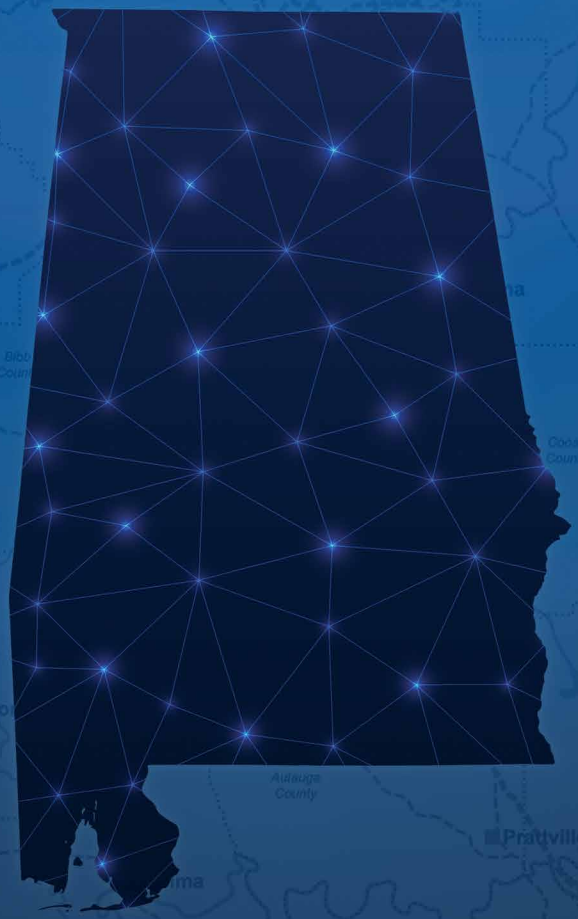
A REPORT BY THE HOOVER INSTITUTION

INNOVATIVE ALABAMA

Prepared for the Alabama Innovation Commission



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Foreword

CONDOLEEZZA RICE

Throughout 2020, Alabama, like most states, struggled to adapt its technology infrastructure to the global pandemic that forced students, workers, and the government into virtual learning and working environments. This dramatic shift highlighted the critical need for technology modernization and innovation at the state and local levels, particularly in education, and underscored the importance of public-private partnerships in developing technology solutions to make our communities more resilient.

This report is the result of a unique partnership between Stanford University's Hoover Institution and the Alabama Innovation Commission. The Alabama Innovation Commission, known as "Innovate Alabama," was created to "examine policies to increase entrepreneurship, spur innovation, and enhance technology accelerators." The commission aims to increase Alabama's competitiveness in the technology sector and educate a twenty-first-century workforce. Hoover Institution scholars contributed to these efforts through data-driven research that enhanced and informed the policy-making efforts of the commission. Together, the Hoover Institution and Innovate Alabama have focused on essential infrastructure upon which technology innovation depends—internet connectivity, internet literacy, access to technology, good governance, and a legal and regulatory environment in which entrepreneurship can thrive.

Since becoming the director of the Hoover Institution, I have emphasized the issues facing state and local government and challenged us to address them as we seek to improve the human condition, foster innovation, and promote initiative and ingenuity. I am proud of the accomplishments of this collaboration and believe that together we can continue to foster research-driven policies that provide better outcomes for our children, our communities, and Alabama's technology innovation sector.

Introduction

Alabama's leaders recognize that the state holds unlocked potential to grow and spread innovative industries across the state. Governor Kay Ivey convened the Alabama Innovation Commission to stimulate economic growth with a focus on entrepreneurship, innovation, and technology. The commission has made progress toward that goal with the signing of the Alabama Innovation Corporation into state law and the establishment of a federal grant–matching program for small businesses. These measures constitute an important step in creating the legal and financial infrastructure necessary to support an innovation ecosystem within Alabama.

A team from the Hoover Institution has written this report to build upon these efforts by conducting data-driven research to assess Alabama's infrastructure in its educational, legal, financial, governance, and physical aspects—all of which are necessary components to transform the state into an innovation hub. The goal of this report is to provide pragmatic, actionable policy recommendations to guide Alabama's leaders as they work to realize their state's full economic potential.

Crucially, Alabama already possesses two key assets. First, it already has important innovation hubs around Birmingham, which has distinguished itself as a thriving center for biomedical technology research and development, and around Huntsville, which boasts the Redstone Arsenal, Cummings Research Park, and NASA's Marshall Space Flight Center. Second, it has passionate, dedicated, and hardworking people in public service, universities, K–12 education, nonprofit organizations, and the private sector who are determined to build a more prosperous future for Alabamians. In our experience, this is an exceedingly rare asset—one which has no market price.

Innovation as the Basis for a Prosperous Society

Innovation is the creative act of seeing a demand curve for a product that may not yet exist, and then putting together the components necessary to bring that product or service to market. A canonical example is the iPhone. Introduced by Apple in 2007, it took the creative leap of combining a cellular telephone, a personal computer, a camera, and a music player into a single handheld device. The result was a completely new product. The global market for such devices, now generically known as smartphones and produced by dozens of firms, is roughly $400 billion per year.

Innovation is also the creative act of seeing how to produce an existing product or service more efficiently, and then realizing the results of that vision such that the price falls and the market expands. A quintessential example is the Swedish firm Spotify, which transformed

the way consumers purchase recorded music: instead of buying and owning audio content (e.g., records, tapes, compact discs, downloads), consumers access music by streaming it on demand for a flat fee. The product—recorded music—is the same. What Spotify changed was the unit cost; and in so doing it earned roughly $9 billion in revenues in 2020.

Successful innovations generate what economists call "Ricardian rents"—the ability to produce more revenue per dollar of input than the least productive producer in that same market. Some of those rents are captured by firms in the form of higher profits than those of their competitors. Some of the rents are captured by government in the form of higher tax revenues than it would have received otherwise, allowing it to finance more public goods, such as roads and schools. Some of the rents are captured by the firm's employees in the form of higher wages than they would have earned otherwise. Those rents are then shared more broadly, as those workers consume housing, food, entertainment, and other services produced by construction firms, restaurants, movie theaters, and the like. Innovation and the Ricardian rents it generates are, in short, the basis for a prosperous society.

Innovation Is People

If innovation is such a good thing, then why don't we see it happening everywhere? The short answer is that innovation is the outcome of cooperation and competition among people with complementary skill sets who have access to investable funds. Some of those people know how to invent new technologies. Others know how to combine technologies that already exist in novel ways. Still others know how to secure financing, write contracts, navigate regulatory mazes, build prototypes, set up manufacturing facilities, and market consumer products. Yet other people, who have saved more than they consume, invest their savings in the people with specialized skills.

Innovation therefore happens in environments in which the educational, financial, legal, governance, and physical infrastructure incentivizes a pool of people with complementary assets—whether those assets be human capital or financial wealth—to come together to take calculated risks. Getting them to do that—to collocate, cooperate, and compete—requires that it be common knowledge that calculated risk taking will be rewarded. Those rewards come in three forms: 1) a share of the Ricardian rents earned by the people who took the risk of investing in their human capital; 2) a share of the Ricardian rents earned by the people who took the risk of investing their savings; and 3) a share of the Ricardian rents allocated to the public goods—the non-rival and non-excludable goods that are essential to the functioning of a society—necessary to sustain life, liberty, and the pursuit of happiness.

The Crucial Role of Government

Government, as the principal producer of educational, legal, financial, governance, and physical infrastructure, plays a crucial role in innovation. Without that infrastructure, people with specialized knowledge and skill sets, and people with investable savings, move elsewhere.

Our recommendation to the Alabama Innovation Commission (AIC) is, therefore, that the state government move simultaneously on a range of infrastructural investments. We provide summary statements about each of these components in the paragraphs below, with more complete discussions in the chapters that follow. We underline, however, that while we discuss these investments individually, we consider them to be mutually reinforcing and mutually dependent.

The Role of Universities in Fostering Innovation and Growth

Universities play a vital role in the development of their local economies and in the innovation ecosystem. In the short run, university students boost their local economies. In the long run, universities can provide skilled human capital. Their graduates can become the leaders in an innovative economy for years to come. In order to accomplish that goal, however, universities must succeed in producing this pool of talented people and in providing a framework that retains them. In chapter 1, "The Role of Alabama Universities in Fostering Innovation and Growth," Joshua Rauh, Natalie Millar, and Gregory Kearney argue that Alabama needs to strengthen the link between its universities and innovation. Various indicators and rankings of innovative practices and behavior show consistently that Alabama finds itself in the middle to bottom third of the country. Rauh, Millar, and Kearney argue that Alabama has an opportunity to develop curricula and academic environments within its universities to attract and keep talented students who are focused on innovation.

To strengthen innovation within universities, Rauh, Millar, and Kearney suggest that Alabama replicate Wisconsin's Alumni Research Foundation (WARF). WARF is an independent, nonprofit corporation run by alumni trustees of the University of Wisconsin that manages the university's patented technologies and invests the revenue to support future university research. While WARF receives substantial funding from investment returns, the bulk of its revenues stems from contributions. The Alabama Innovation Corporation, which was established in May 2021, provides an entity that could potentially emulate WARF.

In addition to creating an entity that provides financial support for innovation, Rauh, Millar, and Kearney suggest that Alabama's universities would benefit from having offices of technology licensing (OTLs) that assist in the commercialization of technology developed at the universities and ensure that some returns from the innovations accrue to the universities. This requires that the individuals who staff the OTLs understand the long-term processes and potential benefits from innovation. It also requires that they are able to connect academics with market opportunities.

Rauh, Millar, and Kearney also suggest that Alabama's universities may want to create new programs that focus on entrepreneurship within MBA programs. In addition, they suggest

that universities use these programs to connect students with successful entrepreneurs, thus improving entrepreneurial quality and impact.

Finally, Rauh, Millar, and Kearney stress the need to invest in amenities that promote strong quality of life in cities and areas surrounding universities, to create an environment in which potential faculty and alumni entrepreneurs will remain and locate their innovative activities.

Outdoor Recreation Infrastructure

In chapter 2, "If You Build It, They Will Come: High-Skill Workers and Alabama's Outdoor Recreation Infrastructure," Alexander Galetovic, Stephen Haber, Jordan Horrillo, and Isabel Lopez develop the idea of quality of life further by arguing that a crucial component to establishing an innovation ecosystem within a state is retaining and attracting human capital. They show that Alabama is exceptionally well endowed with a vast array of natural assets that can be leveraged to expand its outdoor recreation industry, enhancing the state's attractiveness for high-skilled individuals, as well as yielding substantial returns for both rural and urban communities.

Galetovic, Haber, Horrillo, and Lopez also show, however, that Alabama has not invested in its outdoor recreation infrastructure at the same scale as neighboring states. To convert its endowments into assets, the state should ramp up spending on outdoor recreation infrastructure. Funding may come from combining private philanthropy, state funds, federal funds, and revenues from user fees. Because projects will generate externalities and incremental economic activity, over time they will also generate higher tax revenues for the state.

The primary recommendation of Galetovic, Haber, Horrillo, and Lopez is the creation of a joint commission for outdoor recreation infrastructure, named by the governor, that includes broad representation across the public, private, and nonprofit sectors to expand the supply of outdoor infrastructure throughout the state. The joint commission is not a replacement for any state agency, higher education center, nonprofit organization, or private initiative. Quite the contrary, its purpose is to reinforce them. The joint commission might include: the commissioner of the Alabama Department of Conservation and Natural Resources; the director (or a program director) of the University of Alabama Center for Economic Development; the leaders of nonprofit organizations with long-standing interests in promoting outdoor recreation and conservation, or with interests in promoting an innovative Alabama economy, such as the Freshwater Land Trust, Alabama Audubon, the Nature Conservancy, Ducks Unlimited, the Alabama Trails Foundation, and the Economic Development Partnership of Alabama; the mayors of three or four cities; a number of outdoor recreation entrepreneurs operating small-scale firms; and representatives from Alabama-based firms and foundations with demonstrated philanthropic track records.

The joint commission would have three primary goals. First, it would draw on Alabama's Statewide Comprehensive Outdoor Recreation Plan (to be released in 2022) to identify projects that would generate significant positive externalities for the state, and then estimate the scale of the necessary investment. Second, the joint commission would be a vehicle through which funding sources, beyond those already in place, would be identified and pursued. One such source might be the Infrastructure Investment and Jobs Act (H.R. 3684) that is winding its way through Washington, DC. Third, the joint commission would work with state agencies, municipalities, nonprofit organizations, and the private sector to plan outdoor recreation infrastructure projects, select developers, distribute funds, and ensure delivery of projects and services.

Supporting Advanced Manufacturing in Alabama

Since 2010, Alabama has seen a robust rebound of manufacturing, both in its larger cities and nonmetro areas. Much of this manufacturing activity involves new investments and sophisticated techniques, and a sizable share is linked to firms with links to Germany, a country that is at the technological frontier of advanced manufacturing.

In chapter 3, "Supporting Advanced Manufacturing in Alabama," Jonathan Rodden argues that Alabama can solidify its position as one of the most dynamic manufacturing areas in the United States if it continues to build an infrastructure to support advanced manufacturing along the lines of the German model of collaboration between government, educational institutions, and the private sector.

Rodden stresses that Alabama has already made impressive investments in workforce training. The next step is to build robust institutions that help bridge what he calls the "valley of death"—the gap between abstract or academic innovations and their commercial application in the marketplace. The German model is of particular interest to Alabama because it links research on the one hand to application on the other.

Rodden explains that the Fraunhofer institutes, a set of seventy-four public-private applied research institutions organized around specific scientific fields and areas of research, are at the center of the German model. Private and public entities—universities, large corporations, small- and medium-sized enterprises, research organizations, and trade associations—can enter into research contracts with Fraunhofer and gain access to vast collaborative networks and a wealth of focused expertise. The institutes employ permanent staffs of scientists and technicians, along with a rotating group of experts from universities and other institutions. Each institute focuses on applied research in a specific area that often corresponds to a cluster of regional private-sector firms in areas such as optics, lasers, wind energy, and automotive research. Funding combines direct government support, contracts with government entities, and private-sector contracts.

Rodden's proposal is to mobilize existing links with German firms, researchers, and officials to study the German system of institutional support for advanced manufacturing, paying special attention to Fraunhofer and the network of related institutions in the Stuttgart region. He suggests that the Alabama Innovation Commission consider the creation of a delegation that is tasked with exploring whether there are specific aspects of what might be called the "Stuttgart model" that can be applied in Alabama.

Tax Policy, Subsidies, and Innovative Business Investment in Alabama

Innovation and economic growth emerge from a combination of factors and policies, and one of them is tax policy. In recent years Alabama has updated its business tax code and established new incentives for innovative business investment. That legislation includes the Alabama Jobs Act of 2015, the Alabama Incentives Modernization (AIM) Act of 2019, and H.B. 540 and H.B. 609 in 2021. The latter two bills establish the Alabama Innovation Corporation and grant-matching programs for small businesses.

In chapter 4, "Tax Policy, Subsidies, and Innovative Business Investment in Alabama: Past and Prospect," Joshua Rauh and Gregory Kearney provide an initial analysis of the effects of these legislative measures. Overall, they find no statistically robust evidence that the Jobs Act caused Alabama counties to outperform the counties in neighboring states in terms of job growth. They also find no evidence consistent with the hypothesis that targeted Alabama counties outperformed nontargeted Alabama counties. Based on this initial evidence, they argue that these results call into question how useful any new or additional jobs credit programs might be. More generally, they argue that the rules that govern tax relief are often cumbersome and costly for small- to medium-sized businesses to navigate. Instead, they recommend simplifying the tax code by replacing some of the existing, specific tax incentives with broader cuts in the corporate and sales tax rates. They also recommend that the remaining incentives be simpler, of shorter duration, and highly targeted.

Based on existing research on innovation-specific financial incentives, Rauh and Kearney also recommend that the AIC establish venture capital funds that match private investments in companies seeking to move to Alabama. They suggest structuring AIC's programs with guidance and rules similar to those used by Launch Tennessee in its INCITE Co-Investment Fund and Impact Fund, which match private investment in companies seeking to move to Tennessee. One key aspect of their proposal is that for a business to qualify for some amount of co-investment, investment fund dollars must be matched by private dollars, thus providing a market test for fund allocation.

Finally, Rauh and Kearney recommend an amendment to the AIM Act that would remove the requirement to include state funds from the qualified opportunity zone fund designation and replace the "state funds" guarantee of downside losses with some degree

of co-investment to be applied from the future Alabama Innovation Fund (AIF) specified in HB 540, with the AIF having some input to the process. This would eliminate a blanket state guarantee and improve governance around investment decisions.

Establishing the Foundation for Economic Growth: The Alabama Education Laboratory

In chapter 5, "Establishing the Foundation for Economic Growth: The Alabama Education Laboratory," Eric A. Hanushek proposes an independent education laboratory to conduct systematic research and evaluation of Alabama's schools. Hanushek notes that the performance of Alabama's students is currently not comparable to that of students in other US states or other countries that are in direct economic competition. Improving the K–12 schools in Alabama is not a onetime event but a protracted process that must continue over decades. However, long-run growth and development is unlikely to be possible without improvement of the labor force in Alabama.

Hanushek also notes that the state currently lacks the institutional capacity to evaluate new and ongoing education programs and policies so that successes can be expanded and failures curtailed. He also notes that this is an opportune time to develop such a laboratory: there is the COVID-induced critical need for improving Alabama's schools; and there is funding available from the federal American Rescue Plan.

According to Hanushek, the work plans of the education lab would be developed in consultation with existing educational institutions, relevant state departments, and individual school districts. The education lab would also be charged with providing a biennial report on the state of Alabama education, assessing the achievement of Alabama students, their high school graduation rates, and their entry into college and careers. It would provide detailed analysis of the progress of students toward meeting the overall goals of Alabama's plan under the Every Student Succeeds Act, along with an update on the results of its various evaluations and research activities. Finally, the education lab would work with the legislature and with the Department of Education to design appropriate evaluations of new programs before they are implemented. By working with programs before they begin, it is possible to get baseline information and to establish appropriate control groups for evaluations, thus obtaining the most useful information about the effectiveness of new initiatives.

To ensure the education lab's credibility, Hanushek suggests that the results of any analysis would be made public in order to insulate the work from political manipulation. More generally, the education lab would produce its own work and facilitate work by outside researchers. Hanushek argues that the nature of the evaluation and policy issues surrounding schools means that other states can both gain from the insights that would be generated by an Alabama education lab and can provide their own insights to Alabama.

Broadband Infrastructure for Education

In chapter 6, "Alabama Broadband for Education," Sofoklis Goulas, Chunping Han, and Margaret E. Raymond examine the state's commitment to expanding broadband coverage throughout Alabama through the lens of public K–12 education. Current broadband expansion plans can be strengthened if they are grounded in specific needs and uses. They propose that ensuring access to broadband for all Alabama schools and extending broadband coverage to all households with K–12 students could provide critical infrastructure for rapid improvements in school quality. Making broadband for education a priority would open other ways to leverage the investment in health, employment, civics, and public safety.

Goulas, Han, and Raymond argue that universal classroom access to broadband is necessary because it allows coteaching, professional development, and support of student learning in more efficient ways. Moreover, Alabama can realize substantial returns on future broadband investment if it makes coverage of households with K–12 students a priority. Students would have access to digital resources to support their learning regardless of location.

Goulas, Han, and Raymond estimate that by ensuring access for all students, each future graduating cohort will add 2,483 students to the set of college-educated adults. They estimate cumulative gains in personal income over the twenty-year useful life of the fiber equipment at roughly $5.5 billion. After deducting the state's investment, the estimated social welfare return on investment would be 214 percent.

Final Remarks

One of the central themes of the six chapters is that remarkable developments are already taking place in Alabama. These have been pushed forward by talented, dedicated, and passionate individuals in public service, universities, K–12 education, nonprofit organizations, and private enterprise. Investments by the state in educational, legal, financial, governance, and physical infrastructure would not be starting from scratch but would constitute enhancements to an already existing asset: Alabama's people.

1. The Role of Alabama Universities in Fostering Innovation and Growth

JOSHUA RAUH, NATALIE MILLAR, AND GREGORY KEARNEY

This paper also draws on student work conducted as part of the Stanford GSB Spring 2021 Policy Lab by the following contributors. From Stanford GSB: Jonathan Hurowitz, Eric Kotin, Drake Pooley, Tim Rosenberger. From Alabama universities: Jouvens Blanchard (Tuskegee); Jordan Windham, Trey Sims (Auburn); Annisha Borah, Mathew Banker (University of Alabama at Birmingham); DeAndre Grandison (Alabama A&M). We are also grateful to Nate Burns for research assistance.

EXECUTIVE SUMMARY

Universities play a vital role in the development of their local economies and in the innovative ecosystem. Although the direct share of universities in patenting is relatively low, there is no denying that technologies developed within universities, as well as start-ups founded by university faculty and alumni, have been revolutionary.[1] The innovative activity of universities also plays an important role in local economic development. In the short run, university students of course provide economic boosts to their local economies. In the long run, universities can provide skilled, ambitious human capital to local economies that can become the leaders of these areas for years to come—if they succeed in both producing this talent and providing a framework that retains talent created.

In preparing this study, we conducted analysis on innovative activities of universities in Alabama and interviewed numerous stakeholders in both academia and private industry. Our work led us to the following recommendations:

1. Invest in amenities that promote strong quality of life in cities and surrounding areas around universities to create an environment in which potential faculty and alumni entrepreneurs will remain and locate their innovative activities.

2. Develop an entity similar to the Wisconsin Alumni Research Foundation (WARF) that promotes investment into innovative start-ups at universities in Alabama.

3. Encourage universities in Alabama to adopt best practices with respect to technology transfer ensuring optimal incentive structures.

4. Create new programs at current universities in Alabama that focus on entrepreneurship within MBA programs and use these programs to connect students with successful entrepreneurs and improve entrepreneurial quality and impact.

Introduction

Universities have historically been viewed as institutions of knowledge, readying students for both life and career challenges. However, recently universities have taken on an additional role by contributing to the economic development within their respective regions by facilitating and supporting knowledge spillovers through innovation. Specifically, leading universities in particular are expanding their role from simply a knowledge hub to both a knowledge and an innovation center, acting as broker, liaison, and mediator facilitating and supporting technology transfer between the university and the community.[2]

Technology transfer offices at universities are the intermediary between the university, industry, and government organizations. Existing literature indicates that regions are more successful with technology transfers when they partner with other research universities within their respective states or regions, government laboratories, nonprofit research organizations, or private-sector research and development (R&D) units.

Entrepreneurship and technological innovation at universities are also factors of firm location. Juan Alcácer and Wilbur Chung find that firm location decisions depend on the level of academic knowledge and innovative activity as well as potential knowledge spillovers.[3] Furthermore, there are several benefits of attracting innovative firms and facilitating a relationship between the firm and the university. First, Shawn Kantor and Alexander Whalley measure a positive and significant effect for university research activities and productivity gains in local firms.[4] Second, Anna Valero and John Van Reenen find that the relationship between the number of universities and GDP growth depends on increased human capital and innovation.[5] Third, Nicholas Bloom et al. find that disruptive technologies have long-lasting returns for the area where the technology originated; these returns occur in areas with a strong local education, research institutions, and universities.[6]

Alabama, like many states, is fertile ground for the creation of a similar type of innovative environment between its universities and firms. In this report, we examine the current state of innovation in Alabama with respect to universities and compare Alabama's progress to neighboring states. Additionally, we aim to provide an exhaustive list of ideas and considerations from individuals within both academic and private spheres who have the necessary skill sets and knowledge bases to provide useful insight into making Alabama a center of innovation that attracts the best and brightest to the state.

We aim to achieve this by providing specifics about the current status of innovation in Alabama through an analysis of the state's patent production relative to its neighbors.

We then delve into a literature review that provides better context surrounding the necessary conditions in attracting entrepreneurial human capital and developing a culture of innovation within the state. Finally, we provide four specific takeaways and recommendations for the Alabama Innovation Commission (AIC) to consider as initial action items.

The Current Landscape for Universities and Innovation in Alabama

Research institutions such as the Milken Institute and the Brookings Institution have compiled rankings and indexes that evaluate types of innovation in the United States. We report their findings along with data from the United States Patent and Trademark Office in an attempt to evaluate the current landscape for innovation produced by universities in Alabama.

A popular measure of innovation is the number of patents and patent citations produced.[7] For the past ten years, Alabama has ranked between 34th and 37th in the United States for total patents and utility patents according to the United States Patent and Trademark Office. Total patents include utility, design, and plant patents. Of these, utility patents are deemed the most innovative, and most patents produced in all states, including Alabama, are utility patents.

Universities in Alabama as well as universities in other states are not the top producers of patents relative to other entities. From 2011 to 2019, universities in Alabama produced 602 of the 2,841 patents, or approximately 21.19 percent of the patents produced in the state.[8]

In 2017, the Milken Institute ranked the best universities for technology transfer using the Technology Transfer and Commercialization Index. This index weights patents issued at 15 percent, licenses issued at 15 percent, licensing income at 35 percent, and start-ups formed at 35 percent. Using data from 2012 to 2015, the index ranked 225 universities in the United States. Of the 225, the University of Alabama ranked 135th, the University of Alabama in Huntsville (UAH) ranked 137th, Auburn University ranked 141st, the UAB (University of Alabama at Birmingham) Research Foundation ranked 155th, and the University of South Alabama ranked 161st. Each of the five universities ranked in Alabama were strongest in licensing income. The University of Alabama and the University of Alabama in Huntsville received the least weight from licenses issued. Auburn University and the UAB Research Foundation received the least weight for start-ups formed. Finally, the University of South Alabama received the least weight for patents issued.[9]

In a 2019 analysis, the Brookings Institution's *Information Technology and Innovation Foundation* report selected thirty-five metropolitan areas that have the potential to become one of the nation's growth centers. Birmingham, Alabama, was one of the thirty-five selected for its strengths in innovation and workforce development. The areas chosen were required to meet a population and innovation sector job growth benchmark. Second, the Brookings Institution created an Eligibility Index that highlights the potential

for innovation and workforce development. The factors for the index included STEM (science, technology, engineering, and mathematics) R&D spending, patent activity, and the availability of skill-based labor. Of these criteria, Birmingham was in the top half for university STEM R&D spending and was in the bottom half for patent activity and the share of the labor force with a bachelor's degree and STEM doctoral degrees. Birmingham, Alabama's Eligibility Index score was comparable to that of Knoxville, Tennessee, and Dayton, Ohio.[10]

In addition, the Brookings Institution's *State of the Heartland: Factbook 2018* reported on entrepreneurship and innovation. Brookings estimated the share of jobs from new firms as a measure of entrepreneurship in the Heartland. In 2016, 9.8 percent of jobs in Alabama were from new firms created in the last five years. This statistic decreased slightly from 11 percent in 2010.[11] The share of jobs formed from new firms is comparable to others in the Heartland region including Alabama's neighboring states, yet Alabama's share is less than those not in the Heartland. As for innovation, the report refers to the Milken Institute's *State Technology and Science Index*.

The *State Technology and Science Index* is reported biannually. It uses five indicators to evaluate a "state's capacity for achieving prosperity through scientific discovery and technological innovation."[12] Theses subindexes include research and development, risk capital and entrepreneurial infrastructure, human capital investment, technology and science workforce, and technology concentration and dynamism.

Overall, this index ranked Alabama 32nd in the nation in three of the last four reports (2014, 2018, and 2020) and 37th in 2016. In 2020, Alabama's overall rank bested Florida (33rd), Mississippi (50th), and Tennessee (40th), while falling short of Georgia (22nd). Looking at the five subindexes gives a clear picture of Alabama's strengths and weaknesses relative to neighboring states.

The first subindex uses data on research and development inputs to account for technology transfer from universities into the private sector. The Milken Institute forms research and development scores using federal, industry, and academic R&D funding as well as National Science Foundation funding and higher education spending in STEM fields. When it comes to funding, the Walton Family Foundation report, *The American Heartland's Position in the Innovation Economy*, states that at least 60 percent of research and development funding comes from industry where the remainder comes from university funding and federal government funding.[13]

In 2020, Alabama ranked 23rd for research and development. Alabama performed well relative to its neighboring states, surpassing Georgia (32nd), Mississippi (45th), Florida (39th), and Tennessee (35th). Additionally, Alabama's rank was up from 24th in 2018 and 28th in 2016 but down slightly from 2014 when the state ranked 22nd.

The second subindex is risk capital and entrepreneurial infrastructure. The Walton Family Foundation report emphasizes start-ups including those at universities that need crowdfunding, angel investing, and venture capital. Specifically, this subindex examines venture capital investment and growth, small business investment company (SBIC) funding, patents issued, start-ups created, IPO investment, and venture capital investment in specific technologies: nano, clean, and bio.

In 2020, Alabama performed poorly, ranking 46th for risk capital and entrepreneurial infrastructure. Alabama ranked behind Tennessee (26th), Florida (16th), and Georgia (20th) but slightly above Mississippi (48th). Additionally, it is important to mention that Alabama's ranking in this area has been moving in the wrong direction, as this was the state's worst performance in the last four reports (i.e., 39th in 2018, 38th in 2016, and 45th in 2014).

The third subindex is human capital, which was coined as the most important for intellectual property by the Walton Family Foundation. The authors of the report emphasize the rate of return for investing in education. This subindex accounts for the proportion of a state's population that has obtained a higher degree, student aid spending, ACT scores, appropriations for higher education, percentage of population with a doctorate in science or engineering, PhDs awarded and number of graduate students in science, engineering, and health, recent higher education degree awards for science and engineering, and percentage of households with computers and access to broadband.

In 2020, Alabama ranked 36th for human capital investment. Alabama, again, was able to best Mississippi (46th), Tennessee (40th), and Florida (42nd) but fell short of Georgia (26th). Alabama's ranking was slightly better than its rankings in 2016 and 2018 when it ranked 42nd and 38th, respectively; however, this improvement was simply a return to its ranking from 2014 when Alabama also ranked 36th.

The fourth subindex relates to technology and science in the workforce. The Walton report states clustering STEM workers leads to knowledge spillovers, which significantly increases productivity. It also states that skilled technicians without advanced degrees aid in economic growth as well as in research and development. Milken's technology and science workforce subindex examines the proportion of workers specializing in computer and information science, engineering, and life and physical sciences.

In 2020, Alabama ranked in the middle of the pack at 24th for technology and science in the workforce. This rank proved exceptional for the region, as the state outranked Mississippi (48th), Tennessee (45th), Georgia (30th), and Florida (47th). Alabama's ranking in this area improved greatly in 2020 relative to the last few reports where the state was ranked 33rd (2018) and 34th (2016 and 2014).

The fifth and final subindex is technology concentration and dynamism, which are included to measure high-tech business activity. Furthermore, this measure indicates whether public policy implemented leads to successful innovation outcomes. The technology concentration and dynamism subindex by Milken examines the concentration, employment, salaries, and growth associated with high-tech industries.

In 2020, Alabama, again, ranked in the middle of the pack—28th for technology concentration and dynamism. Alabama's ranking was above Mississippi's (50th) and Tennessee's (33rd) but was significantly below Georgia's (9th) and Florida's (16th). While falling short of a couple of states, Alabama's ranking still was up from 29th in 2018, 35th in 2016, and 39th in 2014.

Throughout these different indicators and rankings of innovative practices and behavior, Alabama fairly consistently finds itself in the middle to bottom third of the country. With this in mind, there is a great deal of room for improvement in developing curricula and academic environments within Alabama universities that will attract and keep talented students who are focused on innovation.

Analytic Findings

Through discussions with stakeholders at twelve prominent universities (Auburn, Alabama A&M, University of Alabama in Huntsville, University of Alabama at Birmingham, Troy University, University of Alabama, University of North Alabama, University of North Carolina, Tuskegee, Stanford University, University of Virginia, and University of Texas–Austin) along with five ecosystem partners (Venture For America, Heartland Forward, Innovation Depot, Alabama Futures Fund, and Birmingham Bound) and reform organizations that include the Cicero Institute, we conducted an analysis and literature review designed to better understand how universities can assist in making Alabama more competitive relative to other states by bringing more businesses and entrepreneurship to Alabama.[14]

Through these conversations with the aforementioned relevant stakeholders, and through our own analysis of existing university-related patent data, we examine the impact of universities' innovation and compare it to surrounding state universities (i.e., universities in Georgia, Florida, Mississippi, and Tennessee). We then discuss environmental factors that can lay the necessary groundwork in attracting the best talent to create a culture of innovation within Alabama.

Patent Data Findings and Summary

Wharton Research Data Services (WRDS) was used in preparing this analysis on universities in Alabama.[15] These data were directly parsed from the United States Patent and Trademark

Table 1. Summary of patent data by state

State	*Total patents from universities*	*Total patents within the state including those from universities*	*Percentage of patents from universities*
Alabama	602	2,841	21.19%
Georgia	3,477	26,499	13.12%
Florida	987	31,766	3.11%
Mississippi	119	586	20.31%
Tennessee	1,538	8,394	18.32%

Office, and the data sets consist of patents and citations in Alabama, Georgia, Florida, Mississippi, and Tennessee. For the purposes of this analysis, the dates for collected data range from 2011 through 2019. It is important to note that patents are not the only measure of innovative output. For example, software is an innovative output that does not always seek patentability. Therefore, it is important to take into account some of the limitations in the subsequent analysis.

From 2011 to 2019, universities within Alabama and its neighboring states produced 6,273 patents (see table 1). Combining the Wharton Research Data Services with Google Patents' data allowed for an investigation into total citations, patent citation, and nonpatent citations. Citations for patents are a measure of patent quality and productivity.

On average, patents produced by universities in Alabama have 57.51 total citations. A comparison of total citations of universities within Alabama to those of universities within neighboring states shows that universities in Alabama produce approximately the same number of total citations per patent as universities in Georgia and Tennessee. On the other hand, universities in Alabama produce significantly more citations per patent than universities in Florida and Mississippi.

Patent citations are a measure of how innovation leads to further patent innovation. On average, patents produced by universities in Alabama have 20.67 patent citations. A comparison of patent citations of universities within Alabama to those of universities within neighboring states reveals that Alabama's patents lead to a similar number of patent citations as Georgia's. Additionally, Alabama produces significantly more patent citations than Florida, marginally significantly more than Mississippi, and significantly less than Tennessee.

