infrastructure

and heavy metals extraction. Building these capabilities helped other local companies such as Simplot, an agricultural company that had been planting seeds in Boise since 1929. As HP was setting up shop, Simplot was busy rapidly expanding across the country and into varied lines of business. Whether Governor Andrus intended it, the entry of HP was a boon to Simplot. HP invested in a sewage treatment plant at the exact time Simplot was learning to use wastewater from its agriculture to fuel methane gas plants.[44] Moreover, HP's investment in advanced mineral extraction brought capabilities that dovetailed with Simplot's mining of phosphate to supply a growing fertilizer business. The agribusiness leveraged these new inputs to upgrade its technology, integrate vertically, and compete globally as a worldwide food systems powerhouse.

The capabilities that HP brought, in addition to those that Boise subsequently built, made the location attractive to other high-tech companies, such as Extended Systems and Clearwater Analytics, but none more remarkable than Micron Technologies. It is no coincidence that Micron established itself in Boise, a locale already equipped with productive knowledge and infrastructure. Knowing this, two brothers from Eastern Idaho who had moved out of state, Joe and Ward Parkinson, required only the start-up investment to return home and found their incipient microchip company. Here too, Boise had something to offer. J.R. Simplot, after retiring as the president of his company, invested $1 million in Micron, took a seat on the board, and called the fledging company his baby.[45] His acumen was instrumental as the local business community galloped into the digital age.

Synergies and industrial clusters can emerge from unlikely combinations. For Boise, knock-on and spillover effects built a foundation of productive capabilities that allowed the transformation of larger businesses from being Boise companies that do business across the country, to global companies headquartered in Boise.

The fragility of the high-tech sector: not all growth is created equal

Today Boise no longer possesses the same critical mass of high-tech companies. The synergies that drove Boise's growth over the past 40 years are no longer sufficient for the region's economy to compete globally. In downturns, economies are likely to shed the least competitive industries. Therefore, that Boise struggled more than other cities during the recession implies the city's rapid growth since 2012 may be unsustainable. Led by the growth of health care, hospitality, and government sectors, the city increased output and jobs at annualized rates of 4.8 percent and 3.3 percent, respectively (see Figure 14 for job change by sector). Yet these locally contained service sectors, despite experiencing growth, do not themselves drive growth. The complexity metrics show a decline in Boise's overall level of complexity, which indicates that such local sectors will not sustain the region as advanced tradable sectors depart. The metrics further show that some of the city's historical engines of growth and prosperity such as advanced manufacturing and information technology are at risk.