Nonpatent citations are a measure of how innovation leads to further research such as literature that is not patented. On average, patents produced by universities in Alabama have

Table 2. Summary of patent data by university

University	*Percentage of total university patents*
Auburn University	24.25%
University of Alabama at Birmingham	41.36%
University of Alabama in Huntsville	8.31%
University of South Alabama	4.65%
Alabama State University	0.50%
University of Alabama	19.27%
Tuskegee University	1.66%

Table 3. Summary of growth rates per state (2011–2019)

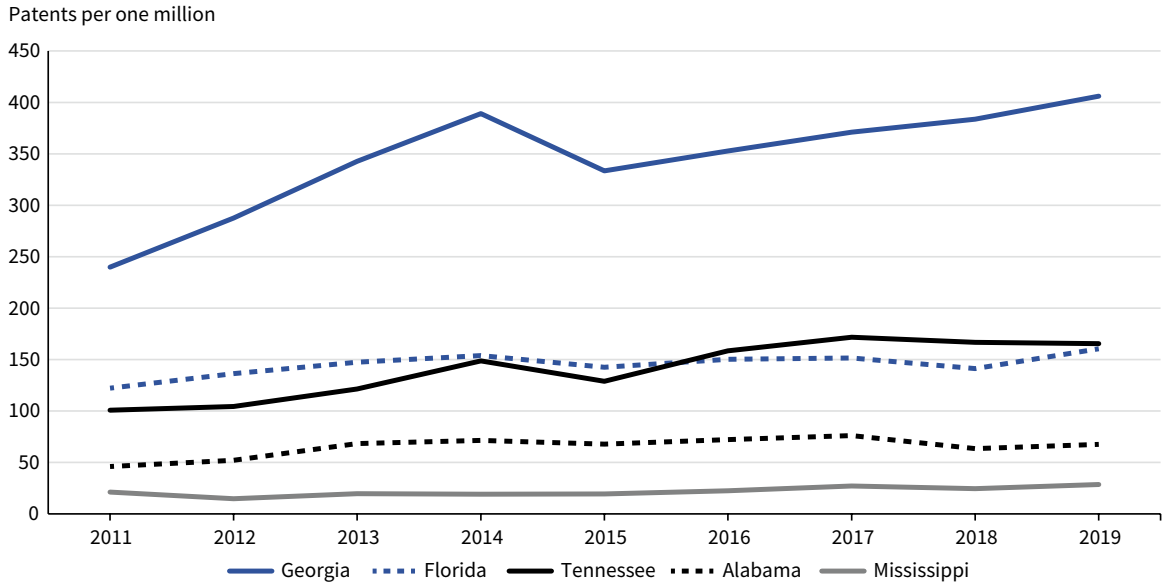
State	*Patents per capita growth rate*
Alabama	0.47
Florida	0.31
Georgia	0.69
Mississippi	0.35
Tennessee	0.64

36.85 nonpatent citations. In a comparison of nonpatent citations of universities within Alabama to those of universities within neighboring states, Alabama's patents are shown to lead to significantly more nonpatent citations per patent than patents in Florida, Mississippi, and Tennessee. On the other hand, patents produced by universities in Alabama lead to marginally significantly less nonpatent citations than those in Georgia.

Auburn University, the University of Alabama, the University of Alabama at Birmingham, and the University of South Alabama produce the most cited patents. These four universities also have significantly more nonpatent citations compared to other universities in Alabama. Additionally, the four universities along with the University of Alabama in Huntsville have significantly more patent citations compared to other universities within Alabama (see table 2).

Patents per capita are one way to measure statewide innovation. Although Alabama has the highest percentage of patents coming from universities compared to its neighboring states, Alabama does not fare as well for overall patents per capita as evidenced by figure 1; Alabama falls behind Florida, Georgia, and Tennessee in patents per capita. Moreover, Alabama's patent per capita growth rate across the nine years is larger than the growth rate in Florida and Mississippi but less than that in Georgia and Tennessee (see table 3).

Figure 1. Patents per one million by state, 2011–2019



Sources: US Census Bureau; Wharton Research Data Services.

All in all, since 2011, Alabama comes second to last in producing patents (see figure 1). Although Alabama produces fewer patents than its neighbors, universities in Alabama contribute more to total patents than universities in neighboring states. Patents produced by universities within Alabama are competitive for patent citations and nonpatent citations. Therefore, universities within the state are producing competitively innovative patents that advance the literature and lead to further innovation. To remain competitive with neighboring states, Alabama should focus on increasing total patent production while maintaining its current quality of those patents produced.

Attracting Talent

Research from Glaeser, Kerr, and Ponzetto suggests that areas with higher levels of firm birth have lower fixed costs and a greater supply of entrepreneurs.[16] The challenges related to fixed costs are addressed in the chapter on taxation policy. However, regarding the question surrounding the human capital problem related to new firm growth, this report highlights the geographic characteristics that are most important to attract and retain highly skilled talent.

Over the last twenty years, Nashville, Tennessee, has become a destination for technology, culture, and business investment. In 2020, Inc.com rated Nashville as one of the best places to start your business, claiming that "the musical city is finding its voice as an emerging tech and fashion hub."[17]

Since 1990, Nashville has growth at ~3 percent year-over-year (YoY).[18] Today, greater Nashville is home to 1.96 million people, generates $140 billion in gross domestic product, and has extremely competitive income and employment numbers ($64,000 median household income paired with 2.6 percent unemployment pre-COVID). Countless larger technology companies, small entrepreneurs, and investors have targeted Nashville for relocation.

Yet, in 1990, the population of Nashville was 577,000, while the population of Birmingham was 623,000, and both had been experiencing 1–2 percent YoY growth. Nashville's trajectory separated itself from Birmingham and other southern cities around this time through a confluence of events. For one, the city was able to obtain two major professional sports teams—the Tennessee Titans and the Nashville Predators. Couple these changes in entertainment with effective tax policy (i.e., low taxation only on income from interest and dividends), and the city thrived. A clear success that resulted from these changes was the United Auto Workers' decision to remain in Nashville without any guaranteed incentives due to the fact that union members wanted to continue living in Nashville because of the sports teams the city had secured a year earlier.

A review of the broader literature largely supports Nashville's approach to taxation and quality of life. According to Richard Florida, areas that are energetic and vibrant are much more attractive to highly educated, talented people.[19] These characteristics are at such a premium that these individuals are willing to spend more money on housing and general living expenses to ensure that they acquire this standard of living. Further, he concludes that attracting and retaining a highly skilled talent pool is a key intermediate variable in ultimately attracting high-technology industries and generating higher regional incomes.

These results are largely consistent with a wider body of literature surrounding regional development that includes the work of Jane Jacobs and Robert E. Lucas Jr., the empirical findings of Edward L. Glaeser, and the writings of others.[20] These writers suggest that talent is *the* primary factor in jump-starting regional development. They further suggest that talent is not necessarily a geographical given but rather a consequence of certain geographical conditions and local initiatives. Therefore, policy makers should focus their attention on instituting policies that foster environments that attract such talent.

Recommendations and Ideas for Implementation

Having reviewed the ideas and findings from the stakeholders as well as assessing the current standing of Alabama universities, this report presents the following recommendations for Alabama universities in fostering an innovative ecosystem within Alabama. The recommendations are as follows:

Investments in Entertainment and Quality of Life

According to the stakeholders interviewed, a key area to consider when making Alabama a sought destination is investment in entertainment, restaurants, and other such quality-of-life-focused areas. This perspective is backed by recent research. The American Institute for Economic Research (AIER) shows millennials do not just move for a job. Instead, around 70 percent of young college graduates decide where to relocate based on quality-of-life factors such as a robust restaurant scene and good mass transit.[21] These survey data are further bolstered by the wider aforementioned academic literature, which suggests that culture is a necessary condition in fostering a growing innovative tech sector.

With this in mind, cities in Alabama should emphasize and develop their appeal as a cultural destination for tourists and residents alike. We highlight three specific endeavors that Alabama should consider in attracting talent:

First, Alabama could consider hosting or supporting a milestone event. For example, Austin, Texas, attributes much of its growth and reputation as a thriving tech city to South by Southwest (SXSW) and Austin City Limits (ACL). The city provides incentives such as free real estate and free support services that allow the event to be successful. In turn, SXSW in particular has allowed Austin to make a name for itself as a knowledge center. Together, SXSW and ACL bring those from outside Texas into the state, to see and experience what it might be like to reside there. Alabama could benefit from bringing people into the state through a cultural event, as it would allow the state to rebrand and show off its thriving culture and Birmingham metropolis. The Economic Development Partnership of Alabama's Innovation and Entrepreneurship conference would be a great place to launch a milestone event.

Second, Alabama should work to attract arts and entertainment to the state. As we mentioned earlier, Nashville secured a GM manufacturing plant, for free—without offering any incentives—purely because the United Auto Workers intervened. Its members wanted to live in Nashville because of the sports teams it had secured in years prior. For Alabama, arts and culture could similarly be a major professional sports team, a musical identity, or even a historical attraction given its rich civil rights history.

Last, Alabama should invest in hallmark infrastructure. Atlanta's beltline, much like the iconic central or golden gate parks, serves as passive space for city dwellers to think, wander, and generally improve their quality of life. Building out infrastructure in the big cities will similarly attract people to the city and inspire the freedom to innovate.[22]

In sum, Alabama has the potential to benefit from investments and initiatives focused on enhancing quality of life outside the workplace. Therefore, we strongly recommend that

the AIC consider the aforementioned ways to enhance the social lives of new innovators entering the state.

Create Investment Entity That Invests in Start-Ups at Alabama Universities

In addition to providing a more entrepreneurship-focused academic curriculum to potential innovators coming to Alabama for school, providing financial support for innovation should be another area of focus for the Alabama Innovation Corporation. A challenge with having universities directly involved in potential funding decisions for projects within the university is the potential for conflict of interests existing between the university and the professors involved with the project. To avoid such an arrangement, Alabama should consider establishing a new separate entity that focuses specifically on new ventures within Alabama universities.

Established in May 2021, the Alabama Innovation Corporation could achieve these goals.[23] A model for this arrangement exists in Wisconsin with the Wisconsin Alumni Research Foundation (WARF). WARF is an independent, nonprofit corporation run by alumni trustees of the University of Wisconsin that manages the university's patented technologies and invests the revenue to support future university research.[24] Although WARF receives a substantial amount of funds through investment returns, the bulk of its revenues is derived from contributions.[25]

In the century of WARF's existence, the organization has given $3.4 billion in the form of direct grants to University of Wisconsin–Madison and the Morgridge Institute for Research, $210 million to faculty inventors, and $300 million in in-kind support over the last fifteen years alone (all figures adjusted for inflation). These funds also ensure that top talent remains at the university. Of the current $100.3 million WARF grant to the university and the Morgridge Institute, $12 million is earmarked for faculty recruitment and retention alone.[26]

Grant decisions are made by WARF's board of trustees, as they are entrusted to guide the organization's priorities each year.[27] Some of the key funding areas the board decides on are related to graduate fellowships, recruitment and retention, and biochemistry innovation among others.[28] The board of trustees making these decisions consists of professionals from a variety of fields. Almost all of them have completed a degree at the University of Wisconsin–Madison.[29]

An entity that operates like WARF would dovetail well with a program focused on entrepreneurship, as there would be ways to fund ideas conceived in the classroom and through working with potential entrepreneurs in residence. With this in mind, we highly recommend that the newly established Alabama Innovation Corporation uses WARF's approach as a framework for investing and assisting new ventures at universities.

Adopting Best Practices with Respect to Technology Transfer at Alabama Universities

In addition to creating an entity that provides financial support for innovation, a university benefits from having an office of technology licensing (OTL) with the following purposes: to foster a culture of innovation, to assist in the commercialization of technology developed at the university, and to ensure that some returns from the innovations developed using university resources and grants accrue to the university directly. This requires the technology transfer office to understand the long-term processes and potential benefits from innovation such as philanthropy.

Jan Youtie and Philip Shapira discuss the development of the technology transfer office and universities' role as a knowledge and innovation hub.[30] They view universities' technology transfer office as a transfer specialist that acts as a broker to see which results are patentable or of high innovative value. After the technology transfer office determines the potential patentability, it presents the discoveries to industry. Therefore, the technology transfer office balances intellectual property management as well as incentives and barriers for faculty and industry participation.

Universities hope for high returns from innovation, yet according to Josh Lerner, university commercialization strategies do not yield returns quickly and most do not yield high returns but rather yield moderate returns.[31] Therefore, the key role of the universities is to focus on development strategies that do not limit licensing.

One strategy Lerner speaks to is venture capital–backed spin-outs and adding staff at a university's OTL to assist professors with establishing new firms. Furthermore, Alabama universities' OTL should follow leading universities' OTL to "reduce the uncertainty of academic entrepreneurs about the spin-out process and ease outside investors and strategic partners' doubts about the new venture." The first point coincides with informing academic entrepreneurs about management and funding in an attempt to avoid costly mistakes. The second point refers to OTL being a trusted intermediate that develops relationships with venture capitalists and corporations. The OTL then proposes and facilitates academic spin-outs utilizing these relationships. The key to successfully employing these two points is securing an experienced staff at the university's OTL.[32]

Depending on the specifics of the start-up, universities can often be essential in the development of a start-up's product. One key example of how a university played an integral role in the development of a start-up's product can be seen in the company SafeStamp Inc. in Austin, Texas. During his time overseas in the military, CEO Matt McGuire discovered that a major issue within pharmaceuticals was the distribution of fake, often dangerous drugs under benign packaging. Through research, he developed a concept of a nanotech indicator to seal medicine packaging that would verify its authenticity to consumers.[33]

The issue for McGuire was that he himself was not a scientist in this field, and he therefore began reaching out to universities with appropriate labs to help him develop the product. After reaching a deal with the university, master's and PhD scientists at Texas A&M developed technology that would glow orange with breath and blue with touch. This ultimately made it impossible to counterfeit drugs using the technology.[34]

In a conversation with McGuire, he explained that without universities his product simply could not have been made. Had he attempted to do this completely on his own, his up-front costs would have been too excessive, as he was not able to raise enough money on the concept of the business alone to contract out a private lab. Further, if he had been able to contract a private lab, he would have found that these labs often do not have the necessary heavy equipment to effectively develop these sorts of technologies. Therefore, for his R&D-intensive project, universities were a cost-effective choice and an absolute necessity in bringing his product to market.[35]

In Matt McGuire's case, Texas A&M had the essential labs to help develop his product. However, other universities may have other facilities that provide entrepreneurs competitive advantages in developing their products and services. The key for universities is leveraging these resources on their respective campuses in attracting new entrepreneurs.

The idiosyncrasies of these contractual arrangements vary significantly by academic institution. In an interview with a venture capital firm familiar with the technology transfer policies at universities across the United States, the following practices emerged as one example of a structure that preserved incentives for faculty innovation in one industry. To start, to enable VC investment, the university must in principle provide a path for the creation of start-up companies into which the know-how to use technology is endowed. Universities that provide strong incentives for innovation generally have an equity investment structure where they take a relatively modest amount of common stock (e.g., 1–2 percent), with some antidilution rights to preserve this, but perhaps through only one or two additional rounds of financing. The university can also have some preemptive rights to purchase into future rounds with additional investments. The university may collect some patent fees, sublicense fees, maintenance fees, and milestones fees (particularly in phased clinical trials in biopharmaceuticals), and may also have a modest royalty of 1 percent of sales. While practices vary across types of innovation, such as software versus biotech, the common theme is the importance of preserving the incentives of entrepreneurs to innovate and creating a path to spin out a company in which the university has some economic interest but not one that gives the university a strong or controlling stake in the business.

- *Equity Structure:* 1.3 percent in common stock (aggregate over two licenses) with antidilution rights to maintain that percentage through the next equity financing of at least $1 million (but this right expires after one equity financing).

- *Preemptive Rights:* Right to purchase up to 10 percent of our round, and pro rata rights in future equity financings.

- *Patent Fees:* $15,000 annually to offset.

- *Sublicense Fees:* 15–25 percent on certain milestones.

- *Maintenance Fees:* $10,000–$55,000 on certain milestones.

- *Dosing Milestones Fee:* $75,000 at first dosing in phase II with licensed product; then $250,000 at first dosing in phase III with licensed product.

- *Change of Control Fee:* In aggregate across two licenses, the university receives $25,000 in cash and 1.25 percent of the topline acquisition amount capped at $1.25 million.

- *Royalties:* 0.75 percent of net sales and $15,000 onetime signing royalty.

According to the representatives in the field, a university would be making a severe mistake in attempting to make large sums of money, using its academic personnel as employees whose intellectual property the university would largely own. Rather, the university should aim to facilitate the commercialization and hope to receive money "on the back end" through philanthropy.

Having a technology transfer office at a university that encompasses the aforementioned purposes would be the best approach to incentivize innovation, attract innovative faculty, and build a local entrepreneurial ecosystem.

Developing Entrepreneurship-Focused Programs within Alabama Universities

At many of the major Alabama universities' MBA programs, there is little focus on entrepreneurship relative to other more conventional areas of business such as finance and real estate. For example, at the University of Alabama's Culverhouse College of Business, none of the specialized master's programs are related to entrepreneurship specifically.[36]

This is much different from other competitive MBA programs where entrepreneurship is front and center. At MIT's Sloan School of Management, for example, the Martin Trust Center for MIT Entrepreneurship offers the Entrepreneurship & Innovation (E&I) Track. This MBA track connects students with key faculty at MIT and provides a tailored curriculum that exposes students to strategies of bringing an idea to market.[37] MIT's program also hires a new class of faculty called Entrepreneurs in Residence who are lecturers at the university, providing important insight into how they were able to succeed in building innovative

companies.[38] A recent study of Stanford's entrepreneurship programs by Charles E. Eesley and Yong Suk Lee concludes that these programs decreased the probability of start-ups' failure and increased firm revenue, specifically affecting the quality of entrepreneurship.[39]

The University of Alabama has The EDGE, which acts as an incubator and accelerator for new ideas, and the Alabama Entrepreneurship Institute (AEI), which aims to be a magnet program for the university.[40] We recommend extending The EDGE and AEI's influence within the business school, using a model closely resembling MIT's approach through the E&I MBA track.

This type of program would be incredibly attractive to aspiring innovators, as it would provide access to real-world successful entrepreneurs; these entrepreneurs could give invaluable insight in addition to the case studies and business fundamentals students are learning in the classroom. That said, this type of program could prove costly and inefficient if the necessary preconditions are not in place. More specifically, we recommend that the AIC focus on creating an environment in which entrepreneurs and innovators are attracted to Alabama and, once the surrounding geographic characteristics are satisfied, then focus on developing an MBA-focused program that complements the environment.

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APPENDIX: ADDITIONAL RECOMMENDATIONS

Stanford GSB students in the Spring 2021 Policy Lab on Alabama Innovation developed a longer list of more specific ideas, not all of which could be assessed in detail given the scope of this report. These are as follows.

Students

1. *Hold start-up competitions with cash prizes.* Almost every Alabama university with which we spoke has some variation of a start-up competition, and most have expanded them over the past five years. These start-up competitions must be paired with mentorship post-victory, as well as with feedback to all participants. Start-up competitions should be opened for entry across universities and not used to gatekeep—a Troy start-up may have a better fit with a start-up competition at Auburn, for example. The prominence of these events, across institutions, could attract national attention.

2. *Create a university-wide entrepreneurship minor.* This is another area where many Alabama universities have already succeeded, ensuring that an achievable university-wide minor exists in entrepreneurship and that the courses cover key topics such as fundraising, hiring, business plan creation, and so on.

3. *Create a business accelerator platform (DealBox) with resources for start-ups.* Invest in technology and service credits provided free to potential entrepreneurs. Examples include no code software, web server credit, business banking deals, remote team software, cloud software, HR and legal services, and so on.

4. *Provide broad access to entrepreneurship resources such as incubators.* Creating a culture of entrepreneurship means that acknowledging entrepreneurs operate atypically. Providing open access to entrepreneurship resources like incubators, maker spaces, and coworking labs is critical to allow entrepreneurship to thrive anytime.

5. *Give students hands-on experience through experiential classes.* Intellectual curiosity is vital for any entrepreneur to get out in the world and solve its most intractable problems. In need-finding classes such as Solving, students begin considering entrepreneurship through the lens of solving other problems, rather than form-fitting a solution to a problem. Similar classes that are successful include Stanford University classes such as Hacking for Defense, Design for Extreme Affordability, Lean LaunchPad, and Startup Garage.

Technology Transfer

1. *Invest in technology transfer offices enough to build a customer service model.* Tech transfer offices must be easy to access for outside stakeholders and unbureaucratic. There are great examples in our interviews of tech transfer offices within the state, such as UAH's, moving quickly to meet a start-up's needs. Different tech transfer offices can have different operating structures, but other universities have found success in dividing processes into routine (e.g., pharmaceuticals) and nonroutine (e.g., physical sciences). Above all, investing enough to move with speed and even a customer service approach is vital to ensure that the pipeline is constantly moving.

2. *Conduct a commercialization review for each new piece of research.* Tech transfer offices can evaluate research as it is published from various parts of the university for commercialization. Depending on the scale of research at a university, this should be a formalized process with expertise developed in specific individuals among the tech transfer office staff.

3. *Provide public-facing commercialization templates.* Universities should have a public-facing commercialization template (term sheet) and sample processes documents. While acknowledging that these can be customizable by deal, providing a template of what to expect can help alleviate confusion and fear, especially from first-time entrepreneurs. These also serve to educate faculty on what to expect when starting on entrepreneurship.

4. *Adopt best practices with respect to technology transfer.* Having spoken with many players in venture capital, we have found that there is an optimal structure that can be adopted that best incentivizes innovation, attracts innovative faculty, and builds a local entrepreneurial ecosystem (see full list of terms above, in "Adopting Best Practices with Respect to Technology Transfer at Alabama Universities").

General Entrepreneurship at Universities

1. *Tie funding to output.* Alabama should adopt a modified funding structure for its universities, similar to one just adopted by Missouri, but including a focus on entrepreneurship. Currently, universities are rewarded for inputs (number of students, hours of classroom time, etc.) rather than outputs (graduate employment rates, entrepreneurial output, etc.). Alabama should tie funding for its public universities to demonstrated excellence among faculty and students and to entrepreneurial output that facilitates economic growth in Alabama.

2. *Recruit entrepreneurs-in-residence.* Universities should establish funding for two-plus entrepreneurs-in-residence for multiyear appointments. These entrepreneurs-in-residence can provide valuable mentorship and expertise to first-time entrepreneurs (both students and faculty).

3. *Create new angel networks based on university ties.* Alabama is in desperate need of more capital for start-up funding. Building off intense loyalty to universities, each university should create an angel network within its alumni network. Plans are under way at the University of Alabama, but each university has an opportunity to better embed with its alumni and create capital flows back to its students through angel networks. These networks should provide alumni with training on how to invest properly in start-ups, a knowledge many investors lack.

4. *Invest in additional wet lab space.* Wet lab space is in particularly short supply, especially in medical-focused communities like Birmingham. Restrictions on the use of wet labs at universities for commercial activities are a large hindrance to private sector start-ups in the biohealth space. Two potential solutions are to open these wet labs on university property to more commercial activities or to subsidize more wet lab space in private institutions such as the Innovation Depot or other coworking spaces.

5. *Provide legal expertise at accessible rates.* The legal structure is one of the most important decisions a start-up can make. Providing monthly or quarterly drop-ins with lawyers trained in venture capital law and regulatory compliance is vital to ensure the sustainability of legal frameworks of new companies. This is also important to ensure that equity and other founder agreements are built properly at the onset, rather than trying to rework these agreements down the line of a company's life cycle.

6. *Build a culture of entrepreneurship (acceptance, failure, risk).* The language and environment that build a successful start-up culture are unique. Alabama universities need to create a better culture supporting entrepreneurship through celebration of failure, greater risk tolerance, and accepting entrepreneurship as a valued career choice. This can be done through marketing campaigns, art installations, awards, and general public relations.

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2. If You Build It, They Will Come

HIGH-SKILL WORKERS AND ALABAMA'S OUTDOOR RECREATION INFRASTRUCTURE

ALEXANDER GALETOVIC, STEPHEN HABER, JORDAN HORRILLO, AND ISABEL LOPEZ

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EXECUTIVE SUMMARY

A crucial component of establishing an innovation ecosystem within a state is attracting and retaining human capital. Alabama is exceptionally endowed with a vast array of natural assets that can be leveraged to expand its outdoor recreation industry, enhancing the state's attractiveness for high-skill individuals and new tourists, as well as yielding substantial returns for both rural and urban communities. Currently, many natural assets remain underdeveloped within Alabama, holding the state back from realizing its full potential to draw high-skill workers and to establish itself as an outdoor recreation powerhouse within the southeastern region of the United States.

To develop these natural assets, Alabama needs to ramp up spending on its outdoor recreation infrastructure. Funding may come from combining private philanthropy, state funds, federal funds, and revenue from user fees on outdoor recreation infrastructure. Because projects will generate externalities and incremental economic activity, projects will, over time, also generate a higher tax revenue for the state and contribute to their own funding.

This chapter's primary recommendation is the creation of a joint commission to expand the supply of outdoor infrastructure throughout the state. First, it would draw on Alabama's Statewide Comprehensive Outdoor Recreation Plan and input from entrepreneurs, municipalities, and other stakeholders to identify projects that would generate significant positive externalities for the state. Second, the joint commission would be a vehicle through which funding sources, beyond those already in place, would be identified and pursued. Third, the joint commission would work with state agencies, municipalities, nonprofit organizations, and the private sector to plan outdoor recreation infrastructure projects, select developers, distribute funds, and ensure the delivery of projects and services.

Introduction

Innovation is the creative act of seeing a demand curve for a product that may not yet exist, and then putting together the components necessary to bring that product or service to

market. Innovation is also the creative act of seeing how to produce an existing product or service more efficiently, and then putting together the components necessary such that the price falls and the market expands.

Successful innovations generate what economists call Ricardian rents—they can produce more revenue per dollar of input than the least productive producer in that same market. A quintessential example is the iPhone; Apple is able to sell iPhones at about three times the price charged by other smartphone manufacturers, while its production costs are only twice as high. Apple can obtain more revenue per dollar of input because consumers value iPhones more than they value other smartphones.

The Ricardian rents from innovation are captured not just by firms in the form of higher profits. Some of the rents are captured by the firm's employees in the form of higher wages than they would have earned otherwise. Some of the rents are captured by the government in the form of a higher tax revenue than it would have received otherwise. Innovation, and the Ricardian rents it generates are, in short, the basis for a prosperous society.

The Challenge of Creating an Innovative Economy

If innovation is such a good thing, then why don't we see it happening everywhere? The reason is that turning an idea into a commercial product that consumers value requires the recruitment and retention of people with a wide variety of specialized knowledge and skill sets. Some of those people know how to invent new technologies. Others know how to combine technologies that already exist in novel ways. Still others know how to secure financing, write contracts, navigate regulatory mazes, build prototypes, set up manufacturing facilities, and market consumer products.

Innovation therefore happens in environments in which there is a pool of people who have invested in developing specialized knowledge and skill sets that are complementary to one another. Such a pool of people can be home grown, but if one is trying to jump-start an innovative economy, at least some of those people must be recruited from outside.

Recruiting High-Skill Workers and Sustaining Communities

Persuading people with scarce skills to move thousands of miles to new homes and new communities is not an event; it is a process. It often starts with short visits that plant a seed in their minds. Those seeds germinate into an idea, and in time they flower into the decision to relocate.

Those crucial, short initial visits often occur because of tourism; and when it comes to people who have invested in the kinds of specialized human capital that is necessary

to launch innovative firms in the twenty-first century, that tourism tends to be focused on outdoor recreation.[1] Whitewater rafting, kayaking, canoeing, hiking, backpacking, bird-watching, skiing, mountain and road biking, rock climbing, and the like, tend to draw high-skill workers and entrepreneurs and then reveal to them the other benefits that will come when they relocate, such as lower housing costs, shorter commutes, and friendlier communities. It would be difficult, in fact, to disentangle the recent high-tech booms taking place in Salt Lake City, Utah; Bend, Oregon; and Boulder, Colorado, from the opportunities they provide for outdoor recreation.

Outdoor recreation is not, however, simply a way to recruit high-skill workers; it is also a way to share the Ricardian rents generated by innovative industries broadly. When an employee of an innovative firm takes a walk on an urban trail and stops along the way for coffee or lunch, she is sharing some of those rents with the restaurant and its employees. When she takes a weekend trip to go rock climbing, she is sharing some of those rents with local outfitters, guides, gas stations, grocery stores, and hotels. The scale of those outdoor recreation expenditures is staggering; across the United States in 2019 value added from outdoor recreation was $460 billion, roughly 2 percent of the US GDP.[2] In short, outdoor recreation, whether urban or rural, helps foster an environment that is socially and politically sustainable.

Permit us to illustrate the idea of shared prosperity through outdoor recreation by pointing to the examples of Placer and El Dorado Counties in California, which stretch from the foothills of the Sierra Nevada all the way to Lake Tahoe, at the border with the state of Nevada. Placer and El Dorado Counties have the seventh- and twelfth-highest median household incomes in the state—at $97,688 and $86,202, respectively—but neither contains a high-tech hub or a manufacturing facility.[3] Their westernmost towns are suburbs of the state capital; but as one heads east, into the hills, they become highly rural. Those rural areas boast the most intensively kayaked and rafted whitewater rivers in the United States, seven major ski resorts, and some of the most popular hiking and backpacking trails in the western United States. Those outdoor recreation attractions sustain countless numbers of small and midsize business—outfitters, bike and ski shops, restaurants and cafes, hotels, gas stations, roadside fruit stands and pie shops, and the like.

To give a sense of what this looks like on the ground, consider the town of Coloma, located on the banks of the south fork of the American River in El Dorado County. Coloma was founded as a gold rush town in the 1850s, but when the gold played out, so did the town; its civic buildings were abandoned and left to decay. In the 1970s, the local economy began a comeback based on the emerging sport of whitewater kayaking and rafting. Fifty years later the most important businesses continue to be tied to the town's proximity to whitewater, such as guide services, equipment rentals, and campgrounds. As whitewater tourism grew, however, other tourism-focused businesses began to emerge. Among the most

important of these are wineries, which began to spring up in the 1990s, and which draw Silicon Valley tourists more interested in granite tasting counters than in Class IV rapids. All of this happened, we hasten to add, without disturbing the social fabric of the town; as of 2019 Coloma still had only 487 inhabitants, and the average commute time to work was eighteen minutes. The median household income was, however, $125,521 and the poverty rate was less than 1 percent.[4]

Hypothesis: Alabama's Natural Endowment Is an Undercapitalized Asset

Alabama has natural endowments—rivers, lakes, mountains, forests, coastline, flora and fauna—that give it tremendous potential to draw and retain high-skill workers and firms at the frontiers of their industries and to then share the rents from those industries broadly across the state. Some of those endowments have been developed by passionate and dedicated Alabamians working through private enterprises, nonprofits, joint ventures, local governments, and state agencies. They have, however, been constrained by the resources at their disposal.

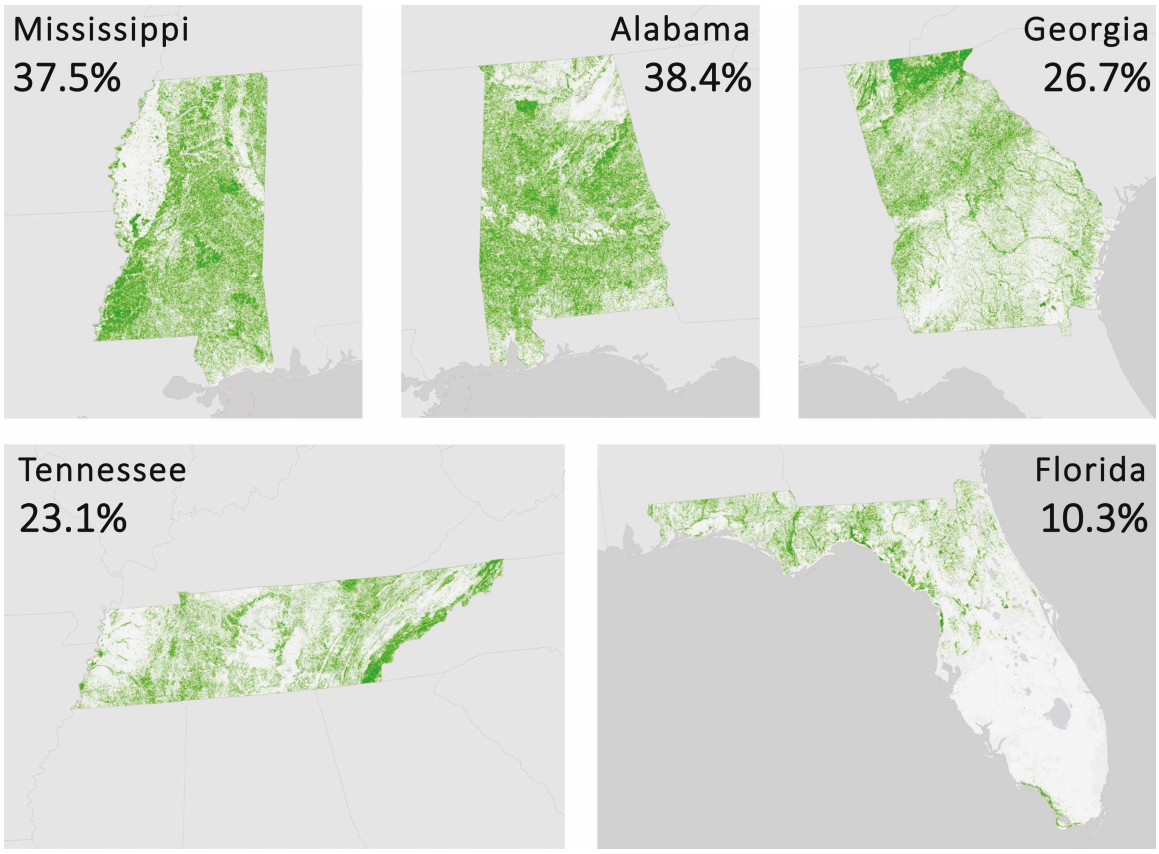
A substantial, coordinated, and long-term program of investment in outdoor recreation infrastructure will yield substantial returns to the state. Some of those returns will be direct, in the form of dollars spent by out-of-state tourists. Some of those returns will be indirect, in the form of the ability of the state to recruit and retain a pool of people with the skill sets necessary to generate the innovative firms that produce Ricardian rents. Some of those returns will come in the form of positive externalities for rural areas—demand for outfitters, guide services, hotels, restaurants, and the like, by high-skill workers in innovative industries. And some of those returns will come in the form of positive externalities for urban areas—demand for housing, restaurants, cafes, and the like along new (or expanded) urban walking trails, bikeways, and blueways.

Alabama's Natural Endowment

We do not think it would take lengthy argumentation to make the case that Alabama has a natural endowment well suited to developing a vibrant outdoor recreation economy. Figure 1, which illustrates the forested surfaces of Alabama and its neighboring states, shows that roughly two-fifths of the state is densely forested. This means that Alabama is about 40 percent more forested than Georgia, 60 percent more forested than Tennessee, and close to four times as forested as Florida. Among its neighbors, only Mississippi rivals it.[5]

Figure 2, which illustrates Alabama's surface water (rivers, streams, lakes, and ponds), and that of its neighboring states, shows that Alabama's forests are paired with abundant lakes, ponds, rivers, and streams. Alabama boasts more surface water area per square mile of territory (3.4 percent) than Tennessee (2.2 percent), Mississippi (3.1 percent), and Georgia (3.2 percent). Only Florida (at 18.5 percent) exceeds Alabama.[6]

Figure 1. Forested land in Alabama and its neighboring states



Source: Tree Canopy Cover, National Land Cover Database (NLCD) 2016 Products (ver. 2.0, July 2020): US Geological Survey data release.

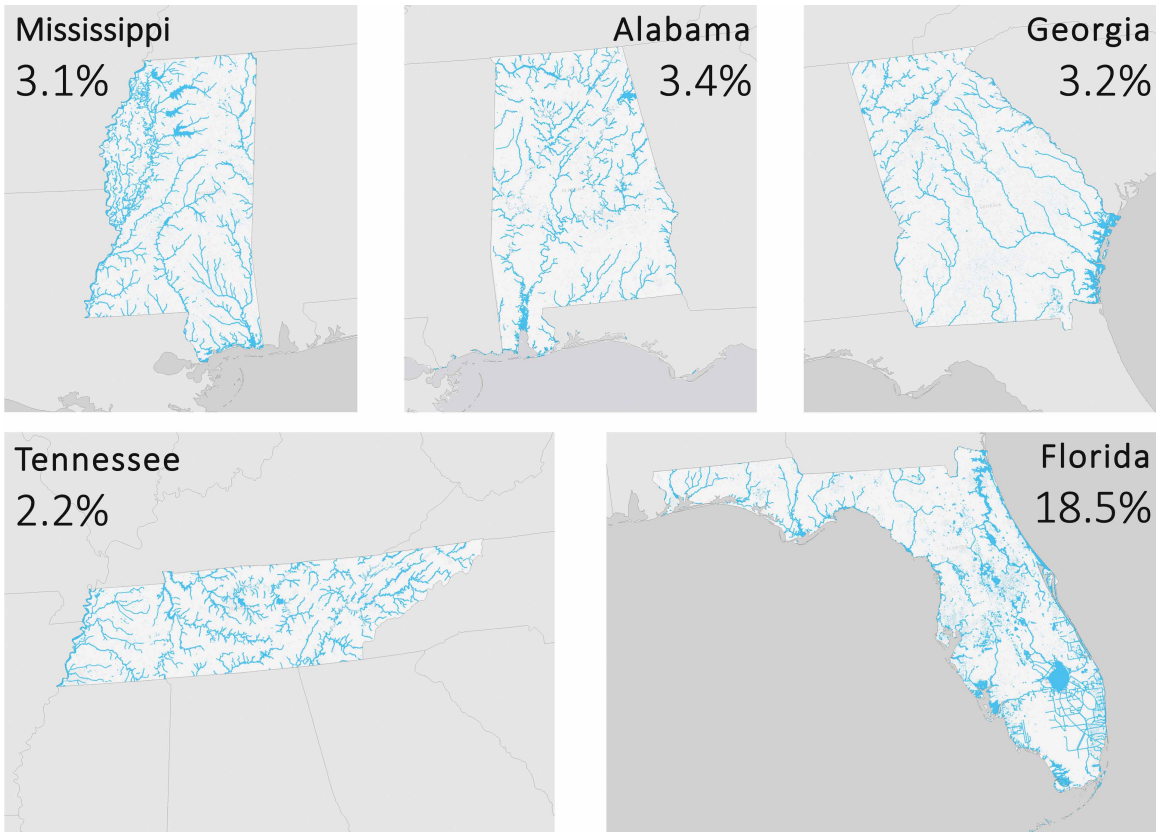
Two facts bring these statistics about Alabama's freshwater endowment to life. First, it is possible to canoe the 650 miles from Weiss Lake, in northeastern Alabama, near the border with Georgia, to Mobile Bay on the Gulf of Mexico near the border with Mississippi, with only nine short portages around dams and locks.[7] Second, Alabama's rivers, lakes, streams, and wetlands are home to more species of aquatic and semiaquatic animals than any other state in the country.[8] From the point of view of kayakers, canoeists, fishers, hunters, and bird-watchers, Alabama is a wonderland.

Alabama's Recreation Infrastructure

It is one thing to have a favorable natural endowment, and another to take full advantage of it. The first is given by nature; the second is the result of investments in outdoor recreation infrastructure.

There is no single agreed-upon metric that captures the degree to which a state takes advantage of its natural endowment. A number of different indicators—some of which

Figure 2. Surface water coverage in Alabama and its neighboring states



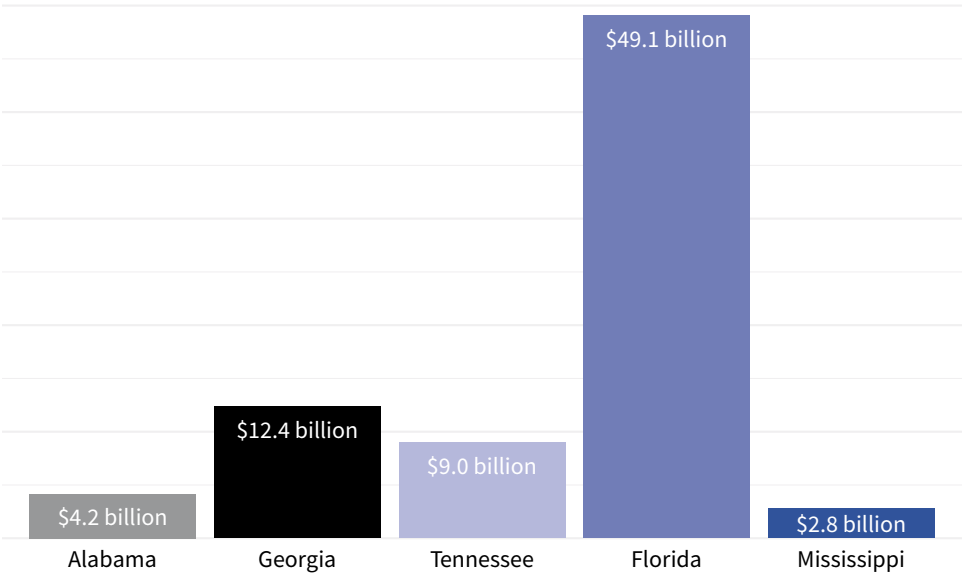
Sources: US Geological Survey, 2019, National Hydrography Dataset, ver. USGS National Hydrography Dataset Best Resolution for Hydrologic Unit 4, 2001 (October 2, 2019).

focus on outcomes and some of which focus on inputs—all point, however, to the same conclusion: Alabama has not taken full advantage of its endowment.

One straightforward way to measure the outcome of Alabama's outdoor recreation infrastructure is to listen to what Alabamians themselves say. A survey conducted for Alabama's 2013–18 Statewide Comprehensive Outdoor Recreation Plan found that 93 percent of Alabama residents stated that outdoor recreation was important or very important to them. Eighty-four percent of Alabamians stated that recreational trails were important or very important to them. Only 56 percent of the respondents, however, said they were satisfied with outdoor recreation facilities and trails in Alabama. Perhaps most pointedly, 47 percent of respondents said they traveled outside the state to participate in an outdoor recreation or trail-related activity.[9] Importantly, the survey also revealed that they tended to visit neighboring states whose natural endowments are not unlike those of Alabama: Tennessee, Georgia, and Florida.[10]

Another way to measure the outcomes of investments in outdoor recreation infrastructure is to look at the revenue it generates. As figure 3 shows, there is a substantial difference

Figure 3. Outdoor recreation industry value added by state, 2019



Source: US Department of Commerce, Bureau of Economic Analysis.

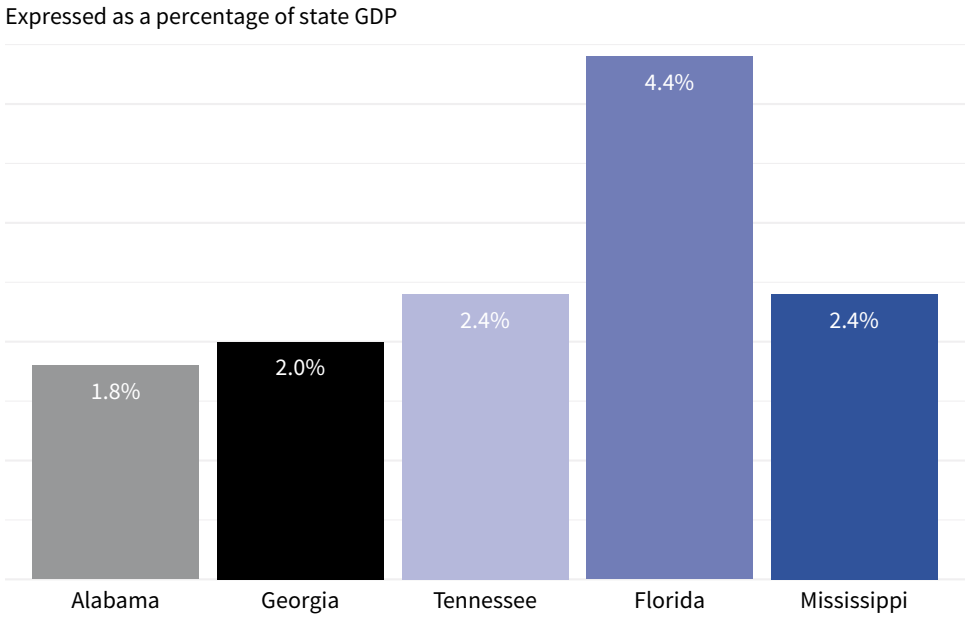
between the revenue earned from outdoor recreation across Alabama and across its neighboring states—and Alabama is at the bottom of the distribution. Florida is an outdoor recreation giant, with outdoor recreation accounting for $49.1 billion in value added.[11] By contrast, outdoor recreation accounts for only $4.2 billion of value added in Alabama.[12] This is slightly higher than in Mississippi ($2.8 billion), but less than half of what is generated in Tennessee ($9.0 billion), and one-third of what is generated in Georgia ($12.4 billion).[13]

As figure 4 shows, these differences in outcomes persist even if we account for differences in the size of the state economies, by expressing the data as a percentage of state GDP. In fact, Alabama moves to the very bottom of the distribution, with outdoor recreation accounting for only 1.8 percent of GDP, as compared with 2.0 percent in Georgia, 2.4 percent in Tennessee, 2.4 percent in Mississippi, and 4.4 percent in Florida.

Yet another way to measure outcomes is the number of jobs generated by outdoor recreation. As figure 5 shows, Alabama is at the low end of the scale, generating only 62,687 jobs, putting it ahead of Mississippi (33,592 jobs), but well behind Tennessee (106,012 jobs), Georgia (143,122 jobs), and Florida (511,100 jobs).

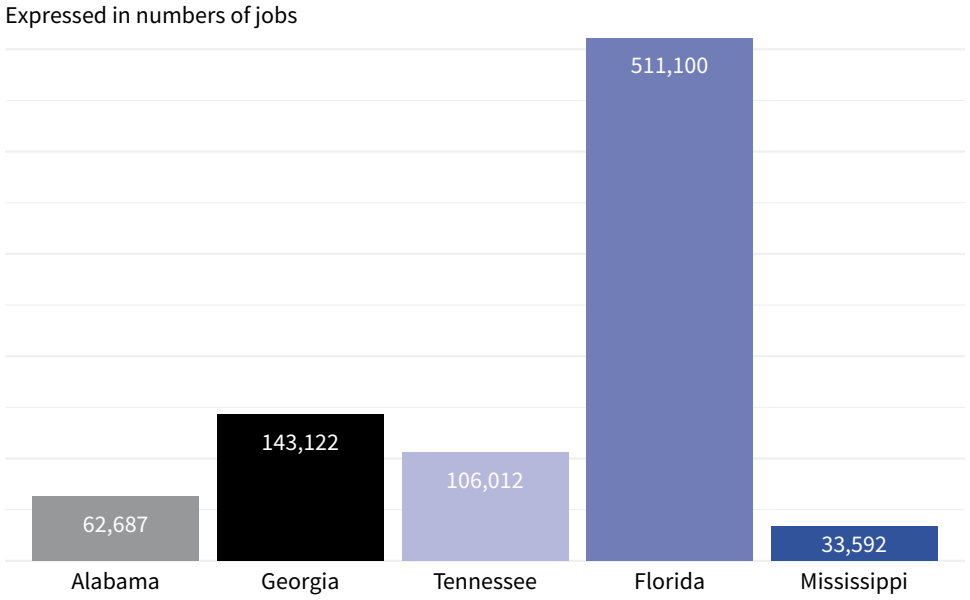
Low levels of job creation translate into low levels of total compensation from outdoor recreation. As figure 6 shows, compensation from outdoor recreation in Alabama totals only $2.0 billion. This compares favorably with Mississippi ($1.1 billion), but pales in comparison with Tennessee ($4.1 billion), Georgia ($6.3 billion), and Florida ($23.4 billion).

Figure 4. Outdoor recreation industry by state, 2019



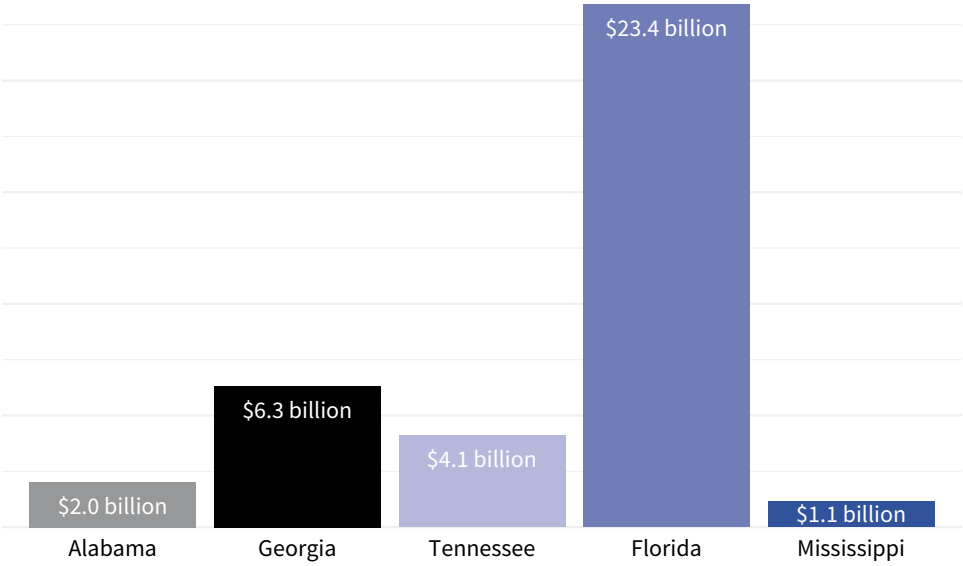
Source: US Department of Commerce, Bureau of Economic Analysis.

Figure 5. Outdoor recreation industry employment by state, 2019



Source: US Department of Commerce, Bureau of Economic Analysis.

Figure 6. Outdoor recreation industry compensation by state, 2019



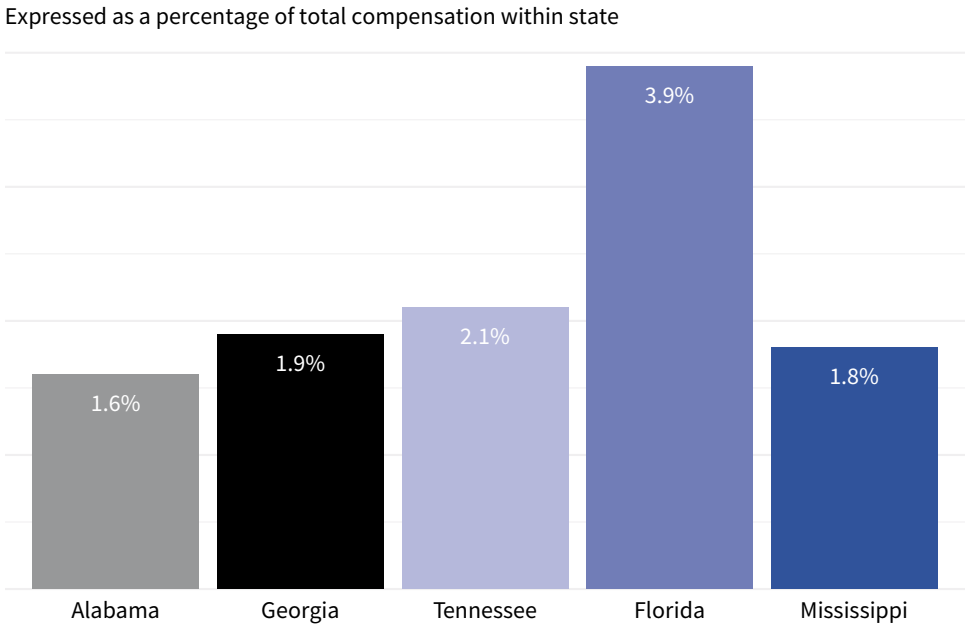
Source: US Department of Commerce, Bureau of Economic Analysis.

As figure 7 shows, this result holds even if we control for differences across states in terms of total compensation earned. In fact, when we make this adjustment, Alabama outdoor recreation (at 1.6 percent of total compensation earned) is behind that of Mississippi (1.8 percent), Georgia (1.9 percent), Tennessee (2.1 percent), and Florida (3.9 percent).

A simple set of facts, perhaps, brings all these numbers to life. Tennessee is much less well endowed than Alabama when it comes to lakes, ponds, rivers, streams, and forested areas (see figures 1 and 2). And, quite unlike Alabama, which has 60 miles of coastline, landlocked Tennessee has no beaches.[14] Nevertheless, Tennessee's outdoor recreation economy generates about twice as much revenue and 70 percent more jobs than Alabama's outdoor recreation economy.

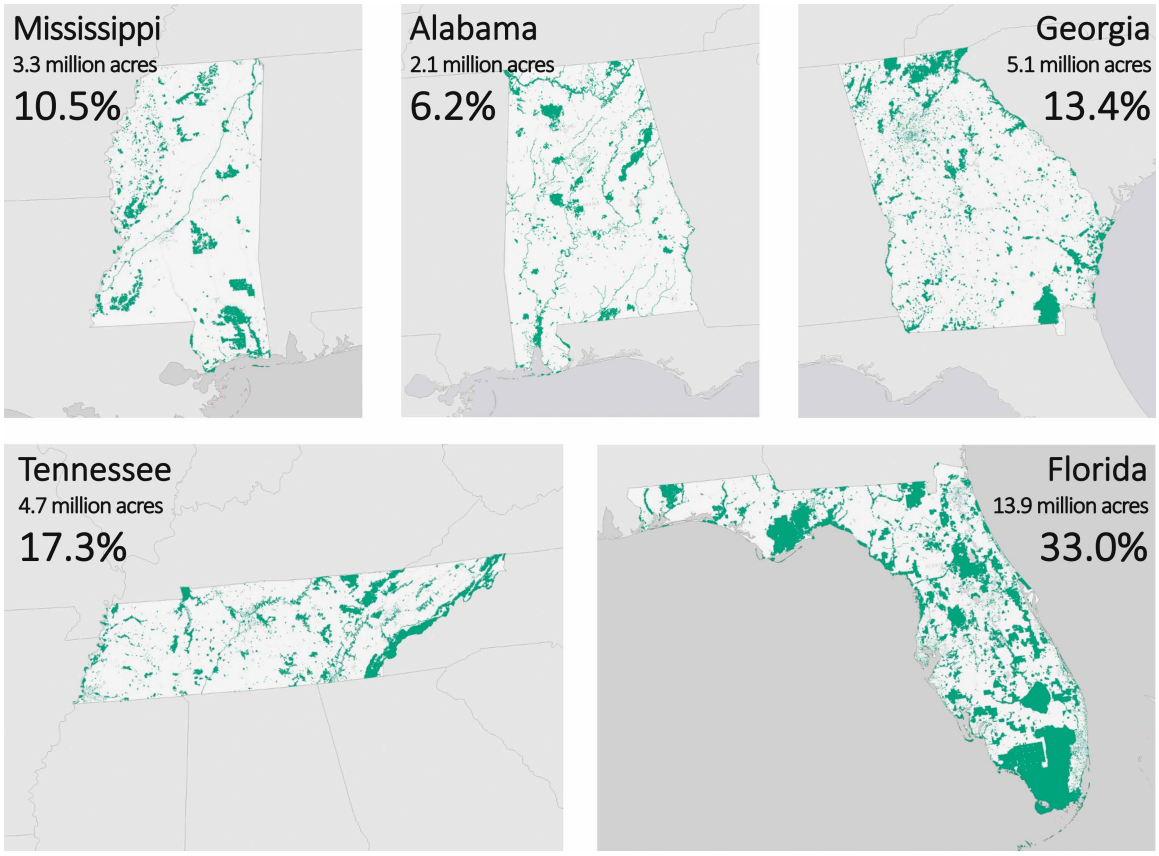
If we look at the inputs to outdoor recreation, we can understand why the outcomes across Alabama and its neighboring states are so different. A key input to outdoor recreation is publicly accessible land. Figure 8 presents the surface areas of Alabama and its neighboring states, with the publicly accessible lands marked in green. We draw the data from the US Geological Survey Gap Analysis Project, Protected Areas Database of the United States (PAD-US), which includes lands managed by the federal government (national parks, national forests, Bureau of Land Management lands), state governments (state parks, wildlife management areas, special opportunity hunting areas, and conservation trusts—such as Alabama's Forever Wild Land Trust, to which we shall return in detail), local governments (county parks, city parks), tribal lands open for recreation, and private parties (conservation easements).[15]

Figure 7. Outdoor recreation industry compensation by state, 2019



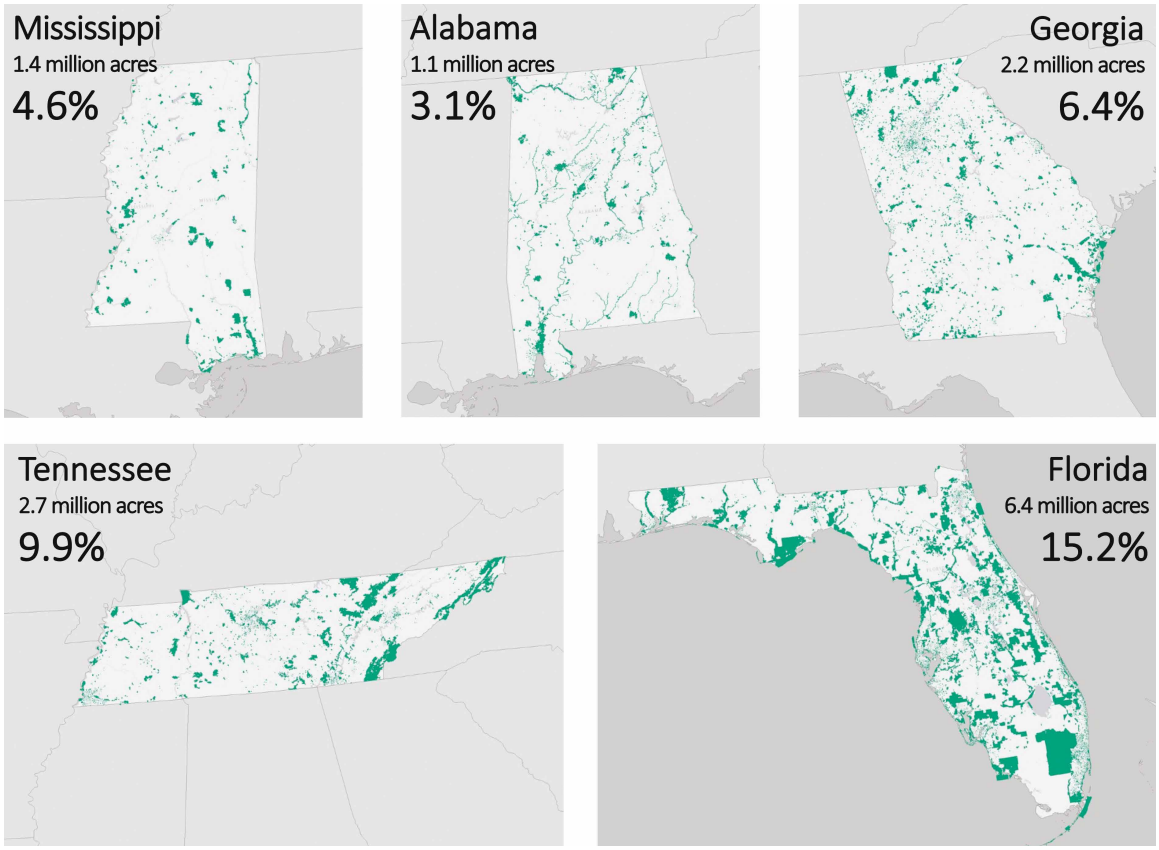
Source: US Department of Commerce, Bureau of Economic Analysis.

Figure 8. Publicly accessible land in Alabama and its neighboring states



Source: US Geological Survey Gap Analysis Project, Protected Areas Database of the United States (2020), 2.1.

Figure 9. Nonfederal publicly accessible land in Alabama and its neighboring states



Source: US Geological Survey Gap Analysis Project, Protected Areas Database of the United States (2020), 2.1.

The absolute differences across states in publicly accessible lands are substantial, with Alabama at the low end of the scale. In ascending order, Alabama has the smallest amount, at 2.1 million acres, followed by Mississippi (3.3 million acres), Tennessee (4.7 million acres), Georgia (5.1 million acres), and Florida (13.9 million acres).

These differences remain even if we control for differences in the size of states. As figure 8 shows, publicly accessible lands account for only 6.2 percent of Alabama's land area, as compared with such lands in Mississippi (10.5 percent), Georgia (13.4 percent), Tennessee (17.3 percent), and Florida (33.0 percent).

One might be tempted to argue that the relatively modest amount of publicly accessible land in Alabama is a function of the fact that the federal government's footprint in Alabama is much smaller than in neighboring states. Figure 9 therefore removes federal lands from the analysis. As it shows, the results are materially the same. Roughly speaking, Mississippi dedicates about 1.5 times more of its land to publicly accessible recreation than Alabama,

Georgia twice as much, Tennessee three times as much, and Florida close to five times as much.

These differences in publicly accessible lands translate into fewer trails for hiking, backpacking, bird-watching, mountain biking, and the like. The AllTrails app, which is widely used by hikers and backpackers, shows the number of trails constructed and marked within a state. While the raster image files that would allow us to measure the length of each trail are proprietary to AllTrails, it is reasonable to believe that there are no systematic differences in average trail lengths across states. The AllTrails data suggests that Alabama lags in trail development, with 721 trails registered, compared with Georgia's 1,301, Tennessee's 1,529, and Florida's 1,899. Alabama surpasses only Mississippi, which has 185 trails listed.[16]

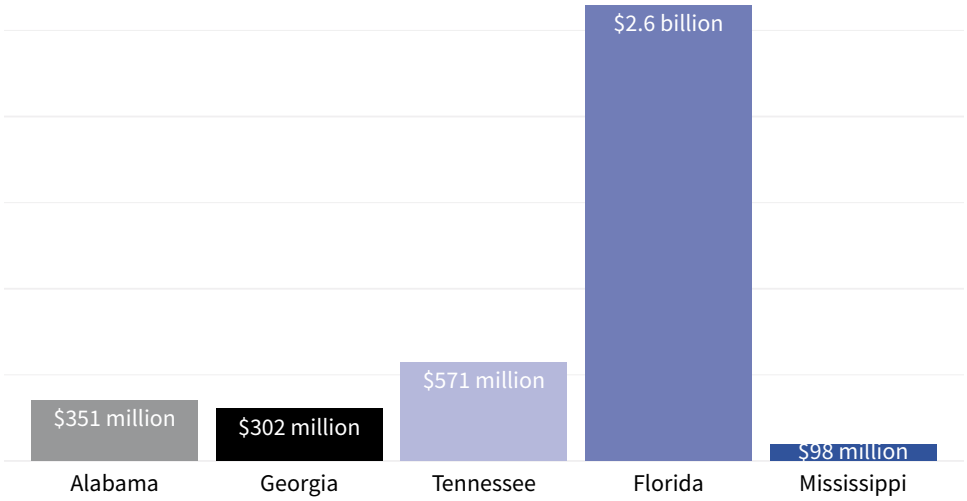
The Funding Gap

One inference that may be drawn from this data is that Alabama outdoor recreation is underfunded relative to the task of enlarging publicly accessible lands, trails, and other outdoor infrastructure. Alabamians seeking to develop trails and other outdoor infrastructure in their local communities leverage federal Recreational Trails Program and Land and Water Conservation Fund grants. These federal programs provide limited funds, however. The apportionments for Alabama in FY 2020 were only $1.7 million for the Recreational Trails Program and $3.4 million for the Land and Water Conservation Fund.[17] The funds allocated through these programs are not sufficient, nor are they necessarily meant, to fund outdoor recreation, or even trail development alone, in any state. They are meant as adjuncts to funding from states or private philanthropy.

In Alabama, the agency charged with the development and maintenance of state parks and other state-owned lands, conservation efforts, environmental protection, and wildlife-related law enforcement activities is the Alabama Department of Conservation and Natural Resources (ADCNR). The agency's 2021 budget, compared with that of its counterparts in neighboring states, can be seen in figure 10.[18] Alabama's budget ($351.4 million) exceeds Mississippi's ($98.7 million), is of the same order as Georgia's ($301.9 million), but is smaller than Tennessee's ($570.9 million), and Florida's ($2,647.7 million).

Importantly, ADCNR receives almost no funds from the state budget. For FY 2020–21 ADCNR's total budgeted expenditures added up to $361.9 million.[19] These were funded from three sources: The most, $168.2 million, was from federal funds, primarily from the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act).[20] Some $88.3 million was generated by ADCNR itself, mainly from hunting and fishing licenses ($23.1 million) and park visitor fees ($43.9 million). And $67 million came from various sources, but mainly the federal Gulf of Mexico Energy Security Act (GOMESA, which provided $26 million)[21] and reimbursements from the

Figure 10. Budgets for state fish and wildlife management agencies, 2021



Sources: State of Alabama, Executive Budget, Fiscal Year 2021, C-12; Georgia Governor's Office of Budget and Planning, HB 80-AFY 2021 Appropriations Bill; State of Tennessee, Department of Finance and Administration, The Budget, Fiscal Year 2020–2021, B-293; Florida Senate, SB 2500 (appropriations for FY 2021); Mississippi Legislative Budget Office: Statement VI: Total State Budget Recommend for Fiscal Year 2021.

BP oil spill Natural Resource Damage Assessment ($22.7 million).[22] Indeed, three funding sources—the RESTORE Act, GOMESA, and the BP oil spill assessment—add up to more than half of the department's 2020–21 funding. Less than $6 million of ADCNR's funding comes from state excises on cigarettes and fuel. Figure 11 summarizes the data, showing the major categories of the FY 2021 budget by funding source.

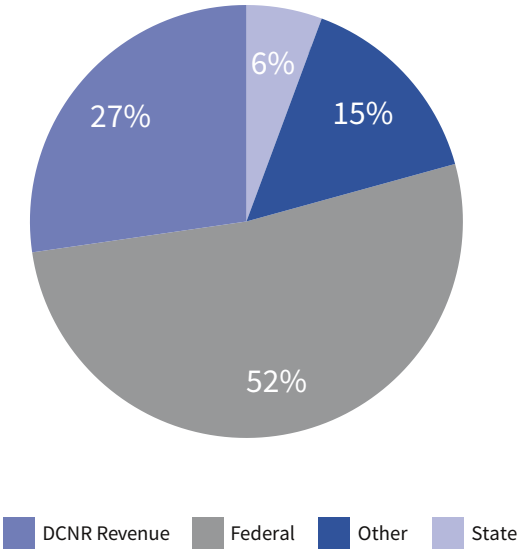
We validate the use of budgeted funds, rather than actual receipts, by examining the actual receipts for FY 2019 and 2020. As can be seen in figure 12, the actual data shows that ADCNR revenue makes up a larger percentage of spending than federal funds do, but there is little difference in the percentage of funds from state taxes.

When all the different metrics are taken together, a consistent picture emerges: there is plentiful room for investment and potential for growth in Alabama's outdoor recreation industry. One can imagine a future in which the state's impressive natural endowment is more fully deployed as an asset to attract and retain high-skill workers who will then share the rents from their innovative industries with Alabama's rural areas.