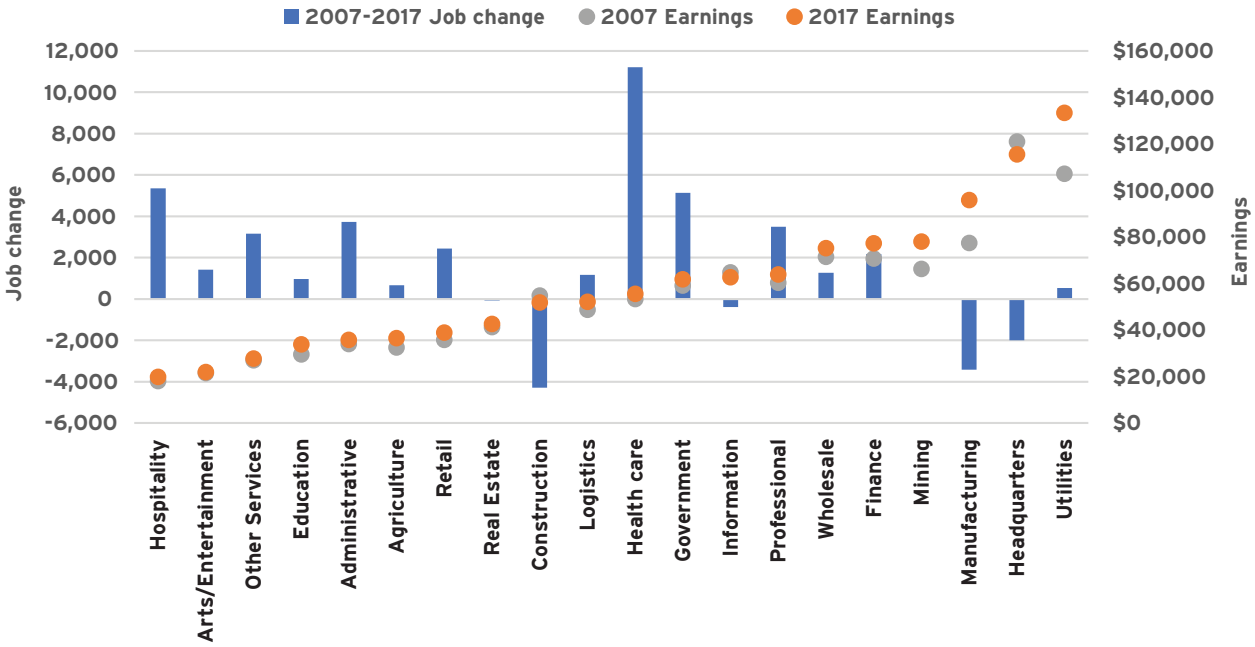
This uneven industrial growth has not been good for the majority of workers. Despite aggregate recovery, median earnings have fallen 6.3 percent since 2007.[46] Similarly, although the city has made recent progress, 12 percent of the population lives in poverty, compared to 10.3 percent in 2007, again showing that many are worse off than prior to the recession.[47]

HP Boise is a shadow of its old self, employing about 1,500 employees, down from a peak of 7,000. Similarly, Micron, while retaining the mantle of the city's largest private employer, requires only about half the 12,000 workers the company employed in Boise at its peak. Despite Idaho's generous state subsidies and a long local history as a darling firm in Boise, Micron chose Manassas, Virginia for its newest expansion, a $3 billion dollar investment expected to create about 1,000 jobs.

FIGURE 14

Job change by sector in Boise Metropolitan Statistical Area

2007-2017



Source: Authors' analysis of Emsi estimates

Our industry network mapping predicts such disinvestment from Boise (see Figure 15). Using both the implicit and explicit measures of industrial feasibility, we can estimate the likelihood that an existing industry will disappear from Boise. Low percentages shown on the vertical axis are a result of the low likelihood in general that any industry will disappear from a city over a five-year period, but the relative probabilities suggest impending threats. The model, which shows out-of-sample statistical robustness, indicates Boise's limited capability to support advanced, technically sophisticated industries such as peripheral computer manufacturing—the industry HP belongs to—or semiconductor manufacturing, Micron's respective industry. That either company exists today in Boise is a result of the path-dependent nature of industrial development, an inertia partially resulting from HP's investment nearly 50 years ago. Nonetheless, their continued presence still entails sophisticated capabilities. Boise should not neglect an opportunity to build on that legacy at a time when other regions are working hard to develop such clusters from scratch, which is much harder.

A lack of investment in education

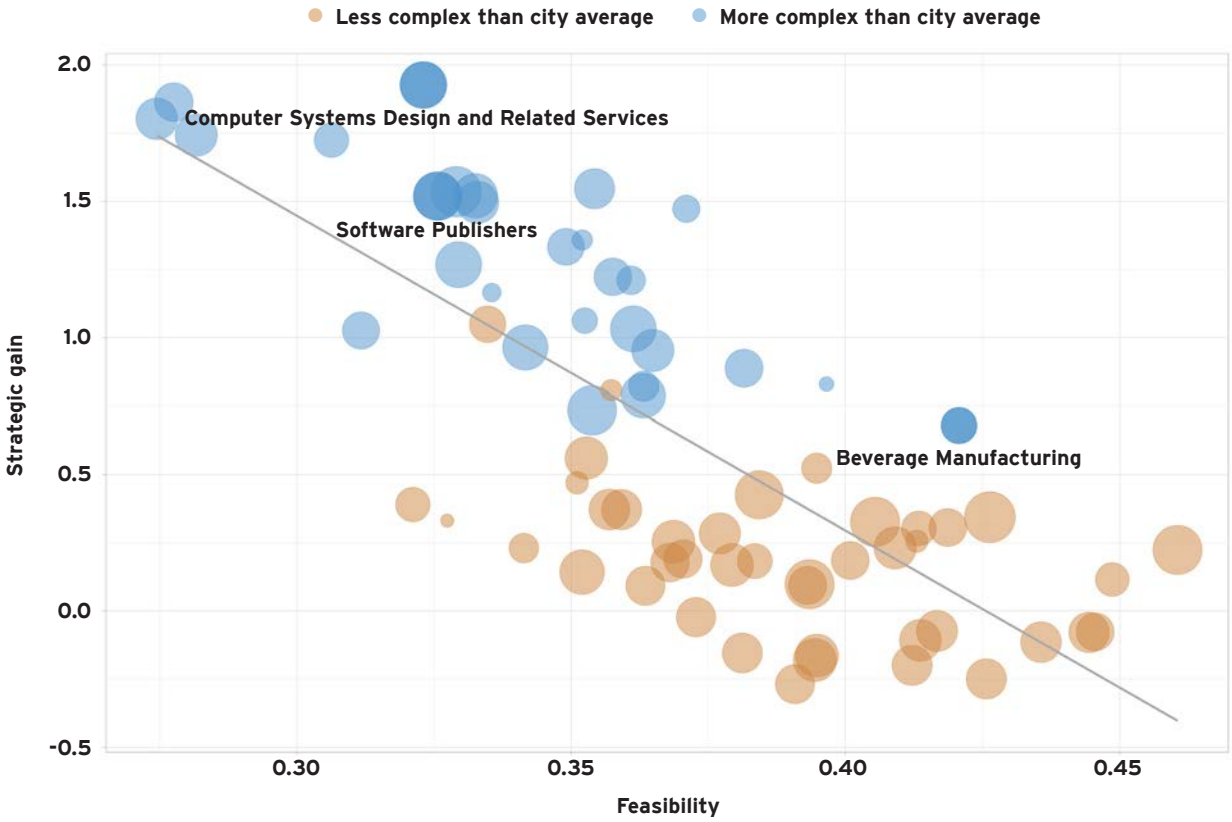
Unfortunately, the education system in Idaho hasn't kept up with the human capital demands of local industry, forcing companies to expand elsewhere. As discussed above, a metropolitan area's capacity to successfully host an industry relies on any number of capabilities, some of which can be directly observed and measured, whereas others are more intangible and are measured implicitly in the co-location industry space. In this section, we analyze Boise and wider Idaho's capability in terms of human capital and argue a lack of investment in education constrains the area's ability to host advanced industries.

By 2020, 65 percent of all jobs will require more than a high school diploma.[48] This statistic for the average place belies the requirements of high-tech clusters. Cities with comparative advantages

FIGURE 15

Industries that are most feasible for Boise to develop offer the least strategic gain

Boise's industry outlook, 2017



Note: Bubble size indicates industries' relative concentration of good jobs.
Source: Authors' analysis

in tech will require closer to 80 percent of their workers to have some postsecondary training.[49] In other words, educational attainment on par with the national average is not sufficient to sustain high-tech clusters. Although Idaho has a fairly average fraction of residents with a postsecondary degree, the absolute number doesn't compare well to its neighbors. It has about half the number of advanced degrees than does Utah, and about a fifth the amount prevailing in Colorado. The future doesn't look promising either. Among Idaho's 18-24-year-olds, 6.6 percent have a college degree compared to 10.5 percent for the entire country.[50] The Idaho Department of Labor projects 49,000 unfilled jobs by 2024, 36,000 of them in science, technology, engineering, and math (STEM) fields.[51] However, according to the National Center for Education Statistics, the state only graduated about 2,000 STEM graduates in 2016.[52] Public higher education is adapting, graduating 169 computer scientists in 2018 compared to 73 in 2013.[53]