Building from Strength: The Achievements of Passionate Alabamians

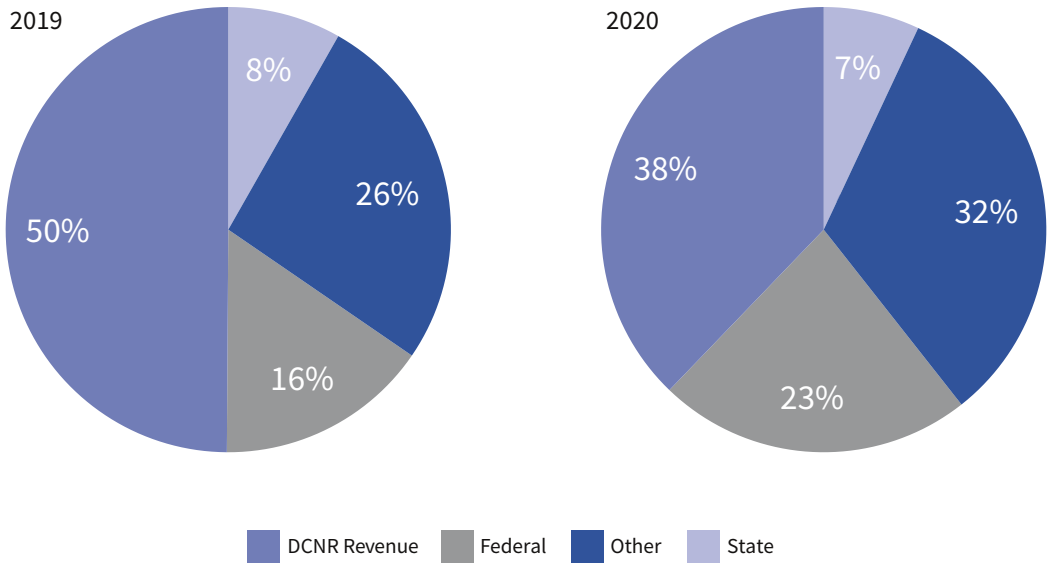
If we have learned one thing from our visits to Alabama, it is that the state is blessed with a rare asset: decent, hardworking, public-spirited people. Some of them lead state agencies,

Figure 11. ADCNR budgeted revenue, by funding source, FY 2021



Source: Alabama Department of Conservation and Natural Resources, *2019–20 Annual Report*.

Figure 12. ADCNR actual revenue, by funding source, FY 2019 and FY 2020



Sources: Alabama Department of Conservation and Natural Resources, *2018–19 Annual Report* and *2019–20 Annual Report*.

some are researchers at universities, others work for nonprofit organizations, and yet others are in the private sector. The programs and initiatives they have launched exemplify the types of investments that can be made to capitalize on the state's natural endowments.

If we have learned a second thing from our visits to Alabama, it is that these passionate people are working with very modest budgets. A substantial, coordinated, and long-term program of investment that draws on the expertise and passion of the Alabamians already doing great things for their state—and that gives them a substantial voice in how those funds are spent—will yield substantial returns.

It is beyond the scope of this report to provide an assessment of every outdoor recreation program in the state. We therefore describe six programs to show how different public-private sector combinations, using a variety of governance structures, are investing in outdoor recreation infrastructure.

The Forever Wild Land Trust

Among Alabama's most far-reaching outdoor recreation projects is the Forever Wild Land Trust (FWLT), which is administered by ADCNR. Most of Alabama's state parks were created in the 1940s. In order to provide greater habitat conservation and public recreational opportunities, the FWLT was created in 1992. Its mission to create state-owned nature preserves and recreation areas is particularly important considering that since it was established, 143,000 acres of lands leased from private owners for the purpose of public hunting have been withdrawn from ADCNR's wildlife management areas. The only funding method to replace those large tracts, or to establish state parklands beyond those created in the middle of the last century, is the FWLT. These acquisitions tend to be strategic; they often allow sections of parks or wildlife management areas to be connected to one another.

It appears that considerable thought was devoted to the FWLT's governance structure when it was set up. The constitutional amendment that established the FWLT specifically states that land can be purchased only from willing sellers; no FWLT land can be acquired through state condemnation powers. Individuals nominate tracts of land for purchase, which the FWLT board of trustees may then offer to purchase at the appraised fair market value. The FWLT board is required to obtain at least two appraisals prior to acquiring a nominated tract, and if there is more than a 10 percent difference between the two appraisals, a third reconciliation appraisal is required. An affirmative vote of at least nine of the fifteen FWLT board members is required to authorize the acquisition of a nominated tract. The FWLT board is drawn from Alabama's universities and the private sector; public officials serve in an ex officio capacity.[23]

Funding for the FWLT is generated by interest earned from offshore natural gas royalties deposited into the Alabama Trust Fund. The FWLT receives 10 percent of the distributed

interest, capped at $15 million for any given year, which will continue until 2032. An additional, though minor, source of funding is the Forever Wild Land Trust state license plate; for $50 per year, Alabama drivers can purchase the tag, with $42.50 from each sale going to the FWLT.

Importantly, funds from the FWLT can be counted by ADCNR and other state agencies in applications for federal grants that require state matches. The FWLT is the sole source of such matching funds; without it, it would not be possible for the state to leverage conservation and trail-related federal grants.

The FWLT has had a substantial impact on the amount of publicly accessible land. As figure 13 shows, it has expanded lands accessible to the public by close to 12 percent.[24] To give a sense of scale, the FWLT manages 210,411 acres, roughly one-half of 1 percent of the total land area in Alabama.

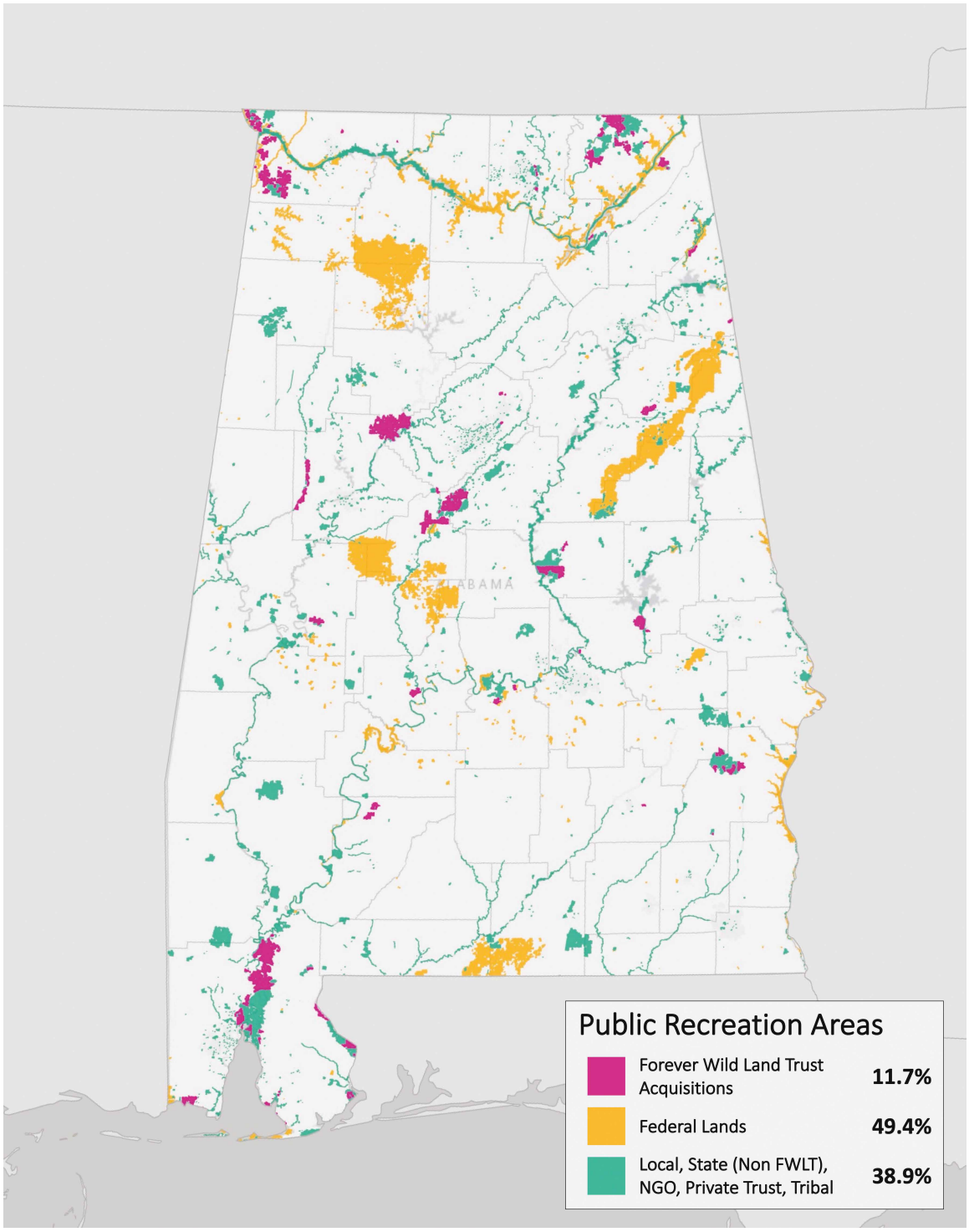
Nevertheless, the FWLT's budget of $15.5 million per year is modest compared to the scale of the challenge.[25] Some back-of-the-envelope calculations perhaps provide a sense of that gap. As we note above, Alabama has the lowest absolute amount of acreage and the lowest relative percentage of its land area dedicated to publicly accessible outdoor recreation. A modest goal would be to achieve the same absolute amount of nonfederal publicly accessible land as Mississippi (which has the lowest amount of such land among Alabama's neighbors, 1.4 million acres, compared with 1.1 million acres in Alabama). During FY 2019–20, the FWLT acquired 6,382 acres.[26] The implication is that at the current levels of funding, Alabama would not obtain parity with Mississippi until 2067.

The Gulf State Park Redevelopment

The Gulf State Park redevelopment exemplifies the combination of a state agency, a university, and multiple, specialized private firms to produce a state park that features a flagship hotel as a major attraction. In the wake of Hurricane Ivan in 2004, Gulf State Park sustained damage and the park's hotel—located directly on the coastline—was left in disrepair and abandoned. In 2010 the Deepwater Horizon oil spill occurred, which resulted in commitments by BP to invest in the communities and ecosystems affected by the spill. ADCNR used $140 million of those funds to revamp the infrastructure of Gulf State Park, with a portion of that money allocated to the development of a new resort hotel—the Lodge at Gulf State Park.[27]

A deliberate, collaborative, and forward-thinking planning process and execution was a pillar of the project. While Gulf State Park is an operation of ADCNR, the University of Alabama Center for Economic Development (UACED), about which we will return in greater detail below, was brought in to play a major role in planning, designing, and managing the redevelopment project. The UACED, in turn, contracted the design firm Sasaski Associates

Figure 13. Forever Wild Land Trust acquisitions, federal lands, and state, local, and NGO holdings in Alabama public recreation areas



Source: US Geological Survey (USGS) Gap Analysis Project (GAP), 2020, Protected Areas Database of the United States (PAD-US) 2.1: US Geological Survey data release.

to lead the creation of a master plan for engaging community members, park visitors, and other stakeholders. The resulting master plan put forward a vision for the park rooted in the idea that sustaining the health of the park's 6,150 acres and seven ecosystems was directly related to the economic vitality of the larger region. It also embraced the notion that a focus on sustainability does not hinder economic objectives.[28] The development and construction work was then carried out by Skanska USA, the US branch of a major Swedish firm that specializes in sustainable large-scale construction projects. The 350-room lodge, as well as some other elements of the park's infrastructure, such as its restaurant, cabins, and cottages, is operated by a private vendor, Valor Hospitality Partners. The rest of the park's infrastructure, including its 16 miles of trails, a 496-site RV campground, and beach access sites, is managed by ADCNR.

The six-year project produced a revitalized Gulf State Park that serves as a benchmark for environmental sustainability. For example, the rebuilt lodge was relocated about two hundred yards behind the original structure to reduce the overall impact to the coastline, with native plant species used to restore dunes and the natural habitat. The Lodge at Gulf State Park is also the first-ever fortified commercial hurricane structure in the United States.

The Red Rock Trail System

Nonprofit organizations play key roles in the development of Alabama's outdoor recreation infrastructure. One example is the Red Rock Trail System, whose master plan was developed by the Freshwater Land Trust, a nonprofit that conserves lands and builds trails in central Alabama, in partnership with the Jefferson County Health Action Partnership, a community-based organization supported by the Community Foundation of Greater Birmingham, the United Way of Central Alabama, and the Jefferson County Department of Health.

The goal of the Red Rock Trail System is a regional greenway in Jefferson County that preserves green spaces while enabling active, alternative methods of transportation for county residents. At its simplest, the mission is to construct 750 miles of interconnected multiuse trails, parks, bike lanes, and sidewalks that will connect the 9,000-acre Red Mountain Park in the Oxmoor Valley to Ruffner Mountain preserve in eastern Birmingham.[29] As of December 2020, 125 miles of trails toward this goal had been completed.[30] At a more complex level, the mission of the system is to encourage healthy lifestyles and improve health outcomes in Jefferson County, enhance access to the county's natural resources, and cultivate a sense of community within the area.

Another goal of the Red Rock Trail System is economic development within Jefferson County. Trail building generates construction jobs, but perhaps more importantly, trails generate positive externalities by raising property values, increasing tourism, and providing a focal

point for new business development.[31] The Rotary Trail, which is a crucial connector in central Birmingham for the larger Red Rock System, and which opened to the public in 2016, is an example. The half-mile-long trail, which takes its name from the fact that the initial tranche of $2.5 million in funding came from the Birmingham charter of the Rotary Club, converted a vacant railroad right-of-way in a blighted part of the city into a landscaped walking/running/biking pathway.[32] News reports indicate that it has spurred the development of restaurants, bars, cafes, and condos next to and around it, thereby helping to revitalize the area.[33]

With more than 600 miles of trails yet to be constructed, significant investment is needed to complete the Red Rock Trail System. The plan proposes 250 miles of greenways as one of its central components, with average construction costs at $500,000 per mile.[34]

The Montgomery Whitewater Park

Municipalities also play important roles in the development of Alabama's outdoor recreation infrastructure. There are many examples, which include the development of waterways and trails, but perhaps the most ambitious such municipal effort is the Montgomery Whitewater Park. Scheduled to open in summer 2023, the 120-acre complex is envisioned as a recirculating whitewater rafting, kayaking, and canoeing facility constructed within walking distance of downtown Montgomery. The project is also envisioned to include climbing areas, zip lines, rope courses, and mountain biking trails.

The conception of the park is that two large markets will support its operating costs, while the park generates positive externalities for business development and employment growth in Montgomery County. The first of those markets is composed of families traveling on the I-65 corridor, which is a major cross-country north-south route, connecting Chicago to Mobile, Alabama. Along the way, it passes through other major cities such as Indianapolis, Louisville, Nashville, Huntsville, and Birmingham. The park's location, just off the I-65, is envisioned as an attraction to families from those cities transiting to and from the vacation destinations on Alabama's Gulf Coast. The second of those major markets is envisioned as the roughly seven thousand military, civilian, and government contractors, plus their families, stationed at nearby Maxwell-Gunter Air Force Base.

The land for the project is being donated by the City of Montgomery, which acquired the land from private landowners. Seventy percent of the development and construction costs of $50 million is being funded by Montgomery County, which has created a Community Cooperative District, composed of community leaders, to oversee the project. Most of that contribution will be financed from issuance of revenue bonds, for which the county is responsible. The state has committed an additional $5 million. The Poarch Band of Creek Indians, which has significant hotel and gambling operations in the Montgomery area

and in south Alabama, is also an investor in the project. Groundbreaking took place in the summer of 2021. The park is expected to open during the summer of 2023.[35]

Connecting with Birds and Nature Tours

One of our central points is that outdoor recreation creates opportunities for private initiative, including small businesses in rural areas. An example is Connecting with Birds and Nature Tours. As is often the case with small business enterprises in rural areas, Connecting with Birds and Nature Tours is an adjunct to an agricultural enterprise, in this case a 200-acre Black Angus farm operated by its third-generation owner, Christopher Joe, who started the business in 2018 to diversify the farm's sources of revenue.

Connecting with Birds and Nature Tours takes advantage of two facts: Alabama's forests, ponds, marshes, and lakes provide critical habitat for more than four hundred species of birds; and wildlife observation has become an outdoor recreation industry in and of itself. Connecting with Birds and Nature Tours has responded to this market opportunity by offering birding tours on Joe's Farm, either on a hayride trailer or by hiking its six miles of trails, to view wood stork, American white pelicans, white ibis, swallow-tailed kite, scissor-tailed flycatcher, bald eagles, great blue heron, great egret, osprey, Mississippi kite, and loggerhead shrike. It also crafts school field trips, which include lessons in tree identification, birdhouse building, and bird-watching. It generates income by charging a day-use fee.[36]

The University of Alabama Center for Economic Development/Cahaba Blueway

The UACED was founded in 1989 and serves as an economic outreach unit to access the school's resources, expertise, and existing university centers and programs to provide technical, grant-writing, planning, project management, and leadership assistance to communities, agencies, and organizations seeking to develop Alabama's economy.[37]

We have already had occasion to mention the UACED in connection with the rehabilitation of Gulf State Park, but the center plays an important role in many other outdoor recreation infrastructure projects. Indeed, it has been tasked with preparing the next Statewide Comprehensive Outdoor Recreation Plan (SCORP), which Alabama must submit every five years to be eligible for federal funding from the Land and Water Conservation Fund. We focus in this report on its role in developing the Cahaba River Blueway, but stress that this is just one of its initiatives.

The Cahaba Blueway is one of the major projects of the UACED. The Cahaba is the longest substantially free-flowing river in Alabama and is among the most biologically diverse rivers in the United States. It also connects some of the state's wealthiest communities around Birmingham with some of its most economically undeveloped communities farther

downstream. Although it is actively fished, it is only marginally developed for public recreation. The goal of the Cahaba Blueway initiative is to make the modest investments in infrastructure necessary for easy river access for kayaking, canoeing, paddle boarding, fishing, and floating, and to then provide marketing expertise, so that the Cahaba River emerges as a destination for recreational tourists. Tourism will, in turn, generate positive externalities for the communities that lie along the river by generating demand for hospitality and retail business, by making those communities more attractive to prospective residents, and by generating demand for better conservation practices that will benefit the entire river ecosystem.[38]

The Cahaba Blueway initiative involves a partnership with multiple organizations and agencies, many with financial resources that complement the technical expertise provided by the UACED. These actors include the Nature Conservancy, the Cahaba River Society, Cahaba Riverkeeper, the Freshwater Land Trust, Blue Cross and Blue Shield of Alabama, Sappi, the Alabama Black Belt Foundation, the City of Helena, the City of Trussville, Shelby County, and the National Park Service's Rivers, Trails, and Conservation Assistance Program. The UACED's role had been to serve as an educator for the leaders of cities and towns along the river, the developer of a brand for the Cahaba Blueway, and the creator of guidelines for standardized signage, as well as guidelines for the design, construction, and operation of river access infrastructure that communities can use. It has also identified Cahaba Blueway access sites that lie within lands that are publicly accessible. Finally, the UACED developed a website, cahabablueway.org, that provides information about how to access and stay safe on the river, as well as connects visitors to local tourism resources, hospitality providers, equipment suppliers, and outfitters.

We note that the UACED accomplishes its many initiatives, which extend beyond providing support for outdoor recreation development projects, with a full-time staff of only seven people.[39]

A Proposal: Building on Alabama's Existing Organizations and Structures

Alabama has a vast potential to transform its natural endowment into outdoor recreation attractions that will contribute to building a more innovative economy. The state can draw on two additional assets, beyond its natural endowment, to accomplish that goal: its hardworking and passionate citizens; and the experience those individuals have with a variety of governance structures for outdoor recreation initiatives.

There is, in our view, one major challenge: funding. ADCNR, the UACED, nonprofit organizations, municipal governments, and private initiatives have accomplished a great deal, but they operate with very modest budgets. The existing approach—patching together funds from multiple sources over the course of many years, project by project—is unlikely to

yield the kind of sustained investment that would be required to build and market Alabama outdoor recreation at a scale to recruit and retain high-skill workers. One can observe the results of that approach by comparing outdoor recreation outcomes across states, as we do in figures 3 through 7. The state bond issue of $85 million for state parks and historical sites, if approved by voters as an amendment to the state constitution this fall, would be an important step in renovating and improving existing facilities. It is not, however, an answer to the challenge of transforming Alabama's natural endowment into outdoor recreation attractions that will contribute to building a more innovative economy. Bear in mind that the rehabilitation of Gulf State Park and the reconstruction of its lodge, alone, required $140 million, and that the estimated cost to complete the Red Rock Trail System's 250 miles of greenways, alone, is $125 million.[40]

Raising and spending funds on a much larger scale than has been done in the past requires a concerted push by the state agencies, university research centers, municipal governments, nonprofit organizations, private initiatives, and the passionate people that lead them. We therefore recommend that the state build on its experience with the Alabama Trails Commission, by creating a Joint Commission for Outdoor Recreation Infrastructure, named by the governor, that includes broad representation across the public, private, and nonprofit sectors.[41]

The joint commission is not a replacement for any state agency, higher education center, nonprofit organization, or private initiative. Quite the contrary: its purpose is to reinforce them. The joint commission might, for example, include the commissioner of ADCNR; the director (or a program director) of the UACED; the leaders of nonprofit organizations with long-standing interests in promoting outdoor recreation and conservation, or with interests in promoting an innovative Alabama economy, such as the Freshwater Land Trust, Alabama Audubon, the Nature Conservancy, Ducks Unlimited, the Alabama Trails Foundation, and the Economic Development Partnership of Alabama; the mayors of three or four cities; a number of outdoor recreation entrepreneurs operating small-scale firms; and representatives from Alabama-based firms and foundations with demonstrated philanthropic track records.

We believe that broad representation on the proposed Joint Commission for Outdoor Recreation Infrastructure is crucial for three reasons: First, the myriad agencies, university research centers, nonprofits, and private initiatives require a forum that allows them to speak with a single voice, such that their message is concentrated and amplified. This is particularly crucial when it comes to raising funds from private philanthropy. Second, broad representation facilitates synergies across actors. Plainly put, when a group of smart, passionate people are in the same room, ideas, and ways to operationalize them, emerge that would not do so otherwise. Third, broad representation embodies a fundamental practice of good governance; interests must be balanced so that wise decisions are made, funds are stewarded with care, and projects are evaluated critically.

The joint commission would have three main charges: First, it would draw up and maintain a master plan for Alabama outdoor recreation with an eye to identifying projects that would generate significant positive externalities, estimate the funding necessary to undertake that investment plan, and estimate the net economic impact of these projects. We note that the UACED is preparing the next SCORP, which might serve as a point of departure for such a master plan.

Second, the joint commission would be a vehicle through which funding sources, beyond those already in place, would be identified and pursued. It is our sense that there are considerable sources of funding from private philanthropy in Alabama, but the importance of investment in outdoor recreation infrastructure has not yet been fully made clear to the philanthropic community. It is also our sense that there are considerable opportunities for state funding of public-private partnerships (PPPs), but there is no ready mechanism to evaluate such PPP proposals. In addition, it is our sense that there are considerable opportunities for the funding of Alabama's outdoor recreation infrastructure from federal programs. Indeed, as we write this, the US Senate is debating and amending a $1.2 trillion infrastructure bill—the Infrastructure Investment and Jobs Act (H.R. 3684). While it is beyond the scope of this report to assess every section and subsection of that bill for applicability to Alabama outdoor recreation, there appear to be several that might be applicable, such as section 11134, Recreational Trails Program; section 11133, Bicycle Transportation and Pedestrian Walkways; section 11206, Increasing Safe and Accessible Transportation Options; section 247, Maintaining and Enhancing Hydroelectricity Incentives; and section 40804, Ecosystem Restoration. Finally, it is our sense that users have a demonstrated willingness to pay for the use of outdoor recreation infrastructure. The fact that roughly half of the Alabamians surveyed in the last SCORP say that they travel out of state to enjoy outdoor recreation opportunities is, in our view, prima facie evidence of that willingness to pay. This revenue should fund at least part of the operation costs and maintenance of the outdoor infrastructure.

Third, the joint commission would work with state agencies, municipalities, and nonprofit organizations to plan outdoor recreation infrastructure projects, select developers, and ensure the delivery of projects and services. The selection of developers is critical. An outdoor recreation project involves the development of an area where service providers and users meet and interact, sustained by the area's infrastructure. Some outdoor recreation areas emerge with only minimal coordination, but for some projects it is more effective for a developer to design and deliver them, striving to maximize their value, by judiciously incorporating the service providers and amenities that attract users. Project design may be delegated to the developer under the supervision of the commission, or the commission may develop design capabilities.

The projects that come through the joint commission may be delivered through ADCNR, municipalities, nonprofits, or PPPs. Regardless of who delivers them, projects should be

reviewed and approved by the joint commission's board. In each case the board should assess the overall feasibility of the project, its interaction with other projects, the project's business plan, fee levels and structure, and funding sources.

A Note about Public-Private Partnerships

We believe that private-sector participation through PPPs will accelerate development of Alabama outdoor recreation infrastructure, as private investors can leverage the capacities of the private sector to execute projects.

There is, however, a misconception about PPPs that must be dispelled: they are not a source of free money. Under a PPP the government selects a private firm (the concessionaire) to build, finance, operate, and maintain an infrastructure project. The typical PPP contract term is long, usually between twenty and forty years. At the end of the contract term all ownership rights revert to the government. At that point the government can manage the infrastructure itself or it can initiate a new PPP to make additional investments in the infrastructure project or revamp it.

To understand why a PPP produces no fiscal savings, it is necessary to understand the distinction between financing and funding in a PPP. *Financing* refers to the up-front costs borne by the concessionaire to build the infrastructure, as well as the mechanisms by which the concessionaire mobilizes those funds through the sale of equity or debt. *Funding* refers to the sources by which the infrastructure generates revenue for the PPP. Funding is generated by user fees charged by the PPP, rents that it charges to other service providers (restaurants, gift shops, and the like), or government transfers.

Consider what happens to a government's balance sheet when we compare the financing of infrastructure using the traditional method of the government issuing debt that is funded by taxes versus using a PPP that is funded by a government transfer. As the first line in table 1 shows, the PPP "saves" 100 in current government spending. In line 2, 100 is still spent on the infrastructure project, regardless of how it is financed. As lines 3 and 4 show, however, taxpayers pay 100 in both cases: in the case of traditional infrastructure provision, future governments use 100 in taxes to pay 100 to bondholders; while in the PPP, future governments use 100 in taxes to pay 100 to the concessionaire and its investors.

Table 2 shows that the same reasoning applies to PPPs funded with user fees. The government seemingly "saves" 100 in current spending and debt (line 1) in order to build infrastructure costing 100 (line 2). It does this without the need to collect 100 in taxes (line 3). It does not, however, get something for nothing; it must relinquish 100 in user fees that it would have collected had it financed the project by issuing debt and then collected the user fees itself.

Table 1. Fiscal accounting: Funding from government transfers

	Traditional provision	*Public-private partnership*
Now:	Issue 100 in debt	"Save" 100 in debt
Now:	Spend 100 on infrastructure	Spend 100 on infrastructure
Future:	Collect 100 in taxes	Collect 100 in taxes
Future:	Pay 100 to bondholders	Pay 100 to concessionaire

Table 2. Fiscal accounting: Funding from user fees

	Public provision	*Public-private partnership*
Now:	Issue 100 in debt	"Save" 100 in debt
Now:	Spend 100 on infrastructure	Spend 100 on infrastructure
Future:	Collect 100 in user fees	Give up 100 in user fees
Future:	Pay 100 to bondholders	Concessionaire collects 100 in user fees

The argument for using a PPP to finance outdoor recreation infrastructure is not, therefore, because it relaxes a budget constraint, but because the addition of a private partner can yield efficiencies in the design, construction, and operation of that infrastructure. Such efficiencies can be substantial and produce a return to citizens in the form of reduced costs or better quality of service. Governments should therefore be mindful about such potential efficiencies—and select private partners accordingly. Indeed, a PPP should be chosen only when it is a more efficient means of provision than a public alternative.

Conclusion

Alabama has a vast endowment of natural assets that can be leveraged to expand its outdoor recreation industry, enhancing the state's attractiveness for high-skill individuals and new tourists, and yielding substantial returns to rural and urban communities. Nevertheless, natural assets remain underdeveloped. To develop these natural assets, the state needs to ramp up spending on its outdoor recreation infrastructure, particularly on projects that create externalities by attracting tourists, both within the state and from other states.

Additional funding is necessary to tap Alabama's natural resource endowment. Funding may come from combining private philanthropy, state funds, federal funds, and revenue from users of the infrastructure. Because projects will generate externalities and incremental

economic activity, projects will, over time, also generate a higher tax revenue for the state and contribute to their own funding.

We also propose a joint commission to ramp up infrastructure spending, select projects, and expand the supply of outdoor infrastructure. The joint commission would have three main charges: First, it would draw up and maintain a master plan for Alabama outdoor recreation to identify projects that would generate significant positive externalities, and then estimate the scale of the necessary investment. Second, the joint commission would be a vehicle through which funding sources, beyond those already in place, would be identified and pursued. Third, the joint commission would work with state agencies, municipalities, nonprofit organizations, and the private sector to plan outdoor recreation infrastructure projects, select developers, distribute funds, and ensure the delivery of projects and services.

NOTES

1 Florida, which is an outdoor recreation powerhouse, surveys tourists regarding their preferences. Sixty-one percent of tourists visiting the state responded that outdoor recreation is very important to them, while an additional 37 percent reported that it is somewhat important to them. See Vincent P. Magnini and Chuck Wyatt, *Florida Statewide Comprehensive Outdoor Recreation Plan Participation Study 2016–2017*, final report (Virginia Beach, VA: Institute for Service Research, n.d.), 34–35, available at https://floridadep.gov/sites/default/files/2016-2017-Participation-Study-w-tags.pdf.

2 "Outdoor Recreation," Outdoor Recreation Satellite Account, U.S. and States, 2019, US Bureau of Economic Analysis, November 10, 2020, https://www.bea.gov/data/special-topics/outdoor-recreation.

3 California has fifty-eight counties. Data refers to 2019 and is from the table "Unemployment Rate," US Bureau of Labor Statistics, Local Area Unemployment Statistics, and US Census Bureau, Small Area Income and Poverty Estimates (SAIPE) Program, retrieved July 28, 2021, from US Department of Agriculture, Economic Research Service, https://data.ers.usda.gov/reports.aspx?ID=17828.

4 "Coloma, CA," Data USA, accessed July 28, 2021, https://datausa.io/profile/geo/coloma-ca#about.

5 Data is from the National Land Cover Database 2016 (NLCD2016), a project conducted by the Multi-Resolution Land Characteristics Consortium (mrlc.gov). Tree canopy coverage is measured at a resolution of 30 m × 30 m using spectral satellite imagery supplemented by on-the-ground sources. Each cell is assigned a value from zero to 100 representing the percent canopy coverage for that area. In this map, "forested" is defined as 90 percent canopy coverage or greater and is shaded in green, with everything less than 90 percent unshaded. This cutoff was chosen to highlight regions of dense, uninterrupted forest and avoid the inclusion of suburban areas. We constructed alternate maps using thresholds of 66 percent and 75 percent, and the results were qualitatively the same (these maps have been omitted for brevity).

6 Features in the National Hydrography Dataset represent the spatial extent of bodies of water, allowing for surface area calculations. Areas shaded in blue were included in the surface area calculation and include rivers, streams, lakes, ponds, canals, weirs, dams, flumes, inundation areas, levees, spillways, and washes. The features displayed on the map have been drawn with a slight outline in order to improve visibility.

7 "Portage and Checkpoint Locations for the Great Alabama 650 Race," *Alabama 2020 650 Guidebook*, September 3 version, accessed July 15, 2021, https://www.alabamascenicrivertrail.com/uploadedFiles/Alabama_2020_650_Guidebook_September_3_version.pdf.

8 Patrick E. O'Neil, "River Systems and Watersheds of Alabama," *Encyclopedia of Alabama*, published August 7, 2008, last updated July 1, 2013, http://encyclopediaofalabama.org/article/h-1627.

9 South Central Alabama Development Commission, *Alabama Statewide Comprehensive Outdoor Recreation Plan, 2013–2018* (2014), 89, https://www.recpro.org/assets/Library/SCORPs/al_scorp_2013.pdf.

10 South Central Alabama Development Commission, *Alabama Statewide Comprehensive Outdoor Recreation Plan*, 89.

11 US Department of Commerce, Bureau of Economic Analysis, "2019 Florida Outdoor Recreation Satellite Account," accessed August 9, 2021, https://apps.bea.gov/data/special-topics/orsa/summary-sheets/ORSA%20-%20Florida.pdf.

12 US Department of Commerce, Bureau of Economic Analysis, "2019 Alabama Outdoor Recreation Satellite Account," accessed August 9, 2021, https://apps.bea.gov/data/special-topics/orsa/summary-sheets/ORSA%20-%20Alabama.pdf.

13 US Department of Commerce, Bureau of Economic Analysis, "2019 Georgia Outdoor Recreation Satellite Account," https://apps.bea.gov/data/special-topics/orsa/summary-sheets/ORSA%20-%20Georgia.pdf; "2019 Tennessee Outdoor Recreation Satellite Account," https://apps.bea.gov/data/special-topics/orsa/summary-sheets/ORSA%20-%20Tennessee.pdf; "2019 Mississippi Outdoor Recreation Satellite Account," https://apps.bea.gov/data/special-topics/orsa/summary-sheets/ORSA%20-%20Mississippi.pdf. All pages accessed August 9, 2021.

14 Scott L. Douglass, "Alabama's Coastline," *Encyclopedia of Alabama*, published March 2, 2009, last updated December 18, 2012, http://encyclopediaofalabama.org/article/h-2049.

15 The data from the Gap Analysis Project is available for download at https://www.usgs.gov/core-science-systems/science-analytics-and-synthesis/gap/science/pad-us-data-download?qt-science_center_objects=0#qt-science_center_objects.

16 The AllTrails web pages were accessed August 9, 2021: "Best Trails in Alabama," https://www.alltrails.com/us/alabama; "Best Trails in Georgia," https://www.alltrails.com/us/georgia; "Best Trails in Tennessee," https://www.alltrails.com/us/Tennessee; "Best Trails in Florida," https://www.alltrails.com/us/Florida; "Best Trails in Mississippi," https://www.alltrails.com/us/mississippi.