More people with advanced degrees will raise the likelihood of high-tech clusters staying, especially if they mirror the needs of the existing industries. But it is not enough to fill the gap. The state must look outside higher education and beyond state lines toward reskilling workers and attracting talent to meet the demand and to retain and

grow sophisticated industry. A lifelong learning infrastructure that responds and contributes to the needs of the local economy requires attention to many confounding factors. The state needs to reduce the prevalence of poverty, ensure the inclusion of rural students, and invest in specialized programs outside the 4-year degree option (such as career technical education (CTE) and apprenticeships) that may better serve the needs of students. Firms must demand skills and competencies versus degrees, since the former provide opportunity for a wider set of pathways. All these issues require a business community deeply invested in the pipeline of talent at all levels. Idaho's goal to move from a current share of 42 percent of the state's 25- to 34-year-olds holding a degree or certificate to 60 percent is laudable for its recognition that the issue of higher education and job preparedness encompasses the entire education and workforce development system.

One salient gap, early childhood education, is a politically sensitive topic in Idaho but also a particularly important one. The payoffs of such programs to the broader economy and to individuals are well established.[54] The state must unlock this potential, or otherwise find alternate solutions to alleviate an education system burdened, from K-12 and beyond, by the need to remediate students unprepared for their grade-level. In some school districts, nearly half the kindergarteners will start school with disadvantages shown to persist through life.[55] In other lower income districts such as Nampa, which lies inside the Boise metropolitan area, the K-12 system is further stressed. There, 67 percent of kindergarten students entered school unprepared. In addition to lost resources remediating students, community poverty further hampers school administrators and teachers who regularly go beyond their duty to help, for example, the 10 percent of their students who meet the federal definition of homelessness.

Despite the challenges, the Nampa district has shown that CTE programs can be a conduit to higher education and employment.[56] Of the 13 percent of their graduates who earn an industry certification, 99 percent go on to higher education or to work in their certified field. Increased support to help students transition through each level of the education system will help Idahoans reach their 60 percent goal and do so in a way that translates to opportunity for those graduates.[57]

For Idaho to meet industry demands and build workforce capabilities, education goals should further encompass adults, such as Idaho's nearly 200,000 low-wage workers, who also stand to gain from increased training opportunities tied to local industry. Government branches such as the Idaho Workforce Development Council can leverage their close links to the business community to tie training programs to specific employer demands. Unfortunately, the Council's funding is countercyclically tied to an unemployment insurance tax, which means that when the unemployment rate is low, the council is less able to fill employer demands and help workers transition, even in the presence of worker demand for opportunity and employer demand for advanced skills.[58]

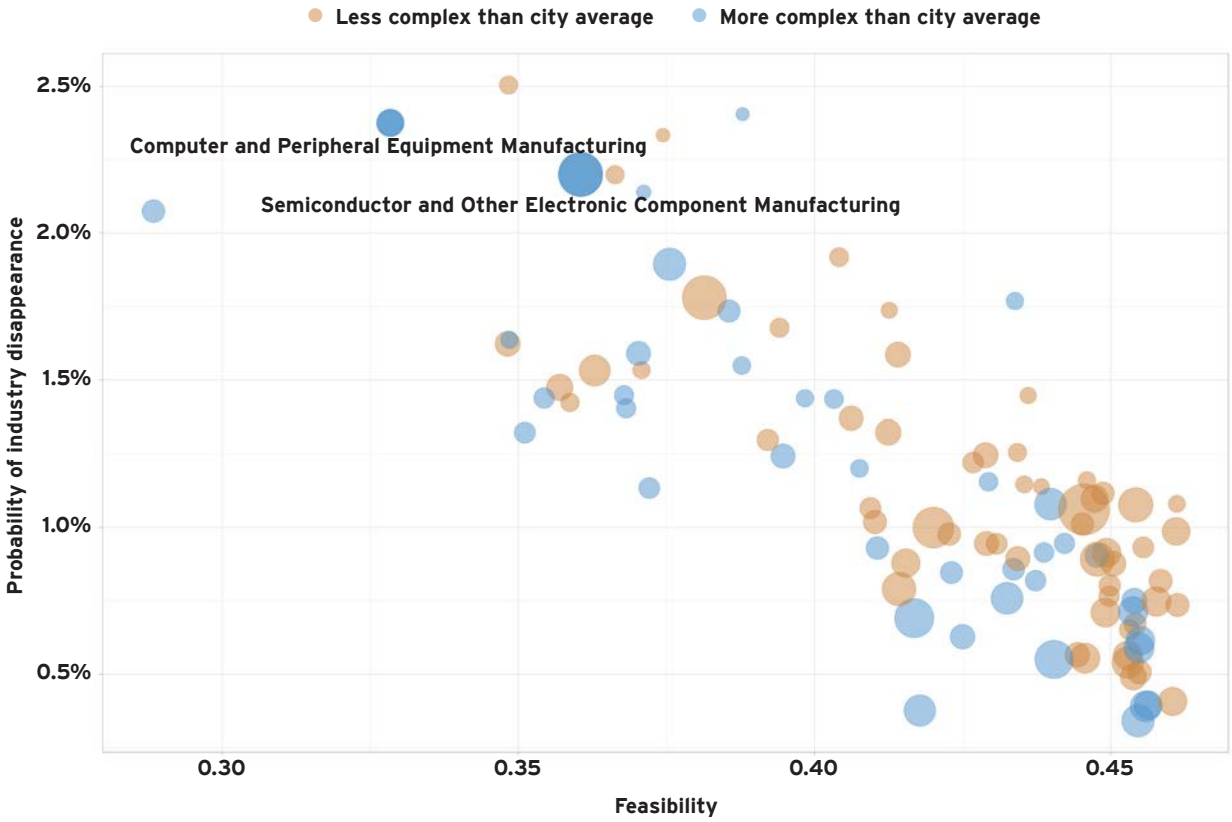
Charting a path forward in Boise and in Idaho

It is the case in cities around the country that nearly everybody wants growth, but almost nobody wants change. Yet the two come hand-in-hand. The key for Boise will be to manage recent growth in such a way as to foster future growth and include all citizens in that growth process. Having traced the industries underlying Boise's historical success, we can understand Boise's outlook, assets, and risks (see Figures 15 and 16). A potential industrial development strategy might focus along two fronts: 1) growing jobs, wages, and opportunity for those with less than a college degree while upgrading their skills, and 2) applying concerted multidimensional effort to develop the capabilities to host more advanced industries and reinforce the capabilities required by the complex industries that have proudly made Boise their home.

FIGURE 16

Industries most likely to disappear from Boise

Boise's at-risk industries, 2017



Note: Bubble size indicates industries' number of jobs.
Source: Authors' analysis

To regain comparative advantage in high-tech industries, Boise can focus on creating more density around industries like information technology, specifically, computer systems design and software publishing. The two industries offer high complexity gain, but as we have seen, are somewhat unfeasible for the city to host in its current state. Government initiatives to develop capabilities can come in many forms. For example, Boise's commitment to use 100 percent renewable electricity by 2030 is the type of forward-looking move that will build opportunities for growth, cultivate talent, and encourage new entrants.[59] But to develop capabilities and build density in high-complexity industries, the education system must rapidly adapt. The state must graduate more students with STEM degrees. But education is a long-term investment, and to maintain current industries, Boise must also find a way to attract talent. Then, as the city employs more high-wage workers, and as more retirees move to Idaho, Boise will need to manage housing supply and allow more dense construction by easing regulation and investing in infrastructure. Otherwise high housing prices will foment inequality and entrench pockets of poverty.