17 US Department of Transportation, Federal Highway Administration, *2019 Recreational Trails Program Annual Report*, accessed August 9, 2021, https://www.fhwa.dot.gov/environment/recreational_trails/overview/report/2019/report2019.pdf. *Note*: Recreational Trails Program funds for FY 2020 were the same as the previous year (FY 2019) under the FAST Act; US Department of the Interior, "The Land and Water Conservation Fund FY 2020 Regular Apportionment," March 31, 2020.

18 In Georgia the counterpart to ADCNR is the Department of Natural Resources. In Tennessee it is the Wildlife Resources Agency and the Department of Environment and Conservation. In Florida it is the Department of Environmental Protection and the Fish and Wildlife Conservation Commission. In Mississippi it is the Department of Wildlife, Fisheries, and Parks and the Mississippi Department of Marine Resources. Data is from State of Alabama, *Executive Budget, Fiscal Year 2021*, C-12, accessed August 9, 2021, https://budget.alabama.gov/wp-content/uploads/2020/02/FINAL-State-of-Alabama-Budget-Document-FY21.pdf; Georgia Governor's Office of Planning and Budget, HB 80-AFY 2021 Appropriations Bill, 69, dated February 11, 2021, https://opb.georgia.gov/budget-information/budget-documents/appropriations-bills; State of Tennessee, Department of Finance and Administration, *The Budget, Fiscal Year 2020–2021*, B-293, submitted February 3, 2020, https://www.tn.gov/content/dam/tn/finance/budget/documents/2021BudgetDocumentVol1.pdf; Florida Senate, SB 2500 (appropriations for FY 2021), 268, 281, accessed August 9, 2021, https://flsenate.gov/Session/Bill/2021/2500/BillText/er/PDF; Mississippi Legislative Budget Office: Statement VI: Total State Budget Recommend for Fiscal Year 2021, accessed August 9, 2021, http://www.lbo.ms.gov/PublicReports/GetBudgetRequestDetailReport/0?report=Statement6&fiscalYear=2021.

19 Alabama Department of Conservation and Natural Resources, *2019–2020 Annual Report*, 7, accessed August 9, 2021, https://www.outdooralabama.com/sites/default/files/pictures/2019-2020%20Annual%20Report.pdf.

20 In FY 2021, $138.3 million of the budgeted federal funding came from the RESTORE Act. As a consequence of the 2010 Deepwater Horizon oil spill, the act established the Gulf Coast Restoration Trust Fund in the US Treasury Department. Eighty percent of all administrative and civil penalties paid in connection with the Deepwater Horizon oil spill are deposited into the trust fund and invested. The returns fund programs, projects, and activities that restore and protect the environment and economy of the Gulf Coast region; see https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/restore-act. Funds are disbursed for specific projects. One should note that budgeted disbursements for FY 2021 exceed actual funding from the RESTORE Act in FY 2019 ($195,250) and FY 2020 ($11,793,012). See, respectively, Alabama Department of Conservation and Natural Resources, *2019–2020 Annual Report*, 7, and *2018–2019 Annual Report*, 7.

21 Under the Gulf of Mexico Energy Security Act (GOMESA) of 2006, Alabama, Louisiana, Mississippi, and Texas receive a portion of the revenue generated from oil and gas production offshore in the Gulf of Mexico. Most goes to the state through ADCNR, but some is allocated directly to Baldwin and Mobile Counties. See US Department of the Interior, "Natural Resources Revenue Data," accessed August 9, 2021, https://revenuedata.doi.gov/how-revenue-works/gomesa/#Revenue-sharing.

22 For information about the legal process to evaluate the damage from oil spills, see US Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, "What Is a Natural Resource Damage Assessment?," accessed August 9, 2021, https://oceanservice.noaa.gov/facts/nrda.html.

23 State of Alabama, Forever Wild Land Trust, *Annual Report, Fiscal Year 2019–2020*, submitted January 29, 2021, https://www.alabamaforeverwild.com/sites/default/files/Forever%20Wild%20Land%20Trust%20Annual%20Report%20–%20FY20.pdf.

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31 Freshwater Land Trust, *The Red Rock Ridge and Valley Trail System Master Plan* (2010), 1.4, https://freshwaterlandtrust.org/core/uploads/2018/01/Old-Website-Full-Red-Rock-Plan.pdf.

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39 "Meet the Team," University of Alabama Center for Economic Development, accessed August 2, 2021, https://www.uaced.ua.edu/staff.html.

40 Freshwater Land Trust, *Red Rock Ridge and Valley Trail System*, 1.4.

41 The Alabama Trails Commission (ATC) was established by Legislative Act 2010-585 (HB 376) with twelve commissioners and seventeen advisory board members. Its mission is to promote, develop, and facilitate a statewide trail system utilizing intergovernmental coordination, advocacy, education, and alternative funding sources. The ATC is staffed by the UACED. See "Alabama Trails Commission," University of Alabama Center for Economic Development, accessed August 6, 2021, https://www.uaced.ua.edu/alabama-trails-commission.html.

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3. Supporting Advanced Manufacturing in Alabama

JONATHAN RODDEN

EXECUTIVE SUMMARY

The United States is falling behind competitors like Germany when it comes to labor productivity growth in manufacturing, and the United States has lagged behind in the adoption of advanced manufacturing techniques. In order to compete, American manufacturers will need to innovate. Innovation in the United States, however, has become concentrated in a small number of metro areas and is increasingly disconnected from manufacturing. At the same time, in the wake of the pandemic, bipartisan calls for the "onshoring" of certain manufacturing jobs have increased.

All of this creates an opportunity for Alabama. After having lost a large number of manufacturing jobs prior to 2010, Alabama has seen a robust rebound of manufacturing, both in its larger cities and in nonmetro areas. Much of this manufacturing activity involves new investments and sophisticated techniques, and a sizable share is linked to firms with links to Germany—a country that is at the technological frontier of advanced manufacturing.

This chapter argues that Alabama can solidify its position as one of the most dynamic manufacturing areas in the United States if it continues its efforts to build an infrastructure to support advanced manufacturing along the lines of the German model of collaboration between government agencies, educational institutions, and the private sector. Alabama has already made impressive investments in workforce training, and these efforts should continue to blossom. The next step is to build robust institutions that help bridge what is known as the "valley of death"—the gap between abstract or academic innovations and their commercial application in the marketplace.

Introduction

In recent years, the growth of labor productivity in the United States has been slowing relative to that of its competitors in Europe and Asia. Productivity growth in the United States has largely been driven by its early lead as an innovator in information technology, but productivity growth in other manufacturing activities has slowed to a crawl.[1] This is an important challenge for the United States, since productivity growth, which depends on technical innovation, is an important component of successful global competition and broad-based prosperity.

A loss of competitiveness in manufacturing is especially troubling since this sector has typically produced relatively high wages for a broad cross section of workers. Since US manufacturing firms have found it difficult to compete with the cost advantages of countries like China and Vietnam, hopes for a competitive advantage must be pinned to innovation and increased productivity. However, in recent decades, manufacturing productivity growth rates in the United States are beginning to fall behind those of Germany and Japan.[2]

The importance of regaining American innovation and competitive advantage in manufacturing is a rare area of bipartisan agreement. It was a central area of emphasis for Presidents Obama, Trump, and Biden. In 2020, the costs and national security implications of fragile global supply chains associated with the pandemic were revealed, and strengthening domestic manufacturing and "onshoring" certain types of production have gained a new bipartisan urgency.

In order to be competitive with the countries at the frontier of global manufacturing, US manufacturers cannot rely on cost advantages; they must innovate. They must embrace new technologies like additive manufacturing and others of the so-called Industry 4.0. An important puzzle is that, while the United States is unquestionably the world leader in scientific research and discovery, this has not translated to commensurate advantages in manufacturing innovation. On the contrary, countries like Germany have surpassed the United States in manufacturing innovation and productivity and, as a result, have maintained larger and better-compensated industrial workforces.

If the United States is to regain its competitive advantage in manufacturing, it is quite possible that Alabama will be one of the leaders of that resurgence. While many US states have been experiencing an ongoing loss of manufacturing jobs during the era of globalization, Alabama is one of several states experiencing a rebirth of manufacturing employment, led by the automotive sector.

The key argument of this chapter is that Alabama has an excellent opportunity to build from its existing manufacturing base and become a leader in advanced manufacturing. Notably, much of Alabama's industrial rebirth is based on new investments borne of partnerships with countries already at the global frontier of manufacturing productivity growth. Above all, this chapter pays special attention to the unique partnership that Alabama has forged with Germany over the last two decades. Alabama is in a position to build on German innovations related to workforce training and institutions to promote collaboration between researchers and manufacturers.

This chapter attempts to answer the following question: How can Alabama build on its existing strength as a burgeoning southern manufacturing powerhouse and become a leader in the transition to advanced manufacturing?

If it can do so, the potential benefits to Alabama are substantial. In contrast to software or internet start-ups, which bring small numbers of high-salary jobs that can easily be lured elsewhere, the buildup of a highly competitive advanced manufacturing sector can bring with it high labor productivity, high-paying jobs, and broad-based prosperity. The job-multiplier effect for advanced manufacturing technologies is substantial. One recent study indicates that every technology-intensive manufacturing job supports at least four other jobs.[3]

In fact, Alabama has already started to build a set of institutions to support advanced manufacturing. While low labor costs and tax incentives may have been important components of Alabama's initial appeal to auto producers, Alabama has subsequently invested heavily, and by all accounts successfully, in workforce training. Demands for high-end training are only growing, and further innovation and investment in this area will continue to produce dividends. Above all, this chapter argues that the next step in Alabama's positioning as a hub of advanced manufacturing is to build from Germany's experience in the infrastructure for research and development.

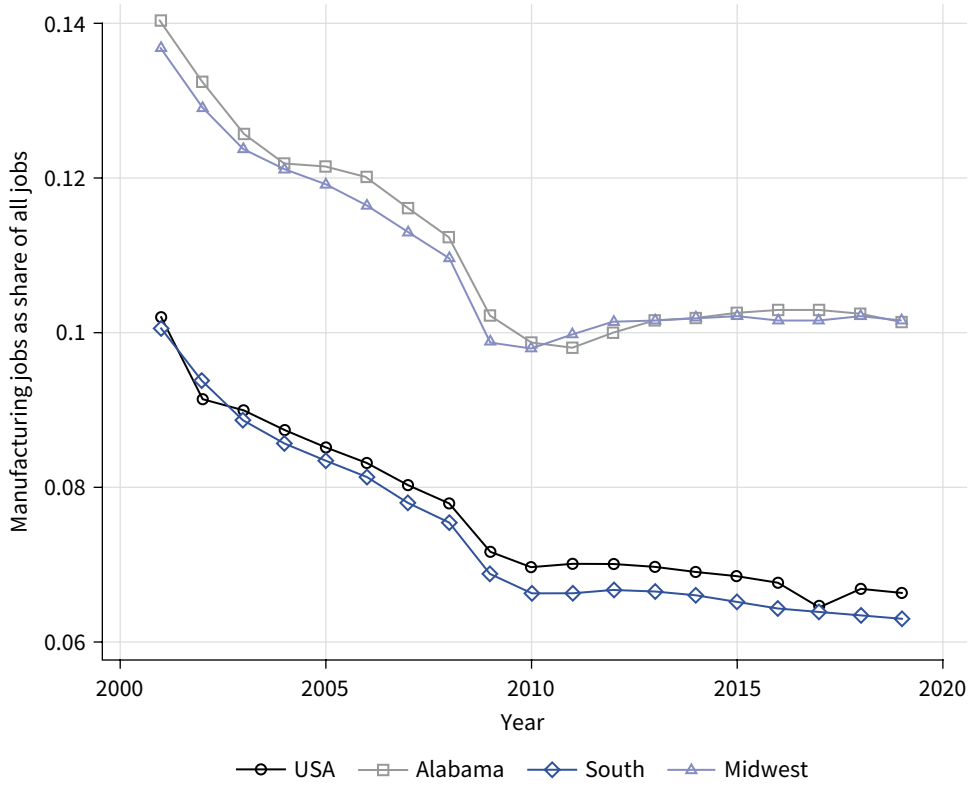
This chapter begins with an overview of the challenges facing manufacturers in Alabama and beyond. I draw on data from a number of sources to paint a picture of the prospects for the development of advanced manufacturing in Alabama. I argue that a crucial weakness in the US system is a long-term decoupling of cutting-edge scientific research from the manufacturing process. There is often a mismatch between the goals of academic researchers at elite universities and those of local manufacturers. I then discuss lessons from Germany and elsewhere in the development of collaborative institutions that facilitate manufacturing-oriented research and development. I discuss Alabama's efforts thus far and consider several possible avenues for further development, concluding with specific recommendations for the Alabama Innovation Commission.

The Current Landscape for Advanced Manufacturing in the United States and Alabama

Considerable attention has been given to the devastating impact of increased global competition on US manufacturing since the 1980s. However, less attention has been paid to the stabilization of job losses and the small, geographically concentrated rebound of US manufacturing that has taken place since its low point around 2010.

Figure 1 displays manufacturing jobs as a share of total jobs in the United States as a whole, in Alabama, in the South as a whole, and in the old industrial heartland of the US Midwest. Manufacturing as a share of employment has fallen precipitously throughout the United States during the era of globalization. However, the free fall of manufacturing jobs stabilized around 2010, and the decline has been much more gradual since then in the United States as a whole, and in the US South as a whole.

Figure 1. Manufacturing jobs as share of total jobs, 2001–2019



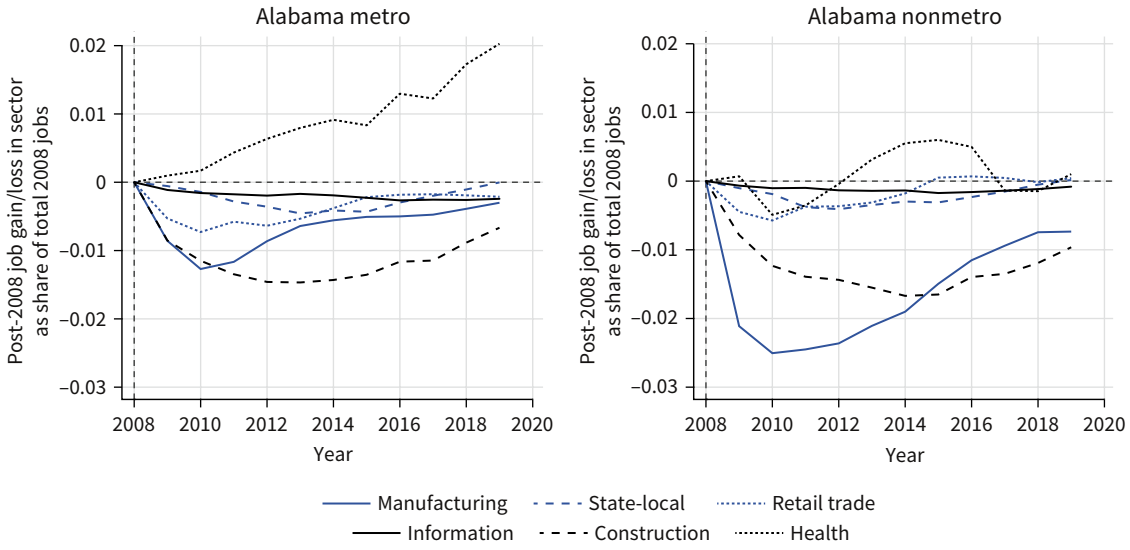
Source: Bureau of Economic Analysis (BEA), Employment by County, accessed from https://www.bea.gov/data/employment/employment-county-metro-and-other-areas.

Manufacturing employment continues to be much higher in Alabama than in the rest of the United States and the South as a whole. Moreover, Alabama is among the small number of US states experiencing a pronounced return of manufacturing jobs since 2011. In this respect, Alabama looks similar to midwestern states like Indiana.

Like many other states, Alabama's recovery from the great recession has been slow. Figure 2 shows that job growth since 2008 has been dominated by the health care sector, especially in Alabama's largest cities. Figure 2 treats 2008 as the base year and examines job gains (or losses) in several of the largest sectors since 2008 as a share of *total* jobs (all sectors) in 2008. This allows us to get a visual understanding of the sectors that contributed most to job losses during the recession, and to the recovery thereafter.

Figure 2 shows that as a share of total jobs, manufacturing and construction were hit harder than any other sector in Alabama. Manufacturing job losses outside Alabama's largest cities were severe. However, figure 2 also shows that manufacturing jobs started a rather impressive recovery in 2010 in both metro and outlying areas, although manufacturing jobs have still not recovered to prerecession levels. The pattern in Alabama is different from that

Figure 2. Alabama's slow recovery from the great recession



Source: BEA, Employment by County.

of some traditional manufacturing states like New York, Pennsylvania, and Illinois, which experienced similar manufacturing job losses during the great recession, but experienced no subsequent recovery.

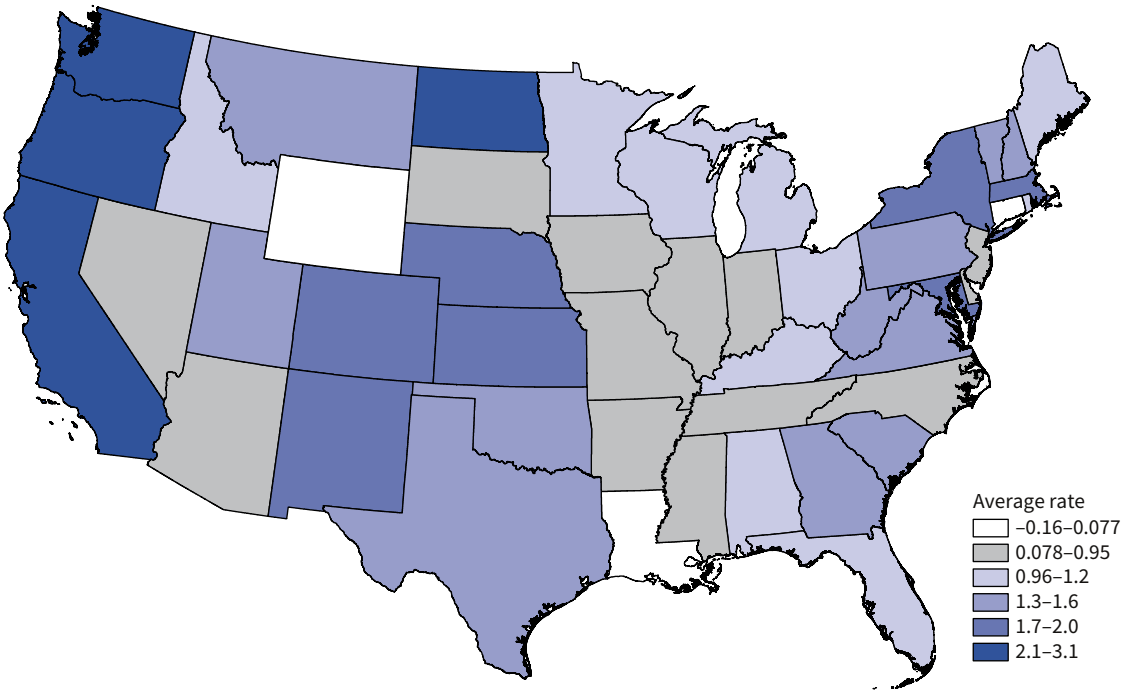
In Alabama, the return of manufacturing is by no means explained by a retreat from globalization. On the contrary, after losing a large number of textile jobs to foreign competition, much of Alabama's industrial rebirth has been driven by partnerships with foreign firms—above all, from Germany, Japan, and South Korea—who have found Alabama to be an ideal location from which to base their North American manufacturing operations.

Alabama is in an excellent position to build on its status as a leader in the revitalization of American manufacturing. Unlike much of the Midwest, a large portion of Alabama's manufacturing infrastructure is new and technologically sophisticated, and Alabama is not burdened with many of the legacy costs associated with manufacturing in the old nineteenth-century manufacturing core of the Northeast and Midwest.

However, Alabama faces many of the same challenges that plague other US regions as they seek to rebuild a modern, competitive manufacturing sector. Above all, the United States lacks some crucial infrastructure for the development of advanced manufacturing. The key claim of this chapter is that Alabama is in a good position to overcome those challenges.

The rate of growth of labor productivity, defined as output per hours worked, has been falling in recent years in several advanced industrial countries. The United States, once a

Figure 3. Average annual growth in labor productivity, US states, 2007–2020

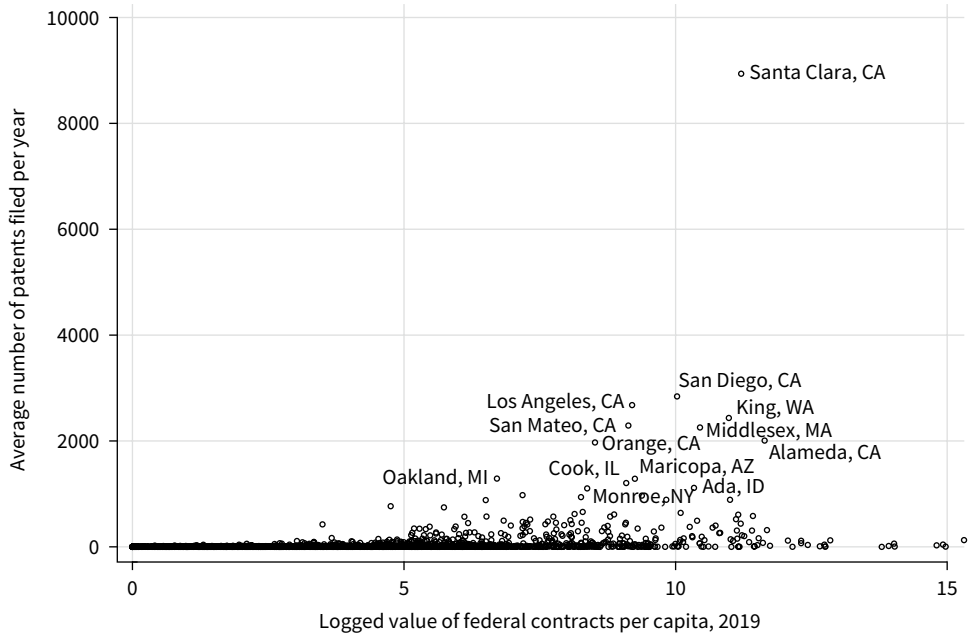


Source: United States Bureau of Labor Statistics, Labor Productivity and Costs, accessed from https://www.bls.gov/lpc/state-productivity.htm.

leader in productivity growth, now demonstrates rates of overall private-sector productivity growth similar to those of Japan and Germany. Moreover, much of the productivity growth in the United States has been driven by the information and communication technology sectors, which have brought immense productivity gains and wealth to highly educated individuals in a relatively small number of cities. However, productivity gains associated with innovations in coastal cities are largely disconnected from American manufacturing. In the period 2004 to 2016, productivity growth in US manufacturing has fallen behind that of both Japan and Germany.[4] Moreover, a large share of US productivity gains is actually driven by the offshoring of the production of computer and electronic products rather than domestic manufacturing.[5]

Figure 3 shows that average annual growth in labor productivity since 2007 has been healthy in the West and parts of New England, but has lagged behind in the manufacturing-oriented states of the Midwest and South. A recent study by the Bureau of Labor Statistics demonstrates that this geographic pattern is driven in part by a strong relationship between information and communication technology as a share of output and productivity growth.[6] With an annual labor productivity growth rate of around 1 percent, Alabama is somewhat below the national average.

Figure 4. Federal contracts and patents, US counties



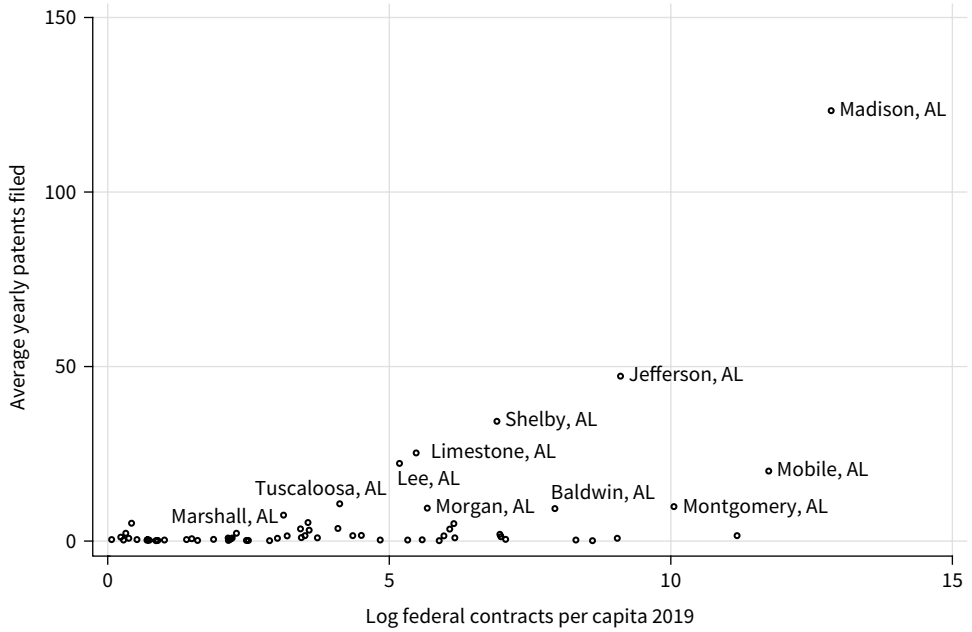
Sources: Data on federal contracts from https://www.usaspending.gov/; patent data from United States Patent and Trademark Office (USPTO), Calendar Year Patent Statistics, accessed from https://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports_cbsa.htm.

Increasing labor productivity is clearly linked to innovation. Many of the states with the highest levels of productivity growth are those that have filed the most patents. An important related fact is that many of these states with innovative knowledge hubs—such as California, Washington, Virginia, and Massachusetts—are also those that have long received especially large flows of federal funding from the Department of Defense. Increasingly, innovation is clustered in knowledge-economy hubs with an ecosystem of universities, federal investment, and start-ups, where relatively little manufacturing takes place.

Figure 4 demonstrates the strong county-level relationship between federal contracts and innovation in the United States, and figure 5 does the same for Alabama. The horizontal axis displays the logged value of all federal contracts in 2019 per capita, and the vertical axis is the average number of patents filed each year since 2000.

The pattern in Alabama is a microcosm of the national pattern. Innovation—at least that which is captured by patents—is relatively concentrated in places with a long history of federal investment in research and development: above all, the Huntsville and Birmingham areas. Although on a much smaller scale than places like Boston or San Francisco, these metro areas have been developing the types of links between industry and universities that facilitate innovation and spin-offs.

Figure 5. Federal contracts and patents, Alabama counties



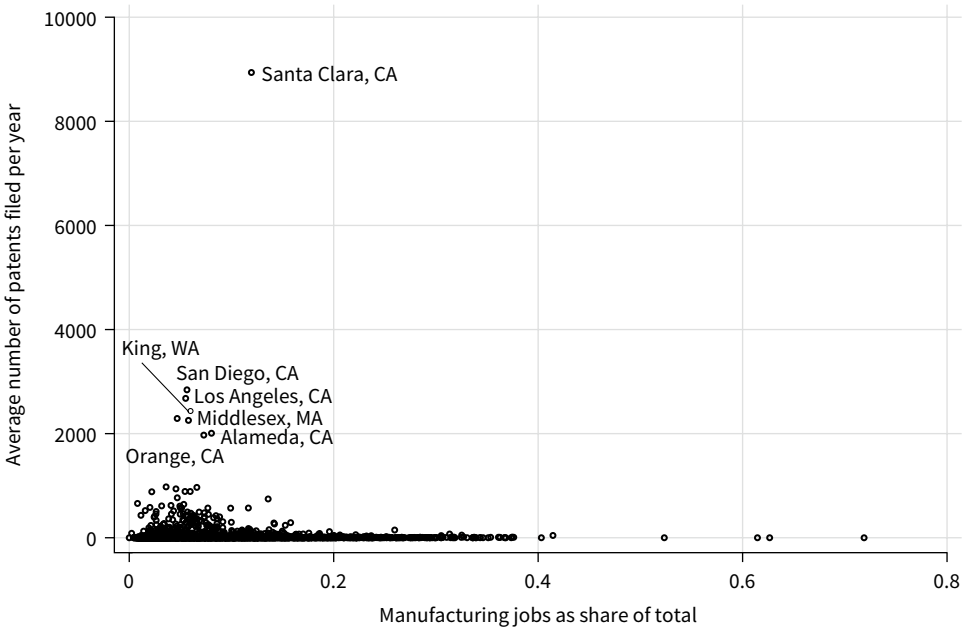
Sources: Data on federal contracts from https://www.usaspending.gov/; patent data from USPTO, Calendar Year Patent Statistics.

While it has made the United States into one of the most innovative countries in the world, there are some potential downsides to this American pattern of geographically concentrated, often federally funded research and development. Above all, this chapter focuses on a growing disconnect between innovation and manufacturing. Figures 6 and 7 display the relationship between average yearly patents and manufacturing as a share of employment, first among all US counties, and then within Alabama.

In the United States as a whole and within Alabama, there is a strong and statistically significant negative county-level relationship between manufacturing and innovation. Rather little innovation takes place in the counties where manufacturing takes place. This can also be visualized in the maps in figure 8: figure 8a displays total county-level patents from 2000 to 2015, and figure 8b shows manufacturing employment as a share of total county population in the 2010 decennial census. Clearly, the geography of innovation and that of manufacturing are quite different in Alabama and the rest of the United States.

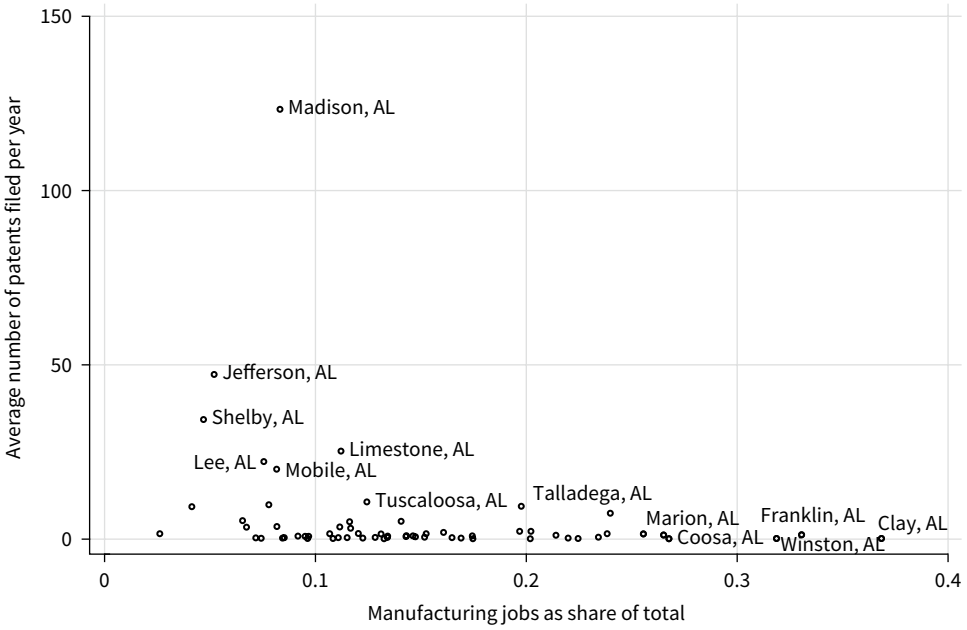
It is tempting to see this disjuncture between manufacturing and innovation as an unfortunate but unavoidable concomitant of deindustrialization, globalization, and the dynamic growth of information technology and the knowledge economy. Indeed, a 2020 study by Autor et al. demonstrates that increasing import competition from China led to less investment in research and development and fewer patents among affected US firms.[7] To state the obvious, increasing foreign competition in the textile industry did not lead to greater innovation in Alabama. Rather, it led to plant closures and deindustrialization.

Figure 6. Manufacturing employment and patents, US counties



Sources: Manufacturing employment data from BEA, Employment by County; patent data from USPTO, Calendar Year Patent Statistics.

Figure 7. Manufacturing employment and patents, Alabama counties

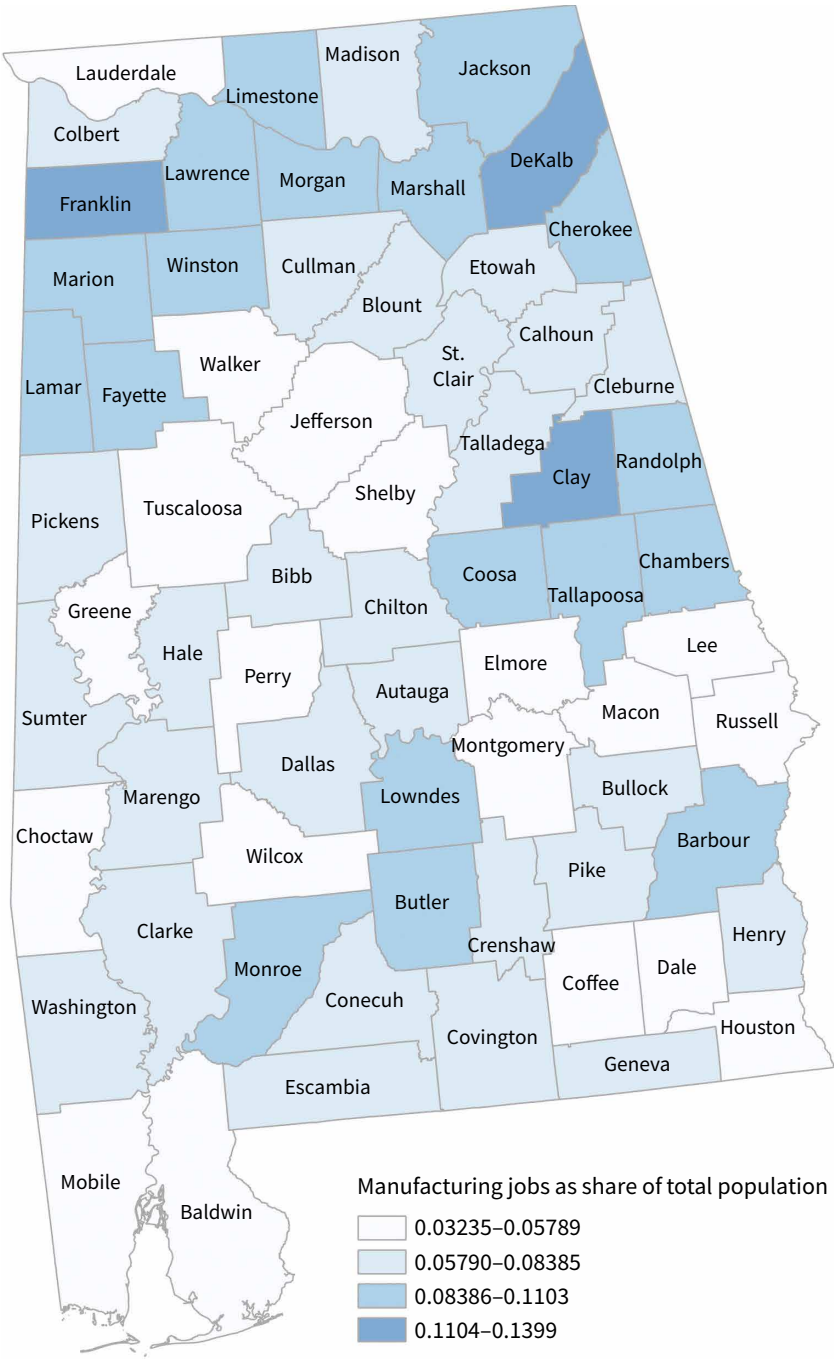


Sources: Manufacturing employment data from BEA, Employment by County; patent data from USPTO, Calendar Year Patent Statistics.