To support inclusive growth, the city will need to foster firms that can employ Boise's workers, provide benefits, and pay a living wage. For example, rather than offering incentives to companies building data centers that employ few workers, leaders should reserve tax dollars for

companies that add high-tech density and high-quality jobs and encourage other industries that absorb existing skills. Beverage manufacturing is one such sector that holds promise. The industry requires many inputs that Boise already provides to other sectors; it is growing across the country, and is likely to provide jobs to people who have been discouraged by the labor market since the recession. The out-of-work, the underemployed, and low-wage workers can be further served by more robust investment in those workforce organizations with the capacity and willingness to provide more skills and certifications that are linked to local industries. In so doing, such organizations will help workers transition into tomorrow's jobs.

The next industrial cluster likely to emerge and be headquartered in Idaho and do business around the world may not be a set of firms resembling HP, Simplot, and Micron. Idaho and Boise are changing, and, as we have seen, dynamic clusters can emerge from unlikely combinations. In the nearby city of Twin Falls, Idaho, local officials and international businesses are forming new industry networks. Chobani, a flourishing dairy product manufacturer, recently moved in, noticing the state's longstanding dairy industry. Their demand for productive inputs motivated Fabri-Kal, a food packaging company researching the use of surplus wheat stubble to manufacture to biodegradable yogurt containers. The two companies' capabilities overlap with those of Glanbia, another international dairy company, also with expanding research facilities in Twin Falls.

Whether it is semiconductor or bio-plastic manufacturing, software publishing or agriculture, ultimately Boise, Twin Falls, and Idaho at large, will lean on their existing advantages. A strategy aimed at developing highly strategic, highly complex industries may be quite tractable and effective in Boise. Twin Falls may require an alternate approach. In either case, Idaho's more intangible capabilities, such as its resilient, pioneering, can-do attitude, constitute invaluable social capital as the capital city strives to transform. The state's access to the outdoors and its livability will continue to draw entrepreneurs the same way these characteristics spoke to David Packard nearly 50 years ago. The task for policymakers and local leaders is to plant the seeds and to build communities where any citizen can turn luck and grit into an American Dream.

Conclusion

The forces of recent economic progress—digitalization, automation, and global trade—have unleashed unprecedented prosperity around the world. These forces have made consumer goods more affordable, workplaces far safer, and have lifted millions of people out of poverty, giving rise to a global middle class. Yet this progress has also been disruptive, as these forces have brought about economic and social change faster than some people and societies have been able to adapt.

This is not the first, nor will it be the last, period of rapid economic and social change. We should not want it to be, either. We must ensure that society adapts to economic transformation in a way that puts people first. Adapting will require robust action from policymakers, business communities, and local organizations to tackle a host of worrying secular trends. These include a divergence of people and places, a decline in labor force participation, and financial precariousness among low-wage workers.

Policy tools must orient around cohesive goals that reinforce each other. Frameworks for inclusive prosperity should focus on charting paths that encourage purposeful growth, employment with dignity, upward mobility, and entrepreneurship. Cities, historically the dynamic engines of technology and creativity, are best-positioned to respond to local needs. Mayors, with support from state and federal policy, and in concert with business and community, can chart a course to capitalize on global progress.

Our findings highlight the value of complex and strategic diversification and illustrate the path dependence of metropolitan industrial development. We leverage these findings to project into the future. And having shown the model's out-of-sample predictive power (i.e., data taken from a different time period than the observation), we build tools to understand regional opportunity. Seizing that opportunity will require local knowledge and political consensus.