Figure 8a: The geography of patents and manufacturing in Alabama

Source: USPTO, Calendar Year Patent Statistics.

Figure 8b: The geography of patents and manufacturing in Alabama



Source: BEA, Employment by County.

In contrast to the Autor et al. study of US firms, Bloom, Draca, and Van Reenen studied a panel of European firms and found that during the era of dramatically increased Chinese import competition, firms that were most threatened by Chinese imports were *more* likely to innovate.[8] This leads to an interesting puzzle: given the impressive track record of the United States in fostering scientific discovery through its world-class universities and labs, and the associated private-sector innovations in fields like information technology and biotechnology, why did increased competition lead to innovation and resilient manufacturing in places like Germany, but to deindustrialization in the United States? Why is the United States falling behind its peers when it comes to innovation in manufacturing?

The Role of Regional Collaborative Institutions

There is a growing realization that countries at the frontier of advanced manufacturing technology have developed a set of collaborative institutions that foster specialized research and development and advanced workforce training. A basic problem is that a good deal of crucial applied research will not be pursued by individual corporations, which are unable to capture a sufficient share of the benefits of technology platform innovations. This is especially true for technologies that produce significant positive externalities and "proof of concept" research, even for promising new technologies. This type of research often falls into what is sometimes called the valley of death—the gap between abstract or academic innovations and their commercial application in the marketplace. An important component of success in the development of advanced manufacturing is to build institutions to bridge this gap.

Unfortunately, the United States has not been a leader in this regard. It has built an excellent university system, where researchers—often funded by federal grants—seek to make groundbreaking, original scientific discoveries that push out the global frontier of knowledge. This is just as true of researchers at the University of Alabama and Auburn as it is of researchers at MIT and Stanford. In American academia, reputations and careers are built on originality, breakthroughs, grants, and top-tier scientific publications. There are rather weak incentives for researchers to focus on applied research—especially that which is of value to local manufacturing firms. Links between regional manufacturers and academic institutions are surprisingly limited, and the American university system is not designed to bridge the valley of death.

The success of advanced manufacturing in Germany is built on the success of institutions that were designed to overcome this challenge. At the center of the German approach are the Fraunhofer institutes, a set of seventy-four public-private applied research institutions. The Fraunhofer institutes connect universities, large corporations, small and medium-sized enterprises, research organizations, and trade associations. They are organized around specific scientific fields or areas of research. Private and public entities can enter into research contracts with Fraunhofer and gain access to vast collaborative networks and

a wealth of focused expertise. The institutes employ permanent staffs of scientists and technicians, along with experts who rotate through from universities and other institutions.

The institutes preside not only over impressive human capital but also over equipment. Some of them operate pilot manufacturing lines, labs, testing equipment, and demonstration facilities. Some of the equipment is on loan from private firms, which benefit from the collaborative research that takes place at the institute. The institutes also hold a large portfolio of patents that can be accessed by clients.[9] The institutes focus on applied research in a specific area that often corresponds to a cluster of regional private-sector firms, in areas like optics, lasers, wind energy, or automotive research. Funding comes from a mixture of direct government support, contracts with government entities, and private-sector contracts.

These institutions are often built not by the central government, but via partnerships between firms, researchers, and regional and local governments around specific industrial applications. Thus, the government of Alabama, the Innovation Commission, and regional partnerships like the North Alabama Industrial Development Association are well positioned to learn and build from this approach. Perhaps an especially useful example for the Alabama Innovation Commission is the Stuttgart Region Economic Development Corporation, which has built links with Fraunhofer and other research institutes, universities, and the private sector.

It is important to note that Fraunhofer institutes and partnerships like the Stuttgart corporation are not in the business of "picking winners" or attempting to build new industries from scratch. Rather, they focus on sectors that have developed networks and clusters of competence over a period of time, where there are willing private-sector partners that stand to benefit from investments in applied research that are difficult to sustain in-house. The Stuttgart corporation, for example, has developed a series of so-called innovation and competence centers with the goal of driving technological progress to develop the potential of already-established firms.

Current Efforts and Future Opportunity

The German model of support for advanced manufacturing has long been in the sights of US policy makers, but progress has been slow. In recent years, the United States has supported the creation of sixteen institutes sponsored by the Departments of Commerce, Defense, and Energy, cofunded with partners in the private sector. The most recent branding of this network is "Manufacturing USA." These institutes are scattered around the United States, and thus far, no such institute has been created in Alabama. No US region has created anything like the network of competence centers in Stuttgart.

Alabama has been developing a sophisticated automotive manufacturing sector. This is true not only of the large foreign-owned factories, but also of a variety of small and

medium-sized firms that are part of the Alabama automotive supply chain. The demand for greater investment in research and development, and the support necessary for a transition to advanced manufacturing techniques, are clearly growing. The same can also be said of the aerospace sector.

Alabama has already positioned itself as a leader in workforce training. Alabama Industrial Development Training (AIDT), a division of the Alabama Department of Commerce, has developed a nationally recognized program of customized technical training, which takes place in classrooms as well as mobile training units that can be customized for on-site use. Another important resource is Alabama's National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP), known as the Alabama Technology Network (ATN). Part of the Alabama community college system, ATN links Alabama's industry groups, firms, two-year colleges, and universities around an agenda of training focusing on efficiency and productivity.

Both AIDT and ATN include training that is of use for firms attempting to adopt advanced manufacturing techniques. But for both institutions, the focus is clearly on specific types of training and workforce development rather than on research and development. The Industrial Maintenance and Technology Team at ATN might be a useful institutional partner in any efforts to ramp up a collaborative system of research and development.

Alabama has also made important initial steps to build institutions that can bridge the valley of death described above. For instance, the North Alabama Industrial Development Association facilitates both training and research. An exciting recent development is the construction of the Alabama Robotics Technology Park, whose mission includes not only training but also the development of new robotics systems and technologies. It includes a research and development center that provides space for collaborative research, as well as an outdoor test track.

Another very important development is the recent establishment of the Alabama Initiative on Manufacturing Development and Education (IMaDE) at the College of Engineering at the University of Alabama, which places new focus on manufacturing technology and techniques as well as workforce education. Areas of specialization will include vision and motion detection, materials handling and processing, automated welding, precision measurement, fastening, and automated guided vehicles.

These and related new efforts should be supported, and Alabama should consider additional steps that build on these achievements, with a relatively high level of confidence that well-chosen investments will have a payoff. Alabama is in an especially fortunate position given its links to Germany, which is Alabama's number one source of foreign investment. According to the Alabama Department of Commerce, eighty-two German firms have operations in Alabama, ranging from large corporations like Mercedes and Siemens to a

number of small specialty manufacturers. The Alabama Department of Commerce has even opened an office in Stuttgart.

Given these relationships, Alabama should be in an ideal position to study the German system of innovation and competence centers, paying special attention to Fraunhofer and the network of related institutions in the Stuttgart region. In fact, Fraunhofer has set up institutes in North America, and the Alabama Innovation Commission might revisit the idea of setting up an Alabama Fraunhofer location that is tailor-made for the needs of Alabama's manufacturers.[10] Even if Fraunhofer is not determined to be the right partner, the Alabama Innovation Commission should consider creating a delegation that is tasked with exploring whether there are specific aspects of what might be called the Stuttgart model that can be applied in Alabama.

For example, the commission might explore ways of building on existing universities and nascent collaborative relationships, like IMaDE, to build a homegrown network of competence centers. One possibility is to conduct a careful study to identify the most promising areas for applied research and development—for example, something as broad as additive manufacturing or as narrow as self-driving vehicles—and then build coalitions around the pre-identified sectors or applications.

Alternatively, the commission might consider a model of competitive proposals. As part of this process, applicants could be required to assemble coalitions of firms and researchers and develop a vision for a sustainable collaboration. With this type of model, applicants would also be required to come up with a specified amount of funding that would be combined with state funding.

Challenges

Perhaps the most obvious challenge to creating institutions and collaborations that support advanced manufacturing is funding. Relative to the Stuttgart region or the state of Baden-Wuerttemberg, Alabama is a low-tax environment with a relatively limited budget for this type of institution building. However, it should be pointed out that in the biotechnology sector, Alabama made an initial investment in the HudsonAlpha Institute for Biotechnology, which has clearly paid enormous dividends in northern Alabama.

The funding challenge can also be addressed by taking full advantage of current and future federal programs, including the Manufacturing USA program, aimed at the development of skills and competence centers to promote advanced manufacturing.

A key challenge is to develop procedures that prevent politically connected investments and minimize the probability of pouring public money into white elephants. These dangers are real, but they should not stand in the way of creating effective institutions for workforce

training and applied research. The commission can learn from the experiences, both positive and negative, of similar efforts in Germany, Japan, the United States, and Alabama itself. Competition and transparency must be the guiding principles of a successful process of investment and institution building.

Recommendations for the Alabama Innovation Commission

Ideally, the Alabama Innovation Commission will be able to do the following:

- Mobilize existing links with German firms, researchers, and officials to study the German system of institutional support for advanced manufacturing. Identify institutions and techniques that might be most suitable for Alabama.

- Work with firms (including small and medium-sized firms) and researchers to identify the most pressing needs for workforce development and applied manufacturing research and development.

- Explore ways to ramp up existing efforts at workforce development and research and development and, if necessary, improve the responsiveness to the needs of Alabama's existing manufacturers.

- Continue to support efforts like Alabama IMaDE and explore ways of using existing partnerships to build a robust system of support not only for training but also for innovative research and development.

- Consider the development of a competitive system in which coalitions of firms and researchers apply for cofinancing from the state for jointly funded competence or innovation centers.

NOTES

The author wishes to thank Arndt Siepmann for a helpful conversation during the development of this chapter.

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4 Baily, Bosworth, and Doshi, *Productivity Comparisons*, figure 6.

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10 It is my understanding that the idea of building a "Fraunhofer Alabama" has been discussed in the past without proceeding very far.

About the Author

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4. Tax Policy, Subsidies, and Innovative Business Investment in Alabama

PAST AND PROSPECT

JOSHUA RAUH AND GREGORY KEARNEY

This paper also draws on student work conducted as part of the Stanford Graduate School of Business (GSB) Spring 2021 Policy Lab by the following contributors. From Stanford GSB: Matt Devine, Jonathan Hess, Jonathan Hurowitz, Rebecca Jacobson, Sarah Johnson, Eric Kotin, Eric Mattson, Yvonne Ploder, Drake Pooley, Jake Sparkman, Patrick Toth, Chris Warley. From Alabama universities: Zahrah Abdulrauf, Andrew Bartholomew (University of Alabama at Birmingham); Madeline Ellison, Andrew Miller, Jordan Windham (Auburn); Arkaysia Hampton (Tuskegee); Jamaal Jude, Chukwufumnanya Onianwa (Alabama A&M). We are also grateful to Nate Burns for research assistance and to Rebecca Lester and Natalie Millar for helpful comments.

EXECUTIVE SUMMARY

Alabama has in recent years taken affirmative steps in updating its business tax code through a series of transformative pieces of legislation, while also establishing new incentives for innovative business investment. The legislation most notably includes the Alabama Jobs Act of 2015, the Alabama Incentives Modernization (AIM) Act of 2019, and H.B. 170, H.B. 192, H.B. 540, and H.B. 609 in 2021. The last two of these measures notably establish the Alabama Innovation Corporation and add matching grant programs for small businesses.

This report provides initial analyses of the effects of these legislative measures. For the Alabama Jobs Act, in effect since 2015, we perform quantitative analysis of employment changes within Alabama as compared to neighboring states. For the AIM Act, we examine whether it has lived up to some of its stated goals with a focus on census tract selection, and consider whether focusing on these census tracts will be useful for future legislation. For the newer legislation, we provide discussion based on the experience of other states and existing research.

Based on these analyses, we provide specific recommendations that we strongly believe will build on the momentum of the recent tax legislation. They are as follows:

1. Simplify the tax code by replacing some of the existing, specific tax incentives with broader cuts in the corporate tax rate and sales tax rates; the remaining incentives should generally be simpler, shorter duration, and highly targeted;

2. Provide the Alabama Innovation Corporation with guidance and rules similar to those used by Launch Tennessee in its INCITE Co-Investment Fund and Impact Fund, which match private investment in companies seeking to move to Tennessee;

3. Encourage the state to consider an amendment to the AIM Act allowing public pension funds to replace the "state funds" guarantee of downside losses with some degree of co-investment from the future Alabama Innovation Fund specified in H.B. 540;

4. Address business broadband concerns in rural areas by extending broadband into these areas contingent on business investment into these areas.

Introduction

Across the country, states are constantly looking to modernize and attract new streams of investment in the technology sector and other innovative sectors. In Alabama, the governor has signed into law major pieces of legislation that have significantly altered the state's economic incentives to attract new business.

State and local governments each year distribute around $50 billion of targeted place-based incentives.[1] Yet assessing the efficacy of these subsidies in actually attracting business is challenging. Dr. Timothy Bartik of Michigan's Upjohn Institute, perhaps the country's leading economic researcher on targeted business incentives, names this the "but for" problem: when one observes companies moving to a state that take up tax subsidies or other incentives, it is difficult to know how much of that activity would have moved to the state anyway, even if tax incentives had not been offered.

Observers might point out that certainly the tax incentives didn't hurt—yet some critical commentators have used a hunting metaphor to describe this as a "shoot everything that flies, claim everything that falls approach."[2] The issue is cost of the ammunition. First, there is explicit cost of the incentive and the opportunity cost of having a different tax system that might bring in the same or more revenue. Second, there is an "opportunity cost" of not having an alternative tax system, one that has a low headline rate and broad base (meaning relatively few special credits and deductions to attract firms).[3]

Much research in fact suggests that incentive-based approaches are largely ineffective in achieving their intended goals. Bartik's main conclusion is that nationally, three-quarters of incentives do not matter, in the sense that the companies would have taken action and made the same moves anyway without those incentives.[4] Dr. Nathan Jensen of the University of Texas studied Texas incentive offerings and stated to the *Wall Street Journal* that "numerous companies [in Texas] applied for incentives after they had already broken ground and, in some cases, after they had completed building. . . . Yet all of these companies received taxpayer dollars for doing what they would have done anyway."[5]

Alabama could be susceptible to such issues. It has taken an approach with relatively high headline tax rates for corporate income and sales tax that also apply to business inputs, and then offsetting these tax burdens with tax incentives for new companies. The Tax Foundation, a think tank based in Washington, DC, ranks Alabama 41st in the country on its overall state business climate as represented by its headline tax rates and the transactions they apply to, but it separately rates Alabama 4th in the country in business incentives.[6]

The existing research suggests that the optimal approach is having a broader tax base with lower headline rates for all. We were not for this report able to obtain Alabama Department of Revenue data on the specific tax incentives taken up by individual firms, so as such we cannot say that Alabama's targeted incentives follow the patterns documented in other states. We do, however, find that the evidence that the Alabama Jobs Act changed employment in Alabama relative to neighboring states is quite limited. The Jobs Act did not seem to generate a discernably different effect on targeted counties relative to nontargeted counties. Our findings also do not provide support for using the opportunity census tract designation as focal areas for future programs. With an understanding that the state may still prefer the current approach with relatively high headline rates and a wide array of incentives, the existing research points to the need for simpler, shorter duration and broader incentives to include smaller businesses in the event a state chooses that direction.[7]

Although legislative change is often necessary, governments must be careful to monitor how those changes are impacting the wider economy. Thus, though many of these pieces of legislation are relatively new, it is important to take note of the initial impact of the changes to determine whether or not the current legislation is sufficient or if changes need to be made. In this report, our intention is to provide specific analysis with respect to how these changes are doing in achieving their stated goals. First, we will provide a brief background of the current state of Alabama's tax policy and how it stands relative to other state tax regimes. We will then provide some initial analysis on the two major changes to state tax law: the Alabama Jobs Act of 2015 and the AIM Act of 2019. Finally, we will provide some key takeaways from these analyses and provide specific recommendations.

The Current Landscape for Taxation in Alabama

Overview of Alabama Tax Environment Today

When assessing Alabama's standing with respect to its tax system relative to the rest of the country, the results are quite mixed. The Tax Foundation's *2021 State Business Tax Climate Index* offers a less than favorable view of Alabama's tax policy, ranking the state 41st in its most general index. This index analyzes five key taxes—individual income tax, sales tax, corporate income tax, property tax, and unemployment insurance tax—and produces a

ranking based on tax structure, complexity, and rates. With respect to Alabama, the analysis reveals middle-of-the-pack corporate tax and individual tax policies and above-average property tax and unemployment insurance tax rates. Perhaps the most salient point is Alabama's high sales tax, ranked 50th among US states. This is due to both a high level of the rate, with Alabama's combined state and average local sales tax at 9.22 percent (the state tax of 4 percent is in the middle of the pack), and a suboptimal structure related to the large extent to which business inputs are included in the tax base.[8]

Regardless of how close Alabama's tax policies are to an "optimal" structure, individual firms are likely more focused on the actual tax burden they will pay. This is the root of the Tax Foundation's *Location Matters 2021* report, which provides multiple key insights about Alabama's tax policy. The report traces eight "model firms," creating example companies and calculating what the tax bills would actually be for these model firms if they were located in each state. Tax burdens vary significantly by firm, as different companies are affected more or less by each major type of tax and its particular structure.

The Tax Foundation's review reveals several key points for Alabama. Alabama is ranked in the best five states for taxes paid by new firms. Tax incentives for new firm creation significantly decrease tax burdens across the economy. However, the state ranks in the middle of the pack for existing firms. Firms with a longer-term view therefore may appreciate the lower "sticker price" for headquartering in the state, but they see a less rosy picture down the road as time passes or as expansions are considered. Of particular note, the state's policies result in the highest tax burden in the country on mature R&D facilities, largely due to the sales tax Alabama levies on manufacturing machinery and R&D equipment. Other businesses such as distribution centers or shared service centers benefit from Alabama's property tax structure. The state should be aware of how existing tax policy creates tax burdens on individual types of firms.[9]

While the Tax Foundation may have a less than optimistic view on Alabama's taxation system relative to the rest of the country, it is important to quantitatively assess the results of the legislation rather than rely on a single ranking. The ideal way to do this would be with data from the Alabama Department of Revenue that identifies which firms actually take up which tax credits, analysis we would be happy to conduct if given access. In the absence of that, we rely on county-level and census tract–level data from national statistical data sources to study the impact of the legislation.

Analytic Findings

Alabama Jobs Act of 2015

To assess the efficacy of the Alabama Jobs Act, it is important to observe overall job growth in Alabama to determine whether the state had statistically improved in the years following

Table 1. Alabama counties versus non-Alabama counties employment growth, difference in difference around the Alabama Jobs Act of 2015

	Pre-period *3/2011–3/2015*	*Post-period* *4/2015–4/2019*	*Change in growth rates*
Alabama counties			
Average change	0.0812%	0.1249%	0.0436%
Standard error	0.0209%	0.0134%	0.0218%
Non-AL neighboring state			
Average change	0.1847%	0.2084%	0.0237%
Standard error	0.4011%	0.3232%	0.0119%
Difference in difference	−0.1035%	−0.0835%	0.0199%
Standard error	0.0517%	0.0418%	0.0100%

the passage of the bill. One way to estimate the benefits of the Alabama Jobs Act is through the use of a difference-in-difference (DiD) technique. In this approach, the researchers observe two different populations: one that is directly impacted by newly passed legislation (the intervention group) and one that is not (the control group). Comparing the evolution of employment in treated counties (e.g., Alabama counties) to those in nontreated counties (e.g., similar counties in other southeastern states) before and after the treatment reveals the effect of the legislation.

Alabama Counties versus Non-Alabama Counties In our first set analysis, we looked at changes in employment in Alabama counties and in counties belonging to states neighboring Alabama. The latter figures were the aggregate averages of all of the counties in Georgia, Florida, Mississippi, and Tennessee. For the purposes of our analysis we defined our pre-period as March 2011 through March 2015, right up until the passage of the Alabama Jobs Act, and the post-period as April 2015 through April 2019. The results of our initial analysis are captured in table 1.

According to this analysis, the difference between the employment growth of Alabama and that of non-Alabama counties was higher after the Alabama Jobs Act but by a very small margin, only 0.0199 percent. To translate this magnitude into an intuitive statistic, consider that in March 2015, private employment in Alabama was 1.467 million people. If the private economy labor market grows at the Alabama post-period monthly rate of 0.1249 percent over four years, it would increase in size by 90,581 jobs over that time period due to economic growth for all reasons (whether related to the incentives or not). Growing 0.0199 percent slower would mean that private employment would have grown to only 75,946 jobs, a difference of 14,635 jobs.

Table 2. Alabama versus neighboring states regression results for employment growth, difference in difference around the Alabama Jobs Act

Variables	*No month-fixed effects*		*Month-fixed effects*	
	Unweighted regression coefficient	*Weighted regression coefficient*	*Unweighted regression coefficient*	*Weighted regression coefficient*
Pre- and post-period	0.0237 (0.0227)	−0.0086 (0.0130)		
Alabama county	−0.1035* (0.0288)	−0.1222* (0.0253)	−0.1035* (0.0288)	−0.1213* (0.0253)
Alabama × post	0.0199 (0.0337)	0.0312 (0.0258)	0.0199 (0.0865)	0.0304 (0.0259)
Constant	0.1847* (0.0200)	0.2401* (0.0114)	−1.1021* (0.1679)	1.6000* (0.2062)
R^2	0.01	0.06	4.72	29.33
Observations	45,590	45,590	45,590	45,590

*$p < 0.001$

The initial analysis above would therefore point to an effect of 14,635 jobs over four years due to the credits—yet this does not say anything about statistical significance or, in rough terms, whether it might just be "noise" in the data. To check the statistical significance of this result, we regressed the growth rates weighted by county employment levels onto two indicator variables—one that accounted for whether the growth rate took place during the pre- or post-period and another that indicated whether or not the county was within Alabama or out of state—and an interaction variable that indicated if the growth rate fell both within the post-period and within Alabama. This third variable serves as the difference-in-difference estimator.

Table 2 shows the results. The 0.0199 percent monthly effect is replicated in the first column, yet as seen here it is not statistically significant to any appropriate degree of confidence. Under standard asymptotics, the 95 percent confidence interval is plus or minus two standard errors from the mean of 0.0199 percent, where here the standard error of 0.0337 is in fact quite a bit larger than the estimate itself. Thus, the statistical analysis does not reveal a statistically detectable effect of the Alabama Jobs Act on employment.

The regression analysis also allows undertaking other specifications, such as weighting by county employment and including month-fixed effects instead of a simple pre-post indicator. Our interaction variable (Alabama × post) expressing growth rate changes in Alabama counties in the period after the passage of the Alabama Jobs Act shows that Alabama counties during this period grew on average 0.0199 percent and 0.0312 percent (unweighted and weighted, respectively) faster for regressions without month-fixed effects and 0.0199 percent and

Table 3. Alabama targeted versus nontargeted counties employment growth, difference in difference around the Alabama Jobs Act of 2015

	Pre-period	*Post-period*	*Change in growth rates*
	3/2011–3/2015	*4/2015–4/2019*	
Alabama targeted			
Average change	0.0692%	0.1236%	0.0544%
Standard error	0.0290%	0.0286%	0.0272%
Alabama nontargeted			
Average change	0.0884%	0.1256%	0.0372%
Standard error	0.0283%	0.0285%	0.0186%
Difference in difference	−0.0193%	−0.0021%	0.0172%
Standard error	0.0096%	0.0010%	0.0086%

0.0304 percent (unweighted and weighted, respectively) faster for the regressions with month-fixed effects when compared to neighboring state counties during the post-period. However, their standard errors are quite large and once again these results are not statistically significant.

Alabama Targeted Counties versus Alabama Nontargeted Counties In addition to looking at Alabama counties versus non-Alabama counties, we wished to assess the degree to which the Alabama Jobs Act was able to create a greater degree of job growth in targeted counties relative to nontargeted counties. We followed the same procedure as we did in the prior analysis, and we used the same time frames for both pre- and post-periods. The results are shown in table 3.

According to this analysis, there was an excess positive growth figure in targeted Alabama counties, besting the nontargeted counties by 0.0172 percent, of roughly similar magnitude to the results in table 1. A similar regression to check for statistical significance can then be run by regressing growth rates weighted by employment levels onto two indicator variables—one that accounts for whether the growth rate took place during the pre- or post-period and another that indicates whether or not the county was targeted by the Alabama Jobs Act—and an interaction variable. Table 4 shows these results.

Our interaction variable point estimates (Alabama targeted county × post) expressing growth rate changes in Alabama targeted counties around the passage of the Jobs Act relative to nontargeted counties would suggest that Alabama targeted counties on average grew 0.0172 percent and 0.0169 percent (unweighted and weighted, respectively) faster during the post-period for regressions without month-fixed effects and 0.0172 percent

Table 4. Alabama targeted versus nontargeted regression results for employment growth, difference in difference around the Alabama Jobs Act

Variables	*No month-fixed effects*		*Month-fixed effects*	
	Unweighted regression coefficient	*Weighted regression coefficient*	*Unweighted regression coefficient*	*Weighted regression coefficient*
Pre- and post-period	0.0372 (0.0323)	0.0218 (0.0235)		
Alabama targeted county	−0.0193 (0.04015)	−0.0171 (0.0369)	−0.0193 (0.0405)	−0.0167 (0.0335)
Alabama targeted county × post	0.0172 (0.0514)	0.0169 (0.0453)	0.0172 (0.0517)	0.0175 (0.0459)
Constant	0.0884* (0.0289)	0.1188* (0.0239)	−1.569* (0.2694)	−1.8966* (0.3176)
R^2	0.02	0.01	14.81	40.51
Observations	6,499	6,499	6,499	6,499

*$p < 0.001$

and 0.0175 percent (unweighted and weighted, respectively) faster for the regressions with month-fixed effects when compared to Alabama nontargeted counties. However, the standard errors around these estimates are again extremely large, and we therefore once again do not find statistically significant results.

Key Takeaway Overall, there is no statistically robust evidence that Alabama counties outperformed neighboring state counties or that targeted Alabama counties outperformed nontargeted Alabama counties. Based on our initial evidence of the incentive-based approach taken in the Jobs Act as well as the aforementioned literature on incentive-based programs, we believe that these results call into question how useful any new or additional jobs credit programs would be.

Alabama Incentives Modernization (AIM) Act

Since the AIM Act only passed in 2019, it is difficult to ascertain the degree to which the policy has either positively or negatively impacted Alabama. However, one area we can view more closely is the issue of census tract selection and whether the state has chosen census tracts that align with the spirit of the federal government's goals with the Opportunity Zone (OZ) designation: enriching both rural and urban areas that have historically struggled to obtain significant private investment.

To do this, we used the US Census Bureau's American Community Survey data set, which includes data on a number of demographic dimensions; however, for the purposes of this analysis we focused specifically on household income.

Designation of Census Tracts When choosing census tracts, a state must designate 95 percent of its OZ tracts as census tracts that are defined as "low-income communities" (LICs). An LIC is defined by the US Department of the Treasury as a census tract with a poverty rate of at least 20 percent or a median family income 80 percent or less than the area it is benchmarked against (metropolitan area for metropolitan tracts, state for rural tracts).[10] The remaining 5 percent of tracts that can qualify are tracts that are contiguous to an LIC.

Of Alabama's 158 OZ tracts designated, 152 are LICs and the remaining tracts are considered contiguous tracts. However, while 152 LICs were selected, a remaining 477 tracts qualified as LICs but were not selected.

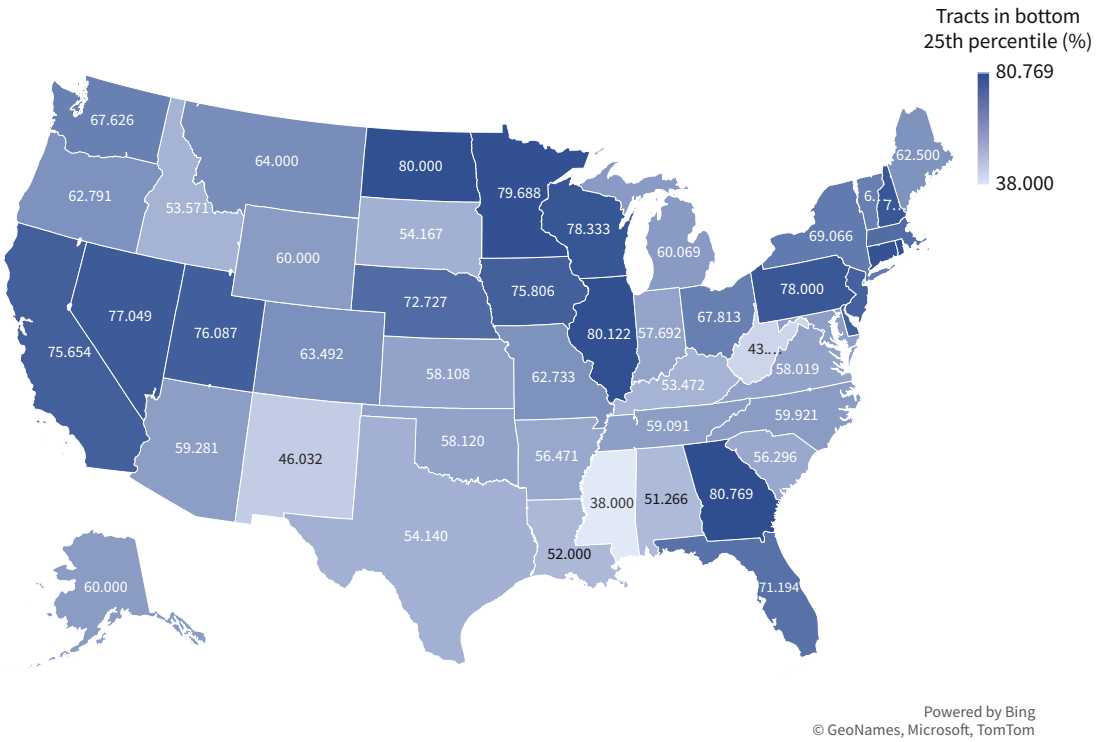
To analyze selection, we determine how many of the LICs selected fell below the 25th percentile of Alabama incomes and how many of those LICs not selected fell beneath the 25th percentile of Alabama incomes. We then compared the proportion of LICs selected in the bottom 25th percentile of state incomes to all fifty states and derived a ranking.

Of Alabama's 158 selected OZ tracts, 81 tracts (all LICs) fell beneath the 25th percentile, giving a proportion selected beneath this threshold of 51.3 percent. However, of the 477 LICs not selected, 204 LICs fell beneath this threshold. The 51.3 percent proportion ranked the 4th worst across all fifty states and Washington, DC (see figure 1).[11]

These results could have occurred for a number of reasons. One possible explanation could be that these census tracts simply provided better opportunities for investment, as they may have had better environmental factors that made them primed for economic growth. That said, recent evidence suggests that potential bias around selection largely hinges on the presence (or lack thereof) of a formal process in selection. In a recent paper, researchers found that on average, tracts with the same political affiliation of the governor are 7.6 percent more likely to be selected as Opportunity Zones. However, this percentage varies significantly depending on the type of process in place for selection. More specifically, the magnitudes range from 0.0 percent for states that used professional advisors to a whopping 25.6 percent for states with no formal process in place.[12]

We cannot provide any specific reasons for the low proportion of LICs selected that are in the bottom 25th percentile relative to other states because we do not know the full details of the application process. But we do know that every county was guaranteed an opportunity zone (OZ) up front regardless of county differences. We want to note that this may be something worth reconsidering in the event of re-designation of OZs. In addition, we hope that this overall analysis may be helpful when considering the utility of using OZ designations as a proxy for the *most* disadvantaged census tracts in any prospective legislative actions.

Figure 1. Percentage of tracts in the bottom 25th percentile



Source: US Department of Census American Community Survey and authors' calculations.

Recommendations and Ideas for Implementation

Simplification of the Tax Code

Following the lead of neighboring states, the Alabama Jobs Act primarily aimed to create a jobs credit for businesses. In total, the Jobs Act originally created three types of credits:

- A jobs credit, structured as a cash rebate of up to 3 percent annually of the previous year's gross payroll (not including fringe benefits) for eligible employees for up to ten years.

- Investment tax credit of up to 1.5 percent annually of the qualified capital investment for a qualifying project for up to ten years.

- An additional 1 percent job credit for companies located in targeted counties with fewer than 25,000 people.[13]

While these were the main tenets of the legislation, a number of other rules governed additional areas of the bill. For example, companies that employ at least 12 percent of their

workforce as veterans qualify for a bonus 0.5 percent job credit. The Jobs Act also provides property tax abatements under certain circumstances.[14]

Although these rules and changes can hypothetically provide much-needed relief for businesses considering relocation, rules of this sort are often cumbersome and costly for small- to medium-sized businesses to navigate, a fact that may partly explain the weak results found in the previous section.

With this in mind, we recommend supplementing or replacing industry and firm characteristic-specific incentives and credits with broader-based business tax cuts such as reductions in the corporate income tax rate.

Co-Investment Guidance for the Alabama Innovation Corporation

This past May, Governor Kay Ivey signed H.B. 540 and H.B. 609 into law, establishing the Alabama Innovation Corporation (AIC). Under the current text of the bill, the AIC will match funds to federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awardees to help "identify policies that will promote entrepreneurship, innovation, and related opportunities in the State of Alabama."[15]

There is some research on these types of grant-matching schemes, and the current literature appears to indicate that at the very least it is unclear whether there is any evidence of positive benefits. Albert N. Link and John T. Scott find no statistically significant employment growth directly related to SBIR funding.[16] Further, Scott Wallsten is critical of the SBIR program's ability to spur innovative activity, as these grants may be subsidizing projects with potentiality for social good but are not viable for private investors.[17]

Knowing that these drawbacks exist, we recommend careful oversight over the selection of these projects. Assessing the likelihood of financial viability by adding qualifying requirements for matching funds should remain the top priority when the AIC is choosing such projects.

In addition to the AIC, the bill establishes the Alabama Innovation Fund (AIF) under the AIC, and this fund will be responsible for investing money into Alabama-based firms. This seems to be consistent with other state approaches to investment. Most states have established some approach with respect to incentivizing new businesses to migrate to their respective states.

These approaches usually fall into one of four categories:

1. State venture capital funds

2. Allocated funds from the State Small Business Credit Initiative (SSBCI)

3. Small business accelerator grants

4. Additional state assistance for SBIR and STTR[18]

Assuming a state is committed to the idea of innovation-specific financial incentives, we believe research supports the first option, at least when using a model that matches some level of private investment. Launch Tennessee is one such state-run investment group that invests in businesses in Tennessee. One key aspect of the fund is that for a business to qualify for some amount of investment, the fund's investment must be matched by private dollars.[19]

Two funds within the Launch Tennessee organization use this approach. The INCITE Fund within Launch Tennessee has already leveraged $87.7 million in private capital, providing companies additional seed, early and expansion stage, in part by attracting and leveraging the aforementioned private investment. The focus of this fund is to create and retain "high-quality jobs" and "accelerate technology commercialization from Tennessee research institutions to Tennessee companies."[20] Launch Tennessee's other fund is the Impact Fund. Established in 2017, the primary focus of this group was more socially conscious, aiming at investment in companies that are solving social, environmental, and economic problems. Investors in this group focus on for-profit ventures in key areas that include agriculture, health care, sustainable living, education, clean energy, and financial inclusion. The Impact Fund aims to make roughly twenty seed-stage investments at $50,000–$150,000 each that will match private dollars at 25 percent, hopefully incentivizing private support for these companies in Tennessee.[21] The specific impact targets could vary from state to state depending on the state's targeted goals. Another similar type of fund is the 49SAF Co-investment Fund in Alaska. The fund will almost guarantee matching investments up to $25,000; however, under stricter scrutiny it will match up to $100,000.[22]

Where will the money for these matching investments come from? For Alabama, much of this funding could come from the SSBCI through the American Rescue Plan. This program has provided $10 billion to fund the SSBCI and would be a useful funding source in establishing a public-private investment fund in Alabama. Further, this type of arrangement is extremely useful in helping the state de-risk its investments, as private entities have already vetted these companies. Therefore, we would strongly recommend that the AIF adopt similar standards to these state investment match programs as an optimal approach in state-assisted investment.

Pension System Concerns and Considerations

Although Alabama's pension system (Retirement Systems of Alabama [RSA]) under the leadership of David Bronner has an impressive history of investing in varied state economic development initiatives, there is concern that the state is sacrificing higher returns to do so

and that language within the AIM Act designed to de-risk specific investments creates an inefficient investment landscape that may hinder all beneficiaries in the long run.

Substantial research suggests that restricting state fund investment to intrastate projects and politically nominated managers leads to funds underperforming relative to their competitors.[23] Pension funds nationally are underfunded by more than $4 trillion and the average age of Alabamians is rising.[24] Thus, limiting the state pension fund from pursuing optimized risk-return strategies is unadvisable. The Alabama Policy Institute estimates RSA currently has a 2x liabilities to assets ratio, including about $1 billion in accounts payable to pensioners every year.[25] It also has not performed well, earning a 2.78 percent rate of return in FY 2019. According to our estimates at the Hoover Institution, Alabama in financial terms has $45 billion of unfunded pension liabilities across its pension systems, an amount that the governmental accounting used by the systems themselves does not reflect. Owing to systematic (not Alabama-specific) flaws in the public budgeting approach to meet pension obligations, contributions would have to rise by around 60 percent simply to keep the unfunded liabilities in Alabama from increasing.[26] Thus, for the financial health of the fund, it should avoid de jure or de facto restrictions on asset allocation and investment strategy that might limit its potential returns.

We therefore recommend an amendment to the AIM Act that would remove the requirement to include "state funds" from the qualified opportunity zone fund designation and replace the "state funds" guarantee of downside losses with some degree of co-investment to be applied from the future Alabama Innovation Fund specified in H.B. 540, with the AIF having some input to the process. This would eliminate a blanket state guarantee and improve governance around investment decisions.

Rural Broadband Development Conditional on Investment

Access to broadband and the internet is of critical importance for an area to be attractive for investment. Without adequate internet access, especially in rural areas of the state, employers will deem quality of life and access to services too low to justify expansion or site selection. Nationwide about 82 percent of households have internet access, yet only three counties in Alabama exceed that mark.[27]

Additionally, knowing that the OZ designations and associated investment incentives are not necessarily targeting the most economically distressed areas, many of these rural areas still remain without the benefits of designation and thus are unattractive locations for investment relative to other areas in the state.

With this in mind, we recommend that the state partner with electrical companies in guaranteeing development of broadband conditional on private investment into rural areas. Once a project is confirmed, the state would ensure that it would create access to broadband

in these areas. This is a more efficient approach to this issue, as it ensures that investment is reaching areas most directly impacted by firms' broadband concerns. Mass broadband guarantees and construction projects could prove costly and unnecessary depending on an area's needs and challenges. The precise structure of such a program is an important topic for future research.

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5. Establishing the Foundation for Economic Growth

THE ALABAMA EDUCATION LABORATORY

ERIC A. HANUSHEK

EXECUTIVE SUMMARY

The long-run development of the Alabama economy depends on the quality of its labor force. While it may be possible to attract new, highly skilled workers to Alabama with a variety of incentives and inducements, development of its citizens through the Alabama schools will remain the central source of talent.

Performance of Alabama students is currently not comparable to that of students in other US states or other countries that are in direct economic competition. Improving the K–12 schools in Alabama must be a central component of any economic development strategy. Such improvement is not a onetime event that relies on any simple and quick solutions. Instead, it must be viewed as a central policy activity that continues over an extended period of time—decades, not years. Success depends crucially on establishing a program of continuous improvement and then staying with it.

The state currently lacks any institutional capacity to evaluate new and ongoing education programs and policies so that success can be expanded and failure can be curtailed. One way to remedy this is to develop the Alabama Education Laboratory. This would be an independent institution that conducts systematic research on and evaluation of Alabama schools.

This is an opportune time to develop such a laboratory. One reason is the recognition of the need for development by the Alabama Innovation Commission. There is also the COVID-19-induced critical need for improving the schools, if only to maintain the current status. And there is funding available from the federal American Rescue Plan.

Introduction

The long-run development of Alabama is closely tied to the skills of its population. And the skills of the population depend crucially on Alabama schools. Alabama students currently fall significantly behind students in other states. This learning gap is not solely attributable to the schools, but the schools are the primary force that can be employed to improve the outcomes.

Improving the quality and impact of the schools is not something that can be done quickly, because there is no simple blueprint for how to get the gains in learning that are needed. Improvement is something that has a large local element, depending on both local demands and local capacities. It is nonetheless something that can be required, aided, and facilitated by the state.

The state currently lacks any place where systematic evaluation and assessment of successful (and unsuccessful) school programs takes place. It is possible to borrow from the experiences of other states and localities, but this is often difficult to do successfully without local modification and adaptation. This raises the need for a concerted effort to have ongoing evaluations of school programs.

Now is a particularly opportune time to address these issues, and it should not be allowed to pass. The federal government has provided substantial additional funding, designed as a way to deal with the COVID pandemic and a way to improve the schools in order to overcome the accumulated learning losses. By directing a portion of these funds toward a new state evaluation function, Alabama can position its schools for long-run improvements.

This chapter begins with an overview of the challenges facing Alabama schools. In that context, it provides an analysis of what feasible improvements in the schools could mean for the economic well-being of individuals and for the state. From these it sketches a way to structure an education laboratory that can begin to provide guidance to the improvement of schools.

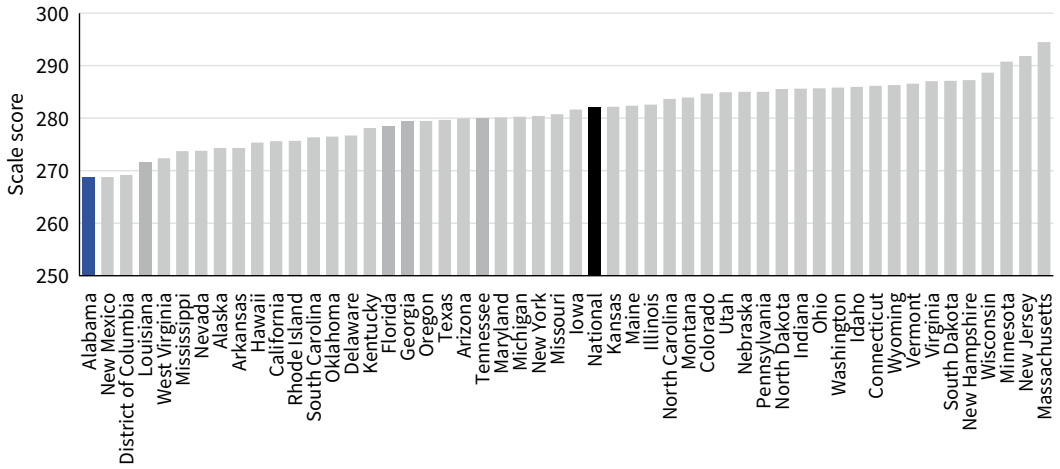
Current Challenge to Alabama

Low educational outcomes in Alabama represent the largest long-run challenge to the state. Improvements in the schools would provide continuing economic improvement. Or, put the opposite way, it will be difficult for the state to sustain long-run economic growth without a significant improvement of its schools.

The clearest picture of the challenge to Alabama comes from the National Assessment of Educational Progress (NAEP).[1] This regular testing—often referred to as "the nation's report card"—provides an indication of the level of performance of Alabama students at different grades and in different subjects.

NAEP is not geared to the individual learning standards of each state but instead is designed to assess generic skills of students that are appropriate for different grades. Importantly, performance on these tests is correlated with the future economic success of students, of each state as a whole, and of the nation.

Figure 1. NAEP mathematics, 8th grade, 2019



Note: DoDEA = Department of Defense Education Activity. Some apparent differences between estimates may not be statistically significant.

Source: US Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2019 Mathematics Assessment.

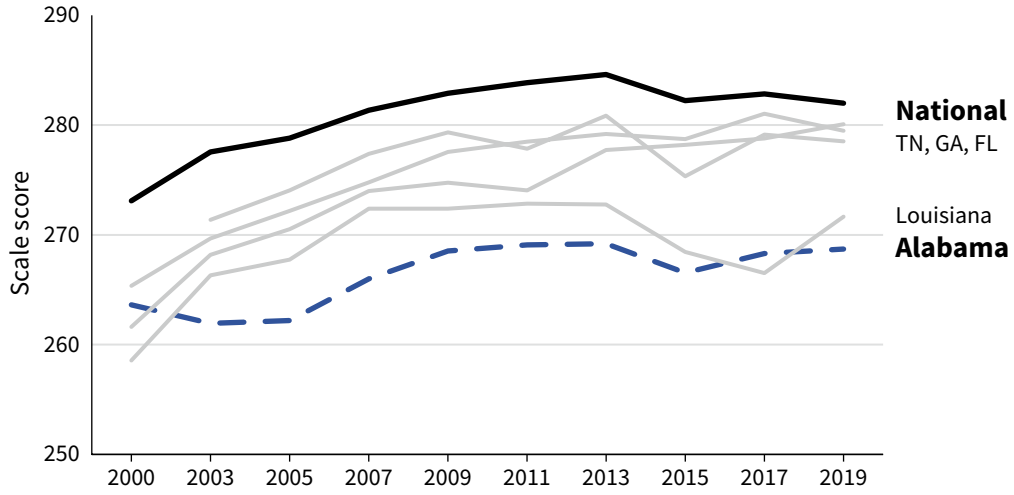
If the most recent scores in mathematics by eighth graders are compared, Alabama students come in behind all other states and the District of Columbia (see figure 1). The average scores are, however, sometimes difficult to interpret. The average eighth grader in Alabama in 2019 fell at the thirty-seventh percentile of national distribution. In other words, 63 percent of all eighth graders in the United States scored better in mathematics than the average Alabama eighth grader. In a comparison with the top performing state, the average Alabama eighth grader placed at the twenty-sixth percentile of the Massachusetts performance distribution.

While Alabama students have performed better over time, the improvement has not been as large as those of students in some nearby states or in the nation as a whole. Figure 2 shows the performance patterns in Florida, Georgia, and Tennessee, which have each pulled away from Alabama over the past two decades, while Louisiana has hovered closer to Alabama.

Another important way to look at the data on student performance is to understand how many students fail to reach even the basic skill level on NAEP. The basic level can be understood as being minimally competitive in the modern, information-based economy. NAEP describes this level for eighth-grade mathematics as:

> Eighth graders performing at the NAEP Basic level should complete problems correctly with the help of structural prompts such as diagrams, charts, and graphs. They should be able to solve problems in all NAEP content areas through the appropriate selection and

Figure 2. NAEP mathematics, 8th grade, 2000–19



Note: Some apparent differences between estimates may not be statistically significant.

Source: US Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996, 2000, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017, and 2019 Mathematics Assessments.

> use of strategies and technological tools—including calculators, computers, and geometric shapes. Students at this level also should be able to use fundamental algebraic and informal geometric concepts in problem solving. As they approach the NAEP Proficient level, students at the NAEP Basic level should be able to determine which of the available data are necessary and sufficient for correct solutions and use them in problem solving. However, these eighth graders show limited skill in communicating mathematically.[2]

Table 1 indicates that 43 percent of Alabama eighth graders cannot reach this minimal level of math competence (compared with 30 percent nationally). The picture is particularly disturbing for Black students—65 percent in Alabama perform below the basic level.

In today's world, however, the comparison is not just with Georgia and Louisiana. Instead there is global competition as international trade and production have opened the world for skilled labor. In a study comparing Alabama students in 2009 with those in the rest of the world, it could be seen that Alabama students were competing with those in Turkey, Serbia, and Bulgaria.[3] This situation does not bode well for the future.

Performance on NAEP and other standardized tests is a harbinger of future economic well-being. It turns out that the skills measured by these tests are closely related to future incomes of students. In fact, the United States rewards these skills more than virtually all countries of the world.[4] But that also implies that the US labor market punishes the lack of skills more than virtually all countries of the world.

Table 1. NAEP mathematics, 8th grade, 2019

	National		*Alabama*	
	Average scale score	*Below basic (%)*	*Average scale score*	*Below basic (%)*
All students	282	31	269	43
White	292	20	279	30
Black	260	53	249	65
Hispanic	268	43	262	50

Another aspect of these skill levels is their impact on economic growth. For both the nation as a whole and for Alabama, long-run economic growth depends largely on the skills of the labor force.[5] The United States as a whole has challenges, because other countries have more-skilled labor forces, which raises doubts about the future competitiveness of the US economy. Within that broad picture, the picture holds at the level of US states.

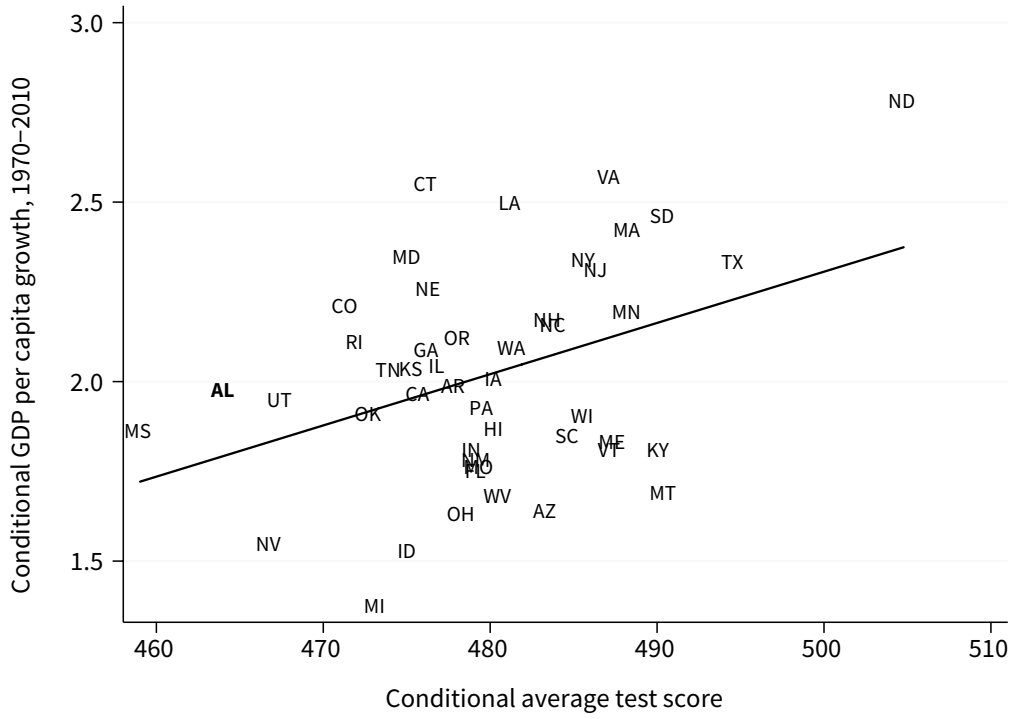
Figure 3 shows how NAEP scores of the labor force in each state relate to economic growth from 1970 to 2010. While a variety of differences across states contribute to differences in growth rates, the skills of the population are central to growth.

The relationship of skills and growth is very strong, and improving schools—improving the skills of the future labor force—would lead to large economic gains. For example, according to the historical impact of skills on growth (seen in figure 3), the gross state product per capita would average 6.3 percent higher over the remainder of the century if Alabama students could improve to the level of Kentucky students (the highest-performing state in the region).

These projections look at the performance of students before graduation from high school and before college. Couldn't similar results be obtained by sending more Alabama students into postsecondary education? Unfortunately, the existing evidence does not support this alternative very well. What students know and can apply after college remains quite closely related to what they know going into college. The international evidence makes this clear: Just adding more college graduates does not change the importance of learning earlier, because learning is cumulative and builds on earlier skills.[6]

It is also the case that the COVID pandemic has heightened the importance of improving K–12 schools. The school closures combined with the heterogeneous return to schools for the 2020–21 school year have left the current group of students noticeably worse off. The learning losses suffered by current students, as described by the Center for Research on Education Outcomes (CREDO), have been large but uneven.[7] The CREDO estimates for the impact of school closures obviously underestimate total losses, which includes the past academic year.

Figure 3. Long-run state and NAEP score



The learning losses imply large economic losses to the current cohort of students. The closure period of 2020, according to historic earnings patterns, imply 3 percent lower lifetime earnings for the average student.[8] This will be significantly larger for disadvantaged students, who suffered larger learning losses. The data for the 2020–21 school year are not fully known, but the additional learning losses mean that lifetime losses are likely to be 6 to 9 percent for the average current student and again even higher for disadvantaged students.

These learning losses from the pandemic underscore also that the labor force in Alabama will not be as skilled as it would have been without the pandemic. Thus, without any improvement for these students, the future growth of the Alabama economy will be less than historic rates. In particular, the average gross state product can be expected to be 3 to 4 percent lower for the rest of the century if the schools manage just to return to 2019 levels but do not improve over those prior levels.

This is a permanent economic loss if the schools only return to the 2019 levels and do not improve. The affected cohort of students will suffer permanent harm and the aggregate economy will be burdened by a less-skilled labor force. It can only be ameliorated by improving the schools over the pre-COVID levels.

A prime difficulty is that these economic effects are not immediate, making them easy to overlook. The situation is somewhat akin to high blood pressure—the silent killer. It is not noticeable until it is too late to correct and its impact is felt. This also implies that politicians—facing election cycles that will not fully see the impacts of any school improvements—are likely to look to fast maturing policies. But the existing research suggests that there is no getting around the need for a skilled and educated population if the economic well-being of the future is to be improved.

Summary of Findings

The long-run challenges for economic development in Alabama are severe. They are not likely to be met without a noticeable improvement in the primary and secondary schools. It is possible to jump-start parts of the development process by developing the existing resources of Alabama and by attracting skilled people from elsewhere. But sustaining this development, again, goes back to developing the state's own children.

Meeting the Challenge

Experience and research provide strong overall guidance on improving the quality of K–12 schools. But it is guidance that also requires considerable local development and adaptation.

At a fundamental level, the key elements of strong programs are highly effective teachers and personalized learning for each student. There is overwhelming evidence from across the country that quality teachers and leaders are the single most important element of a quality school. For example, a study conducted in Gary, Indiana, examined learning growth of disadvantaged students in elementary school classrooms and found that the best teachers added one and one-half years of learning each academic year, while the poorest added just one-half a year of learning.[9] Thus, across classrooms in the same school, the *difference* in achievement amounted to one full year of learning each year, depending on which teacher the student had.

Combined with effective teachers is the necessity of engaging with individual students. Any classroom has a range of students in terms of their preparation for the material in the grade. These differences in preparation were clearly made larger by the closures and uneven return to school during 2020–21. It is important to recognize these differences if the outcome is to be high performance by all students. Meeting students at *their* starting points requires personalized approaches.

These two elements interact with a third—technology. First, attempts to personalize learning have not always been successful in the past, in part because it requires both considerable teacher skill and a good appreciation for the learning of each child. This reality, however, interacts with recent experience. Because of the pandemic, enormous investments have

been made in both the technology itself and in how to help teachers use the technology. An important potential beneficiary of the use of technology is personalized learning.

As schools move forward from the pandemic, technology will almost certainly be an important element and the new technologies to help teachers will almost certainly be better than what existed in the past.[10]

Nonetheless, just identifying these elements of highly effective schools does not ensure that they can be effectively applied across different schools. Different schools have both different demands and different capacities. It is difficult simply to legislate good teachers or individualized instruction or to ensure that the best technology gets used. Instead, the common approach wraps up efforts in specific programs or policies.

Two historically common approaches are regulating teacher preparation and licenses and using teacher salaries to attract high-quality teachers. Unfortunately, neither of these has proved very successful. First, the requirements for teacher certification typically do not mirror what is needed to be an effective classroom teacher.[11] Nor do requirements for teacher preparation programs.[12] It has proved to be very difficult to improve teacher effectiveness through regulating the entry to teaching. Second, teacher salaries—by tradition and by contract—typically are closely related to the amount of teaching experience and to the graduate degrees of the teacher. Yet, neither of these factors is closely related to effectiveness in the classroom.[13] Many studies have shown that the probability of being a great teacher is independent of whether the teacher possesses a master's degree or not. Additionally, except for general improvements in the first few years of teaching, added experience is not consistently related to the classroom performance of teachers. Just paying existing teachers more has little impact on student learning.[14]

What has proved more successful is providing direct incentives for better performance. For example, in a large-scale and ongoing program, Washington, DC, has addressed the importance of having a highly effective teaching force. The IMPACT program of the District of Columbia Public Schools uses a very sophisticated rating system for teachers to determine large rewards for the best teachers and dismissal for the least effective teachers.[15] This program has been shown to lift the performance of students. The Dallas school district has combined a sophisticated evaluation of teachers with incentives as a means of attracting high-quality teachers to the lowest performing schools.[16] The program has shown that such incentives can effectively turn around such schools. As a result, the Texas Legislature developed a statewide program to provide incentives for other districts to emulate this incentive approach.

Such programs and incentives have demonstrated that there are clear ways to improve the performance of students. But they have not been widely reproduced in other districts, suggesting that local implementation is very important.

A Proposed Plan

A primary lesson from Alabama and other states is that there is no simple policy or program that will lead to steady and sustained improvement of schools, despite the considerable attention given to the improvement of K–12 education. And even where there is documented success, such as that in Washington, DC, there has been limited transfer to other locations.

The main problem does not seem to be a lack of ideas and proposals for improvement. Indeed, there is vast experimentation and investigation of ways to improve learning, contributed by parents, teachers, schools, districts, and states. This experimentation and search for ways to improve the schools is happening regularly in Alabama and in the other states.

One key piece that is missing is a way to sort through the successes and failures and to use past experience to develop better school designs. It is in practice very difficult to look at a new or ongoing program or activity in schools and decide whether it is successful in improving student outcomes. While the participants may be happy or unhappy with the experience, it is hard to know whether the results for students are good or bad. This is because it may be possible to assess the achievement of students in a given program, but it is difficult to know what they would have done outside of the given program. As a result, programs may be retained, modified, or discarded without clear understanding of how they impacted student outcomes.

An overarching potential solution to this problem (at least for major programs and policies of the state) is the development of an Alabama Education Laboratory charged with regular evaluation of programs in the state. The idea is to have an independent unit that has both the expertise at and responsibility for judging the efficacy of different programs introduced to improve Alabama K–12 education. The Alabama Education Laboratory could have a research agenda to review some programs regularly along with the flexibility to focus on selected programs as times and circumstances evolve.

This capacity has not previously developed in Alabama. While there have been scattered examples of relevant research and evaluation at the state's Department of Education and across various parts of in-state universities, there is no institution or place where there is consistent and systematic evaluation of Alabama school programs. And in general the state is not well positioned to have such evaluations. For example, the Department of Education has never released individual student data that can be used for such analyses.

This is an opportune time to establish an ongoing, independent evaluation institution. Funds for the establishment of a new institution can be secured from the significant amount of education funding that is flowing to Alabama from the American Rescue Plan.

By using these onetime special purpose funds to establish initial funding for the laboratory, it is possible to ensure a flow of analysis and ideas into the future—and thus to establish the general principles of continuous improvement of the schools.

Similar activities have developed in a number of other places.[17] They have contributed to the development of policies that bring programs to scale in the states. For example, evaluations of the Dallas program that incentivized effective teachers to work in disadvantaged schools contributed to the development of a statewide program to reproduce the approach in other Texas districts. And rigorous analysis of the Tennessee reforms in teacher evaluation has supported its continuation as a state policy.

The exact structure of these differs, but several features are key to their usefulness and thus would be replicated by the lab.

1. These institutions are structured to provide secure data storage and use and to ensure confidentiality of protected individual records. Thus, the work can be done with confidential administrative data currently available in Alabama.

2. Their work plans were developed in consultation with the existing educational institutions—the state departments and the individual district administrations. Specifically, individual projects are approved by the relevant governmental body, even though the exact focus can be initiated by either the laboratory or the educational institution.

3. The results of any analysis are made public and are not subject to any censorship.[18] Sponsoring educational institutions are given advance copies of reports or publications in order to ensure accuracy and preclude surprises, but the integrity of the evaluation process is guaranteed by public release of any analysis.

4. The lab would produce its own work and facilitate work by outside researchers. The nature of the evaluation and policy issues surrounding schools means that states can gain from considerable work on Alabama issues that is funded by others—philanthropies, federal research agencies, and others. The lab can be an important way to attract this kind of "free" research and evaluation.

5. The lab would take responsibility for vetting the scientific integrity of proposed work. This requirement is designed to make sure that unsound analyses are not pursued by either lab personnel or outside researchers.

6. The lab would work with the legislature and the Department of Education to design appropriate evaluations of new programs before they are implemented. By working with programs before they begin, it is possible to get baseline information and

establish appropriate control groups for evaluations, thus obtaining the most useful information about the effectiveness of new initiatives.

7. The lab would be charged with providing a biennial report on the state of Alabama education. This report would assess the level achievement of Alabama students, their graduation from high school, and their entry into college and careers. In this, it would provide detailed analysis of the progress of students toward meeting the overall goals of Alabama's plan under the Every Student Succeeds Act (ESSA) along with an update on the results of its various evaluations and research activities.

8. The lab would be charged with reviewing existing scientific research in currently relevant policy areas and with ensuring that the relevant policy makers are aware of the state of research and evaluation in their areas.

This lab would be an independent organization overseen by an Alabama institution of higher education. By being independent of the current policy makers in the state, the lab would operate under an impartiality that would be vital to its credibility.

The Alabama Education Laboratory would be established by the Alabama legislature. This legislation would set out the charge to the organization and ensure access to student and institutional data. Its base funding would come from American Rescue Plan funds. Ongoing research and evaluation would be provided by a combination of future state appropriations, state and federal grant making, and philanthropic grants.

Conclusions

The long-run economic development of Alabama depends on the quality of its labor force, and the Alabama K–12 schools are central to the development of a high-quality, competitive labor force. Without effective schools, Alabama will be unable to have sustained economic development.

There are immediate ways to improve the educational opportunities—such as the broadband initiative described elsewhere in this report and the recently passed STEM initiative of Chairman Bill Poole. But their long-term success depends on establishing a program of continual improvement where the components of these and other policy initiatives are systematically evaluated and improved. Right now, Alabama lacks a process for identifying effective programs, for expanding on success, and for eliminating poorly performing policies.

The development of an Alabama Education Laboratory as an independent evaluation center would provide a way of institutionalizing the research and evaluation of Alabama schools. It can be mandated by the legislature and initially funded by federal funds from the American Rescue Plan.

NOTES

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18 Presentation of results is, of course, controlled to ensure that no confidential information about students is disclosed.

About the Author

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6. Alabama Broadband for Education

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EXECUTIVE SUMMARY

Many critical building blocks are already in place that position Alabama for significant change in the way it educates its public school students. Public elementary and secondary schools in Alabama are almost universally equipped with broadband internet in instructional classrooms. Teachers and administrators have some familiarity and expertise with digitally based tools, though these tools' use to support instruction is not as robust as for administrative functions. The expansion of support to teachers in their instructional roles is both technically and programmatically feasible.

The digital divide in Alabama is real, recognized, and ready to be fully redressed. Commitments to statewide deployment of broadband networks already exist, with strong starts in construction underway. Further state fiscal commitments and the opportunity for support from the American Rescue Plan and national infrastructure funds will create a onetime moment to rapidly deploy broadband to unserved communities and accelerate the time to impact the lives of K–12 students for decades to come. Once these resources are deployed, many other uses of the network can deliver additional streams of benefits in health care, job training, civic engagement, and public safety. The social return on broadband investment for public K–12 education alone exceeds 200 percent.

Recommendations

1. Make access to broadband by K–12 students and their families a top priority when awarding subsidies to telecom providers for the construction of new broadband facilities in unserved areas. Universal access will immediately elevate the ability of K–12 students to learn when they are not in school, effectively closing the "homework gap." Ubiquitous access will also stimulate novel approaches to in-school instruction, since students will be able to engage in activities when not in school.

2. Extend the eligibility for programs to support subscriptions for internet in order to cover the bandwidth of new broadband networks and ensure that all citizens can take advantage of the digital social and economic offerings.

3. Concentrate greater focus on educators' professional development, creating generalized competence and new pathways to mastery of digital education resources for personalized instruction, student support, and educator professional communities.

Introduction

Improving public education in Alabama is critical if the state aims to improve its outlook for the future. What students learn today in elementary and secondary schools directly affects the quality of the labor force five to forty years into the future, which in turn directly affects the economic and social well-being of the entire state. Gains in the level of student learning in Alabama would have one of the highest payoffs of any of the options the Alabama Innovation Commission might consider. To that end, a team from Stanford and two Alabama universities investigated ways to realize substantial improvement in educational attainment for Alabama K–12 students.

The need for better student outcomes was known before the coronavirus pandemic. Efforts to raise student learning were underway for some time, with many noteworthy results. The pandemic, however, sharpened the contours of the problem. In Alabama, as in other states, the coronavirus pandemic highlighted preexisting disparities in the opportunity for high-quality K–12 education across Alabama. It also revealed that students face unequal access to telecommunications infrastructure that could support learning in the digital environment when students are not in classrooms.

Despite the challenges it introduced, the pandemic has not been entirely negative in its impact. It prompted policy makers and educators to respond swiftly, demonstrating a novel capacity for action. It also prompted new allocations of public funds—on top of ongoing commitments—to expand access to broadband internet facilities and to provide subsidies for subscribers with limited financial resources. These effects brought forward the possibility of modifying how K–12 education is organized and delivered in Alabama in ways that quickly and significantly can raise student achievement.

The Alabama Innovation Commission has a seizable moment to alter dramatically the trajectory of the state's public education system in order to realize better outcomes for students, educators, and the state as a whole. This briefing paper presents a proposal to elevate the performance of Alabama public schools by greatly expanding the state's reliance on digitally based instructional resources and rapidly building teacher competence with individualized student learning plans. Making it a priority to rapidly deploy broadband internet facilities and provide needs-based support for internet service subscriptions in communities with significant populations of K–12 students will form the foundation for transforming schools into centers of digitally supported curriculum and instruction. Closing the homework gap would also create ancillary benefits in health care, employment, and public safety.

This proposal rests on strong efforts already underway in Alabama; shifts in focus and priorities will make it possible to achieve gains in student outcomes more rapidly and more equitably than is currently happening. Adopting the recommendations in this proposal will ensure more equitable access to high-quality digital education resources and support a greater share of students finishing high school ready to pursue further training or education. With modest gains in high school graduation and postsecondary program completion, a future stream of economic benefits in the state will *more than repay* the required investment on a reasonable schedule and build enduring improvements to the state economic climate beyond K–12 education.

This briefing paper begins with a detailed description of the Alabama K–12 landscape. We present original analysis from interviews with over two dozen Alabama school district superintendents about current availability and use of broadband within schools, which serves as the motivation for the proposal that follows. Estimates of the future economic impact of the proposal and suggestions for implementation conclude the paper.