The goal of the framework presented in this report is to help in that task, by providing a data-driven guide, or a map, tailored to local industrial structures, driving toward complex, diverse, resilient places. Through four case studies, we demonstrate how the methodology provides a nuanced picture of how state and local decisionmakers may prioritize their investments. We do this by analyzing which industries will thrive given a metropolitan economy's existing industrial, human, and technological capabilities. Our findings can also help firms understand which metropolitan regions possess the talent and density of capabilities necessary to support their success.

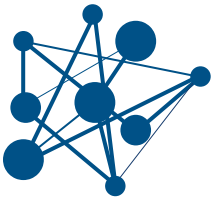
The findings and metrics on economic complexity presented here are not designed to be narrowly prescriptive about the industries metro areas should pursue. Rather, we hope they provide useful insights to decisionmakers and firms alike as they navigate growth opportunities. Most importantly, this work seeks to instill a capability-based approach to growth, in which firms specify the inputs they require to be productive and in which cities become more resilient and attractive as they invest in those inputs. This should in turn encourage a dialogue about the specific inputs needed for growth—from roads, to broadband, to clean energy, to specific know-how and talent.

As our research progresses, we hope to further inform how the industries expected to grow will in turn generate jobs and opportunities for existing workers. This will provide guidance for companies, reskilling organizations, and workforce programs to better tailor the content

of their programs to the industrial demand of their cities. As technology continues to bifurcate work and social outcomes, leaders will also need to innovate their social institutions. Broad access to a lifelong learning infrastructure will become key as specialized knowledge becomes a prerequisite for most jobs. Firms too need to take the opportunities afforded by automation to do things differently: Increase training, improve job quality, and contribute to lifelong learning.

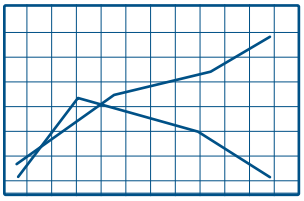
Just like work is changing—so should policymaking. Today, we have better data, more evidence of what works, and better tools to improve outcomes. New strategies are sorely needed as global trends render traditional policy ineffective and as many people and places are left behind. Inclusive growth leads to resilient people and places. It depends on nimble institutions that foster industry and support workers.

Key policy insights



Increase complexity of industrial composition. We find that economic complexity is correlated with urban success. *To grow and attract complex industries, focus on building capabilities.* Cities can chart a path to growth through strategic diversification of industry.

Identify industries that maximize feasibility and strategic gain. Often there is a tradeoff between industries that are feasible and those that offer the most potential growth. To chart a growth strategy, industrial development efforts should *consider both the ability of a city to host an industry, as well as the strategic value of that industry.*



Prepare for industrial growth and decline. Using our research to anticipate the growth and decline of industries, a city can *prepare for occupations that will be in demand by upskilling existing workers and attracting others* with existing skill sets. Understanding which industries are expected to contract will allow workers and cities to prepare.

Focus on capabilities in order to grow and attract industries. Although tax incentives may attract firms, they do not develop capabilities. Rather than engage in a race to the bottom, cities should *prioritize worker skills and infrastructure over tax incentives.* These efforts should be tailored to the specific requirements an industry needs to be successful.

Ensure growth industries fit local workforce skills and provide upward mobility. *Target industries that match a city's workforce skills, pay well, and offer worker benefits.* Foster entrepreneurial activity to enhance upward mobility by building a diverse economy with numerous complementary capabilities.

Develop institutional foundations for inclusive growth. *Offer affordable housing, lower commuting cost and time, and provide support and benefits that are linked to workers*, not just jobs. Support wage subsidies and other related policies which are good for both sides of the labor market.

Glossary and equations

In this section we provide brief definitions and equations for key terms and measures. For a more in-depth and technical discussion on the methods and findings, please see our working paper, "Economic Complexity and Technological Relatedness: Findings for American Cities."

Revealed Comparative Advantage (RCA): The ratio of the share of a given industry in a city's employment and the national share of the industry. We use it as an indicator of whether or not an industry is nascent in a city, when RCA < 1, or a specialization of a city, when RCA > 1. This signal is used to construct a matrix that connects each city to the industries in which it specializes.

$$RCA_{ci} = \frac{X_{ci}/X_c}{X_i/X}$$

Diversity: The number of industries a city hosts with an RCA greater than one.

$$\text{Diversity}_c = K_{c0} = \sum_i M_{ci}$$

Ubiquity: The number of cities in which an industry is found with an RCA greater than one.

$$\text{Ubiquity}_i = K_{i0} = \sum_c M_{ci}$$

Where, $M_{ci} = 1[RCA_{ci} \geq 1]$

Economic Complexity Index (ECI): A metric that describes cities and their implicit capabilities by capturing the ability of a city to host many industries while giving a higher weight to those that are less ubiquitous.

$$\text{Av. Ubq.}_c = K_{c1} = \frac{\sum_i K_{i0} * M_{ci}}{K_{c0}} \rightarrow K_{c2} \rightarrow \cdots \rightarrow K_{c\infty} = ECI_c$$

Industrial Complexity Index (ICI): A metric that describes industries and their implicit capability requirements by considering the diversity of the cities that manage to host that industry and the ubiquity of that industry around the country.

$$\text{Av. Div.}_i = K_{i1} = \frac{\sum_c K_{c0} * M_{ci}}{K_{i0}} \rightarrow K_{i2} \rightarrow \cdots \rightarrow K_{i\infty} = ICI_i$$

Proximity: A measure of the implicit overlap in capability requirements by two industries. Estimated by the degree to which two industries tend to cluster together in the same cities, it gives a minimum conditional probability for a city to be competitive in an industry given that it is competitive in some other industry.

$$\phi_{i,i'} = \frac{U_{i,i'}}{max(U_{i,i}, U_{i',i'})}$$

Where $\text{co-occurrence}_{i,i} = U_{i,i} = M_{ci}^T * M_{ci}$

Colocation Density (Feasibility): A measure of the implicit capability overlap between a city and a given industry. The measure summarizes the implicit proximity of all the industries present in a city to a given industry.

$$density_{c,i'}^{\text{implicit}} = d_{c,i'}^{I} = \frac{\sum_i M_{c,i} * \phi_{i,i'}}{\sum_i \phi_{i,i'}}$$

Occupational Density: A measure of the explicit capability overlap between a city and a given industry. The measure summarizes the explicit proximity of all the industries present in a city to a given industry. The explicit proximity metric is derived by estimating the minimum conditional probability that an industry (i) demands a given occupation with relative intensity given that (i') also does. The explicit proximity matrix uses the latest version of the Occupational Employment Statistics industry staffing patterns.

$$density_{c,i'}^{\text{explicit}} = d_{c,i'}^{X} = \frac{\sum_i M_{c,i} * \psi_{i,i'}}{\sum_i \psi_{i,i'}}$$

Strategic Index: A measure that assesses the quality of a city's position in the industry space. It conveys the value of all industries absent from a city weighted by each of their densities (how proximate they are to the rest of the local productive structure.)

$$SI_c = \sum_{\cdot} d_{c,i}(1 - M_{c,i})ICI_i$$

Strategic Gain: Captures the potential of a particular nascent industry (i) to improve the capabilities of a city through that industry's relatedness to more, and more complex, **nascent** industries (i').

$$SG_{c,i} = \left[\sum_{i'} \frac{\phi_{i,i'}}{\sum_{i''} \phi_{i'',i'}}(1 - M_{c,i'})ICI_{i'}\right] - d_{c,i}ICI_i$$

Appearance and Disappearance Probabilities: Probabilities of large RCA fluctuations from a model adjusted on both Colocation Density and Occupational Density against the recorded changes of industries' RCA at the city level within 5-year windows. We consider large RCA fluctuation as those in which the RCA goes from 0.05 and below to 0.25 and above, which starting at baseline, requires a specialization increase of 500%.

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