The Issue

The bottom line is this: the public education system in Alabama falls short of providing the results that are needed if the state is to realize its other development goals.

Alabama public schools educate the majority of youths in the state and therefore have the largest share of responsibility for developing human capital of all public institutions. Despite years of effort and several significant initiatives, the level of knowledge and skills of students in Alabama public schools is not on par with that of other states in the region or the national average.

There are numerous consequences to the state from having underperforming schools. A brief list includes:

1. Lower student achievement leads to weaker labor force participation.

2. Lower student achievement depresses wages and career progression.

3. People who are undereducated are less capable of experimenting and innovating with products and processes.

4. Lower student achievement slows Alabama's economic growth.

5. Underperforming schools cloud the reputation of the state in other parts of the world.

6. Underperforming schools dampen the chance to recruit outside employers to operate in Alabama.

7. Underperforming schools hinder the likelihood of substantial gains in status and rewards for educators.

Many of these effects translate to lower state revenues and higher requirements for state support over a person's work life and retirement years. Several have strong, negative effects on other state priorities, such as expansion of the employer base or building innovation hubs around the state. Finally, while each effect has its own ripples through the citizens and communities in Alabama, none of these address the important considerations of educational equity and social justice, which adds further to the urgency of the situation.

How can state leaders dramatically and rapidly improve student learning in Alabama? Alabama K–12 schools stand at a critical pivot point. Improving the outcomes for students in Alabama cannot rely solely on delivering more on previous solutions. Traditional models of K–12 public schools face increasing pressure due to shortages of qualified teachers, especially in science, technology, engineering, and mathematics (STEM), so simply maintaining the status quo is a challenge in many districts. Efforts to cultivate a stronger teacher pipeline within the state require both diversification and realignment of teacher prep programs, which themselves face budgetary and operational constraints that inhibit rapid transformation.

While there will always be a need for teachers and administrators, Alabama leaders have a moment of opportunity to choose a path forward that blends local educators with the growing global array of high-quality instructional resources that are available in digital form. The chance to augment the hard work of educators with world-class education supports can significantly elevate the quality of student-centered instruction. That path, however, requires a commitment to ensuring all students and educators—regardless of location or income—have access to high-speed broadband internet to support learning in school and in their homes.

The Current Landscape for K–12 Education in Alabama

Policy leaders face a dual challenge with the current condition of public education in Alabama. First, the knowledge and skills that students develop in Alabama schools is insufficient for the demands of twenty-first-century life. Second, the considerable efforts and resources addressing the problem to date have not moved the needle. Each side of the problem deserves further delineation.

Student Learning

By many measures, Alabama public schools do not support the level of learning that readies graduates for further investment in their human capital, whether through training, military service, or postsecondary education. Alabama has remained below the national average for over two decades at both the fourth and, for over a decade, the eighth-grade levels.

Table 1. Proficiency rates for Alabama K–12 students, 2018–19 assessments

Student group	*Percent proficient*	
	Reading	*Math*
All students	45.27*	46.52
Asian	64.57	78.73
American Indian	30.38	38.27
Black	28.08	28.04
Hispanic	28.94	37.16
White	55.08*	56.25

**Student groups that met academic targets listed in the Alabama Final Consolidated State Plan, approved in 2019 by the United States Department of Education to comply with Every Student Succeeds Act requirements.*

Source: https://www.alabamaachieves.org/reports-data/.

We examined the proficiency rates for Alabama public school students. In 2018–19, 45 percent of Alabama K–12 students were proficient in reading and 47 percent were proficient in math. As shown in table 1, there is dramatic variation in proficiency rates across Alabama school districts and student groups and subgroups by as much as 34 percentage points in reading and 50 percentage points in math. Similar disparities exist for low-income students. It also bears noting that the most recent results (measured before the pandemic) fall short of the targets established in the state's approved plan under the federal Elementary and Secondary Education Act, as amended by the Every Student Succeeds Act of 2015.

Proficiency rates are particularly worrisome for Alabama high school students. In the 2018–2019 state assessments, 42 percent of Alabama high schoolers were rated proficient in reading and math, respectively. These numbers are hard to equate with a four-year cohort graduation rate in 2021 of 92 percent and a designation of College and Career Readiness for 75 percent of graduates.

The quality of K–12 schools has wider impacts across the state. It is holding down university ratings, which are directly tied to innovation and state productivity. The best in the state, Auburn University, is ranked number 97 in the nation, with an 81 percent acceptance rate. The next highest ranking in the state is a tie at number 143 for Samford University and the University of Alabama, with acceptance rates of 83 percent and 85 percent, respectively, primarily from in-state applicants.[1]

School Improvement Efforts

Alabama policy leaders deserve recognition and commendation for their extensive array of efforts in pursuit of improved academic performance of K–12 students.

Many changes have already occurred. It is fair to say that every aspect of K–12 school design and delivery is under review, and dozens of working groups and committees are working on facets of the system simultaneously. A few of these deserve special mention:

- Extensive content review and consultation with classroom educators led to the adoption of new learning standards in math and reading.[2]
- Districts and schools across the state were given new systems for tracking student effort and learning.[3]
- New pay programs have been designed to address teacher turnover in STEM subjects.
- Efforts to address teacher shortages are being piloted with novel forms of distance education.
- A multiyear commitment to professional development is underway for teachers and administrators in early reading.

While these efforts are commendable, the impact on student learning is not apparent. In addition, major problems persist: Teacher shortages have grown due to accelerating rates of teacher retirement. In June 2021, the Alabama State Department of Education (ALSDE) listed 2,700 jobs for certified teachers on its jobs board.[4] Before and during the pandemic, gaps in instructional readiness of teachers have been noted, especially as concerned the use of digital resources in preparing and delivering lessons.[5] Perhaps of greatest concern, there is no definition or regular measurement of the quality and impact of instruction.[6] Statewide efforts to address this shortage began but were overwhelmed by the pandemic's demands on educators and administrators.

Teachers' own knowledge and teaching skills need to be aligned with student abilities at the *students'* point of readiness to create engaged learning. Even without performance measures on teachers, it is safe to assume there is wide variation in the quality of teaching that occurs in Alabama classrooms. Supporting teachers and their pedagogy and delivering high-quality personalized instruction to K–12 students are dual priorities moving forward, pandemic or not.

Broadband Internet Infrastructure in Alabama

Robust broadband capacity has been recognized as vital to the future of Alabama.[7] The Broadband Alabama Strategy, revised in 2019, stresses the importance of a modern system to support the labor force, education, commerce/finance, health care, civic engagement, and emergency services. Of these expected impacts, only training/employment development

and education have the potential to grow the economy. The rest create limited-duration returns on their related costs.

When Governor Kay Ivey chose to focus on expanding the scope of broadband infrastructure in Alabama, it was with eyes wide open. Alabama ranks thirty-eighth in the nation in broadband penetration. Significant disparities exist in the accessibility of broadband internet, defined as 100 Mbps download/10 Mbps upload.[8] Even before the pandemic, the problem of "digital deserts" was known and understood. Over 226,000 residents have no terrestrial internet service of any kind. Even where terrestrial telecom facilities exist, much of the physical plant cannot support the technical requirements for video streaming and multiperson use. When the criterion of high transmission speed for both downloads and uploads is added, the number of stranded Alabamians rises to 415,000. Income and geography play large roles, but even in metro areas, 30 percent of households lack access to high-speed internet/broadband.[9] Across the state, only 44 percent have access to "affordable" service of $60 a month or less; this contrasts with the national average of 51 percent.[10]

The cost of fully deploying broadband has been estimated by the Alabama Department of Economic and Community Affairs (ADECA) to be between $4 billion and $6 billion.[11] State leaders have taken several steps to expand the broadband infrastructure in Alabama. Enactment of the Alabama Broadband Accessibility Act in 2018, with amendments a year later in Act 2019-327, established the Alabama Broadband Accessibility Fund and a budget of $47.4 million through 2021 to subsidize construction projects and serve previously unserved or underserved communities. Through 2020, $47.1 million in new construction had been committed at an average cost of $788 per new connection.[12] The efforts by state programs to stimulate additional deployment of fiber networks has made inroads, but there remain large areas of Alabama that are yet unable to join the broadband age.

The advent of the pandemic prompted even more investment, specifically to subsidize internet service subscriptions for students and their families. ADECA created Alabama Broadband Connectivity for Students (ABC for Students) and helped over 200,000 school-aged children connect and participate in remote learning. As the program sunsetted at the end of the 2020–21 school year, families became eligible for the federally subsidized Emergency Broadband Benefit Program. In addition, the Federal Communications Commission (FCC) committed $7.17 billion to the Emergency Connectivity Fund in order for schools and libraries to afford more physical connections, digital learning devices, and affordable service plans throughout the 2021–22 school year.[13]

Even with these responsive programs, students across the state were stranded if they lived in areas without service. ALSDE took strong measures to address the gap, including wiring school buses for mobile Wi-Fi, but many students still faced challenges.

We know that access to affordable internet can have significant impact on student learning. Increased access in the United States and globally has improved both the number of years and the quality of students' schooling and increased professional support and development for educators.[14] With ubiquitous deployment of broadband infrastructure, the largest hurdle to realizing these benefits for Alabama would be eliminated, along with additional benefits in other areas of public life such as health and public safety.

AREN and the E-rate Program

Across the United States, the federal E-rate program for K–12 schools and postsecondary educational institutions financially supports access to the internet. The Universal Service Administrative Company, under the direction of the FCC, administers the E-rate program. The E-rate program provides discounts to eligible schools and libraries for telecommunications and internet services, including internal connections, maintenance, and managed broadband networks. The discounts range from 20 percent to 90 percent of the costs of eligible services, depending on the share of students in a district who live in poverty. In 2020, Alabama received $811 million in E-rate subsidies.

The Alabama Research and Education Network (AREN) manages the backbone of the network, which connects more than 600 libraries and schools and the Alabama supercomputer to the internet. Managed by the Alabama Supercomputer Authority, AREN provides services to 94 percent of school systems in the state. In particular, AREN, through its service providers, installs, maintains, and monitors school systems' internet. Examples of education-related AREN-led initiatives include a synchronous distance education program in 2005, a one-to-one learning device program in 2018, and a 2019 program that provided internet to libraries.

Broadband access is a necessity in order to provide online education. K–12 online learning was already increasing across the United States prior to the pandemic. In the 2017–18 school year, 21 percent of public schools and 13 percent of private schools offered at least one online course. Of the schools that offered at least one online course, 81.9 percent were primary schools.[15]

Leader Perspectives on Broadband for Education

Having physical facilities to support broadband-based education in Alabama is only half the equation: having educators ready to take advantage of the resource is also required. To better understand the frontline story, we conducted interviews with school superintendents (or their designated representatives) from twenty-seven Alabama districts. The state superintendent of education supported the effort with a personal endorsement and encouraged district leaders to participate. Superintendents graciously spent time explaining the status of their schools in accessing and using broadband to support the work of their educators.

The interviews covered six topics:

- Students' and teachers' access to broadband and technical devices
- The districts' experience with AREN and E-rate
- Teachers' use of digital resources in teaching and administration
- Professional development and IT supports to develop teachers' digital skills
- Online instruction offered by the district
- The districts' use of digital resources to help low-income or low-performing students

Their responses offered a deep and rich view of the many facets of provision, use, and support of broadband and the digital offerings it can support across the districts. A full presentation of the findings are presented in Appendix A along with tables of responses to the interview questions.

The picture for broadband deployment and use that we gained from our interviews with superintendents was encouraging. Their districts have made broadband internet and technical devices widely accessible by students and teachers at school. It is clear that significant functions of educators are already supported with broadband technology and digital programs and applications. At the same time, there is still notable room for expansion in the use of digital resources in teachers' instruction, the offering of online courses, and help for disadvantaged students. Based on these findings, the focus in the future should be student-centered, including but not limited to improving access to technology by rural and small districts, expanding online instruction for both core and noncore courses, and providing tailored help and support for disadvantaged students.

A Proposal: Make Alabama the Broadband for Education State

Alabama is poised for change. With a few marginal adjustments in an already strong start, the state can realize dramatic growth in its human capital and economic health. This proposal describes the overall approach and provides details on how the Alabama Innovation Commission, the governor and the state legislature can accelerate the rate of growth.

Improving the K–12 public education system in Alabama has been a desire for years, for good reason. The future benefits of improved learning for individuals are well known and well documented: greater employability, greater chances of completing higher education, higher wages, longer and more productive work lives. What has been missing is an approach that can achieve the improvement at scale.

The quality of schools arises from a host of factors. Of these, the largest available lever of change is the efficacy of instruction. Any plan to raise the caliber of student learning must support current and future educators in delivering high-quality instruction to every student every day. The pandemic prompted us to see that "classroom" might take on different dimensions even if not required by public health concerns. The plan must also recognize that much of learning occurs when students are *not* in classrooms; club activities, sports, outings, homework, and community-based experiences are examples. An approach to student-centered learning from instruction provided by teachers, backed by high-quality course materials and lessons, can only occur at scale if we can ensure that teachers have the proper access to instructional resources and the support to guarantee that they deliver high-quality instruction.

As part of its final recommendations, the Alabama Innovation Commission has a chance to move aggressively on these ideas. It can do so by strengthening the focus on K–12 education as a driver of its Broadband Alabama initiative. Ensuring physical facilities and services are available also needs to accompany targeted support to make certain that all students have equitable opportunity to access and use it. These commitments open horizons of possibility in K–12 schools to enrich existing practices with a wider range of digital instructional resources and new high-quality teaching methods that match materials and instruction to student needs. This shift requires that educators and leaders complete new paths of professional development to increase the educator labor force's capacity and expertise.[16]

This proposal builds on many important advances already in place in Alabama—in schools and in communities. Still, it will require a multiyear initiative to build the necessary political coalition, secure the required funds, and organize the waves of needed construction. As the policy leaders and educators in the state have already demonstrated, this proposal can benefit from the strong capacity for action that has been on display over the pandemic period.

Policy Design

Ensuring equitable opportunities for learning in K–12 schools and full preparation for postsecondary options will require a three-part solution:

Access to Broadband The Alabama Innovation Commission could advance educational excellence in Alabama schools by leveraging broadband technology and its use in the public K–12 arena. Two related strands of effort are needed. First, the small number of schools that are not connected to broadband networks in all instructional classrooms should be heavily or fully subsidized to achieve **universal connectivity in the K–12 public education system.** The value of a ubiquitous broadband network that links every school building and instructional classroom justifies extended subsidies to telecom providers to complete the necessary construction. Universal classroom access opens new horizons for co-teaching, professional

development, and support and deployment of student learning supports in more efficient ways. With ensured broadband access, barriers to using best-of-breed instructional resources in Alabama K–12 classrooms would be removed.

Help the Unserved Alabama can realize substantial returns on future broadband investment if it makes coverage of households with K–12 students a priority. Alabama can leverage approved state and federal funds it already plans to spend just by adding consideration of the number of K–12 students in unserved census tracks when making subsidy decisions for new broadband facilities. The state can **close the "homework gap."** Students would then have access to digital resources to support their learning, regardless of location.

Implementation Considerations:

- E-rate program funding and ASA support are available for connecting the last handful of schools and classrooms. (School district budgets already fund the residual construction costs and ongoing subscription charges.)

- The Alabama Broadband Fund, managed through ADECA, is the logical lead for managing a statewide broadband deployment plan.

- Even before the COVID pandemic, the state legislature approved a bump in General Fund commitments starting in 2020, which are expected to grow further.

- Alabama received $1.8 billion in aid from the Coronavirus Aid, Relief, and Economic Security (CARES) Act of 2021.[17]

- Alabama received $2.1 billion from the Coronavirus State and Local Fiscal Recovery Fund as part of the American Rescue Plan. These funds are authorized for use in several areas, including broadband construction.

- The pending bipartisan Infrastructure Bill in Congress includes $65 billion for broadband deployment and subscription support for the nation. If Alabama gets 1 percent of that, it will amount to $650 million in support.

Affordable Internet Service Subscriptions The state's recent COVID experience with internet subsidies for students illuminated the need for a policy and program to ensure affordable service across the state. Many state leaders will look at statewide broadband deployment as "déjà vu all over again," replicating the experience with the Universal Service Fund for ubiquitous telephone service. And they would be right: the same income barriers will persist when broadband is everywhere. The upside is that the earlier experience

can serve as a foundation to ensure that all broadband service providers offer adequate and affordable service to every household.

Implementation Considerations:

- During the COVID pandemic, the Alabama state legislature initially approved $100 million in CARES funds for internet subscription vouchers for low-income families with public school students; half the amount was later reallocated to other uses because there were fewer applications than expected. ADECA quickly devised a process to disburse the funds that worked until the end of the 2020–21 school year. Thus, a dedicated mechanism for delivery of subsidies already exists to support low-income families with school-aged children.

- Consistent with current policy directions, the governor and the state legislature have the discretion to establish broadband internet as an essential utility. It would then be possible to make adjustments to public assistance and universal services programs in order to provide needs-based support on a sliding scale. Families with K–12 elementary and secondary students could receive their support bundled with other forms of public assistance instead of through the ADECA internet voucher program.

Expansion of Use of High-Quality Instructional Materials in Classrooms For this plan to succeed, the Alabama State Department of Education has a critical role to play. If Alabama is to become the Broadband for Education state, ALSDE will need to maximize its expertise and available resources to support ubiquitous personalized learning, high-quality instruction in school, extended support learning by students, and learning support by teachers and administrators.

Implementation Considerations:

- The American Rescue Plan includes funds to support the capacity building that this proposal will require. The Elementary and Secondary School Emergency Relief Fund in 2021 provided $2 billion for education aid to the state of Alabama.[18] That can be leveraged for much of the organizational design and professional development needed to realize this proposal.

- Budget allocations must be redirected for ALSDE professional development to rapidly expand the competence of curriculum leaders and teacher leaders to integrate digital education resources into programs for Alabama K–12 students. The professional development of education leaders and district heads of curriculum must be rapidly accelerated to champion greater access to high-quality instructional materials inside and outside of Alabama and to support optimal classroom instruction.

- One option to upskill the teacher force is to develop a career path to certify and reward educators who complete intensive training in online personalized learning that includes competence in continuous-improvement practices.[19]

- It will be especially important to harness best-of-breed online offerings in subject areas that are currently lacking qualified high-impact teachers. ALSDE already has experience with curricula review in most subject areas and which could seek deeper evaluations of online resources, especially those that support personalized instruction and pacing.

- Experience in other communities showed that adoption of high-touch high-bandwidth education was more successful when there was readily available tech and instructional support of teachers and school leaders (perhaps through use of coaches).

- It will be important to recognize the ongoing need for professional development as the supply of high-quality instructional resources grows and evolves.

Economic Impact Analysis

Decisions to create statewide broadband access must reflect consideration of the costs in relation to expected benefits. Once in place, the network will be available for multiple uses; commerce, health care, public services administration, civic participation, skills training/upskilling, and entertainment will all gain from the larger number of connected households.

This proposal has framed the investment in a statewide broadband network only in terms of its value to Alabama public K–12 education. We have developed a simple economic impact analysis to estimate the required investment from state resources, a narrow scenario of benefits, and the returns on the initial investment over time. A full explanation of the investigation and methods appears in Appendix B. Here, we provide a brief summary of approach and results.

We expect that access to broadband everywhere in the state will improve education in Alabama and that the gains will be widespread. Many of them, however, will be hard to isolate. One place where we can segment the impact is for students whose overall academic attainment improves enough that they shift from only having a high school diploma to pursuing a college degree. That is admittedly a small portion of all those whose welfare will be improved due to broadband, and we do not wish to imply that this group alone should bear the full cost of the investment. Nonetheless, they provide a concrete way to illustrate the benefit side of the proposition.

Using statistics shared in earlier portions of the briefing paper, and explained fully in Appendix B, we calculate that by ensuring access for all, each future graduating cohort

will add 2,483 students to the set of college educated. Using published analyses from labor economics, we predict that the premium in lifetime earnings for having a college degree over a high school diploma is $765,000. The cumulative gains in personal income over the twenty-year useful life of the fiber equipment is around $5.5 billion. We consider this the marginal gain in social welfare for the state. After deducting the state's investment, the estimated social welfare return on investment is 214 percent.

We examine a pure financial return on investment by looking at personal income taxes. We use a 9 percent tax burden to quantify the share of that new income that would return to the state. In the twentieth year, the state will see a cumulative increase in state income tax revenue of $495 million. This produces a financial return of 28 percent of the initial state investment at the end of twenty years.

NOTES

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8 While the FCC defines broadband as 100/3, the standard is insufficient to support multiple users of a single connection. This is the likely scenario for families with students using the internet for schoolwork while others simultaneously access other resources.

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10 Tyler Cooper and Julia Tanberk, *The State of Broadband in America, Q2 2021*, BroadbandNow Research, August 18, 2021, https://broadbandnow.com/research/q2-broadband-report-2021.

11 Caroline Beck, "Broadband Expansion to Underserved Areas Could Cost $4B-$6B," *Alabama Daily News*, February 1, 2021, https://www.aldailynews.com/broadband-expansion-to-underserved-areas-could-cost-4b-6b.

12 ADECA reports that the new grants awarded since the publication of the 2021 Annual Report raise the average cost per new service to $806. Telephone conversation with ADECA representative, August 3, 2021; Alabama Broadband Accessibility Fund 2021 Annual Report, Alabama Department of Economic and Community Affairs, January 28, 2021, https://adeca.alabama.gov/maps-plans-and-reports.

13 "FCC Launches Country's Largest Effort to Close Homework Gap," Federal Communications Commission, June 29, 2021, https://www.fcc.gov/document/fcc-launches-emergency-connectivity-fund.

14 "Connecting Learners: Narrowing the Educational Divide," The Economist Intelligence Unit, 2021, https://connectinglearners.economist.com/data/EIU_Ericsson_Connecting.pdf.

15 eLearning Statistics, ThinkImpact, 2021, https://www.thinkimpact.com/elearning-statistics/#2-K–12-elearning-statistics.

16 The policy ideas and recommendation in this proposal complement work in two other Hoover briefing papers. This initiative lends itself well to the activities of research and evaluation proposed by Eric Hanushek in his EdLabs recommendation. Additionally, the instruments that are proposed for financing this plan are consistent with the work of Joshua Rauh in his paper on state and local tax policy.

17 "How Much Each State Will Receive from the Coronavirus Relief Fund in the CARES Act," Center on Budget and Policy Priorities, March 26, 2020, https://www.cbpp.org/research/how-much-each-state-will-receive-from-the-coronavirus-relief-fund-in-the-cares-act.

18 Caroline Beck, "K–12 Schools Look to 'Fill the Gap' with Incoming $2 Billion COVID Relief Funds," *Alabama Daily News*, July 13, 2021, https://www.aldailynews.com/K–12-schools-look-to-fill-the-gap-with-incoming-2-billion-covid-relief-funds.

19 "School Culture of Innovation," Future Ready Schools, Alliance for Excellent Education, accessed July 12, 2021, https://futureready.org/implementation-guide/school-culture-of-innovation/.

APPENDIX A: LEADER PERSPECTIVES ON BROADBAND FOR EDUCATION

Having physical facilities to support broadband-based education in Alabama is only half the equation: having educators ready to take advantage of the resource is also needed. To better understand the frontline story, we conducted interviews with superintendents (or their designated representatives) from twenty-seven Alabama school districts. The superintendents graciously spent time explaining the status of their schools in access to and use of broadband to support the work of their educators.

The interviews covered six topics:

- Students' and teachers' access to broadband and technical devices
- The district's experience with the Alabama Research and Education Network (AREN) and the federal telecommunications support program E-rate
- Teachers' use of digital resources in teaching and administration
- Professional development and IT supports to develop teachers' digital skills
- Online instruction offered by the district
- The district's use of digital resources to help low-income or low-performing students

Access to Technology

Overall, the respondents reported that students and teachers in Alabama have solid access to broadband internet and technical devices for learning and instruction at school. In all interviewed districts, 100 percent of instructional classrooms have access to broadband internet (table 1). In a large majority of districts, all students have individual devices, such as computers, laptops, or pads, for their classroom learning (table 2). In addition, all respondents say that 100 percent of their teachers have individual devices for their instruction (table 3).

Broadband Internet access at home for students and teachers varies. In half of interviewed districts, more than 70 percent of students have access to broadband internet at home, including 17 percent of districts with above 90 percent of students with broadband internet at home (table 4). In roughly half of the Alabama districts, more than 90 percent of teachers have broadband at home (table 5).[1]

Interaction with AREN and E-rate Program

More than two-thirds of the surveyed districts participate in AREN (table 6). This contrasts with 94 percent of all districts across the state. For the majority of respondents, AREN

provides value by setting a process for securing internet service, negotiating a rate discount with the internet provider, or providing the means to build a local network hooked up to fiber internet (table 7). The majority of surveyed districts that participate in AREN connect to the internet through a local provider (table 8). Nearly 90 percent of respondents said participation in AREN was a net benefit, with reduced internet cost being the most commonly reported reason (tables 9 and 10).

The field is not consistent when it comes to estimating the value of joining the AREN consortium. Nearly one-quarter of respondents believed participation was mandatory (tables 11 and 12). Regardless, all respondents saw the reduced cost of internet services as being beneficial. At the same time, more than half the district leaders mentioned drawbacks to the program: excessive paperwork was most frequently reported (table 13). All of those mentioning administrative burden were in rural or small districts. Two-thirds or more of interviewed districts owned inside wiring, pedestal at point of presence, wired ethernet, and wireless hotspots in their district (table 14). The responses show that 100 percent of instructional classrooms in almost every district are wired to ethernet (table 15). In more than 90 percent of districts, 100 percent of instructional classrooms had Wi-Fi connection (table 16). These responses identify the chief benefit for districts—the service subsidies—and suggest the possibility of streamlining the process for districts with limited staff.

Teachers' Use of Digital Resources and Districts' Offer of Professional Development and IT Support

In spite of extensive connectivity, the interviewed districts have yet to fully utilize the technology in instruction and learning. Teachers' use of digital resources is most prevalent in administrative functions such as recording attendance or grades or corresponding with school and district colleagues. Nearly all the respondents indicated that 100 percent of their teachers regularly used digital resources for administrative functions (table 17).

Use of fast internet to support lesson planning was less prevalent across all the grades, according to our respondents. Roughly half the superintendents reported that all their teachers used these resources, though most said that 50 percent or more of teachers were using digital sources for planning and instruction (tables 18 and 20–22). Fewer teachers use digital resources to share lesson plans or resources (table 19).

Professional Development

All represented districts provide professional development opportunities for teachers to develop competence in the use of digital resources in teaching and administration, primarily through training, paying for training by external providers, and sharing useful information and resources with teachers (table 23). All represented districts also provide IT support to help teachers use digital resources in teaching and administration

(table 24). The most common means were deploying IT staff for on-site instruction and troubleshooting as well as offering training classes. Further research needs to probe whether the training and IT support solely addresses electronic administration or drives instruction as well.

Online Instruction

While twenty-five among twenty-seven represented districts offer at least one course that primarily relies on broadband for instruction (table 25), around half do not offer any such courses for elementary or middle schools and half the districts provide less than 30 percent of primarily online courses for high schools (tables 26 and 27). Fewer districts have courses exclusively offered online (table 28). Exclusive online instruction, when offered, tends to spread across core and noncore courses for elementary and middle schools and concentrate on elective and advancement courses for high schools.

The majority of districts reported that their reliance on online instruction to fulfill instruction plans for elementary and middle schools was somewhat small or very small; around half of districts responded that way in regard to high schools (table 29). The most prevalent reasons for districts to offer online courses were to make courses available to more students and to make high-quality courses available to students (table 30). It is also notable that half of the districts adopt online courses to fill in a shortage of educators. This is not surprising given that nearly 60 percent of districts had 1 percent to 10 percent of teacher positions vacant (table 31) and that one-third of districts had teacher turnover rates of 11 percent to 20 percent (table 32).

A substantial proportion of district leaders said they expect a greater share of online education in instruction in the next five years, particularly for high schools (table 33). However, a large majority did not plan to provide synchronized instruction for any grade span in post-pandemic time, especially for elementary schools (table 34).[2]

Use of Digital Resources to Help Low-Income or Low-Performing Students

The interviewed district leaders said they try to use digital resources to help education for low-income and low-performing students. They employ a variety of ways to help underserved students access the internet during out-of-school time, primarily by providing Wi-Fi hotspots in various venues (e.g., school buses and parking lots), extending time for students to stay in school, and working with local libraries (table 35). More than 70 percent of districts also subsidize broadband internet at home for students from low-income families (table 36). In addition to technology access, districts help develop underserved students' skills at using digital resources for learning, mainly through the support of teachers, classes, and resource sharing (table 37). The majority of districts also provide web-based support for low-performing schools through remedial classes, tutoring, and information sharing (table 38).

Summary

The picture for broadband deployment and use that we gained from our interviews with superintendents was encouraging. Their districts have made broadband internet and technical devices widely accessible by students and teachers at school. At the same time, there is still notable room for expansion in the use of digital resources in teachers' instruction, the offering of online courses, and help for disadvantaged students. Based on these findings, the focus in the future should be student-centered, including but not limited to improving access to technology by rural and small districts, expanding online instruction for both core and noncore courses, and providing tailored help and support for disadvantaged students.

NOTES

1 The Alabama State Department of Education shared its most recent technology audit of the prevalence of internet in schools and in students' homes. Due to the pandemic, some districts did not complete the audit, but those that did showed student rates of available internet that were on par with the reports from our superintendent respondents.

2 Synchronized instruction refers to classes that some students attend in person while other attend online.

Table 1. Variation among districts in percentage of instructional classrooms having access to broadband internet

Response	*Frequency*	*Percent*
0%	0	0
1–10%	0	0
11–20%	0	0
21–30%	0	0
31–40%	0	0
41–50%	0	0
51–60%	0	0
61–70%	0	0
71–80%	0	0
81–90%	0	0
91–99%	0	0
100%	27	100

Frequency and percentage of respondents indicating percentage of classrooms within their district having access to broadband internet.

Summary: In every interviewed Alabama district, 100 percent of instructional classrooms have access to broadband internet.

Table 2. Variation among districts in percentage of elementary, middle, and high school students having access to individual devices for classroom learning

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	0	0	0	0	0	0
21–30%	0	0	0	0	0	0
31–40%	1	4	1	4	1	4
41–50%	1	4	0	0	0	0
51–60%	0	0	0	0	0	0
61–70%	0	0	0	0	0	0
71–80%	1	4	0	0	1	4
81–90%	0	0	1	4	0	0
91–99%	1	4	0	0	0	0
100%	23	85	24	92	24	92

Frequency and percentage of respondents indicating percentage of students within each category in their district having access to individual devices, such as computers, laptops, and pads, for their classroom learning.

Summary: An overwhelming majority of interviewed districts report that 100 percent of students in elementary, middle, or high schools in their district have individual devices, such as computers, laptops, and pads, for their classroom learning.

Table 3. Variation among districts in percentage of elementary, middle, and high school teachers having access to individual devices for instruction

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	0	0	0	0	0	0
21–30%	0	0	0	0	0	0
31–40%	0	0	0	0	0	0
41–50%	0	0	0	0	0	0
51–60%	0	0	0	0	0	0
61–70%	0	0	0	0	0	0
71–80%	0	0	0	0	0	0
81–90%	0	0	0	0	0	0
91–99%	0	0	0	0	0	0
100%	27	100	26	100	26	100

Frequency and percentage of respondents indicating percentage of teachers within each category in their district having access to individual devices, such as computers, laptops, and pads, for their classroom instruction.

Summary: Every surveyed Alabama district indicates that 100 percent of teachers have individual devices for their instruction.

Table 4. Variation among districts in percentage of students having access to broadband internet at home

Response	*Frequency*	*Percent*
0%	0	0
1–10%	0	0
11–20%	0	0
21–30%	1	4
31–40%	0	0
41–50%	3	13
51–60%	2	8
61–70%	4	17
71–80%	7	29
81–90%	3	13
91–99%	3	13
100%	1	4

Frequency and percentage of respondents indicating percentage of students in their district having access to broadband internet at home.

Summary: In half of the Alabama districts, 71 to 80 percent or more of students have access to broadband internet at home. Seventeen percent of districts have a share of students with broadband internet at home above 90 percent. The lowest reported share of students with access to broadband at home in a district is in the 21 to 30 percent range.

Table 5. Variation among districts in percentage of teachers having access to broadband internet at home

Response	*Frequency*	*Percent*
0%	0	0
1–10%	0	0
11–20%	0	0
21–30%	0	0
31–40%	0	0
41–50%	2	8
51–60%	1	4
61–70%	0	0
71–80%	4	16
81–90%	6	24
91–99%	7	28
100%	5	20

Frequency and percentage of respondents indicating percentage of teachers in their district having access to broadband internet at home.

Summary: In roughly half of the Alabama districts, more than 90 percent of teachers have broadband at home. The lowest reported share of teachers with access to broadband at home in a district is in the 41 to 50 percent range.

Table 6. Number and percentage of districts participating in the Alabama Research and Education Network (AREN)

Response	*Frequency*	*Percent*
Yes	19	70
No	8	30

Frequency and percentage of respondents indicating participation in AREN.

Summary: More than two-thirds of surveyed Alabama districts participate in the Alabama Research and Education Network (AREN).

Table 7. Variation among districts in arrangements with the Alabama Research and Education Network (AREN)

Response	*Frequency*	*Percent*
AREN serves as an administrative hub to process the application for the internet service for the district.	12	63
AREN serves as an administrative hub to negotiate a rate discount for whatever the internet provider serves each school's geography.	11	58
AREN provides a network hub hooking up the schools in the district to the fiber internet.	12	63
Other	3	16

Frequency and percentage of respondents indicating specified arrangements with AREN. Responses are not mutually exclusive. Responses under "Other" include: "They are internet service provider based on allocation of speed," "professional development information, support via email," "A very knowledgable [member of] staff that helps when asked."

Summary: For the majority of interviewed Alabama districts, AREN serves as a hub to process the application for internet service, negotiate a rate discount with the internet provider, or provide a network hooked up to fiber internet.

Table 8. Number and percentage of districts providing connection to AREN through a local provider

Response	*Frequency*	*Percent*
Yes	12	63
No	7	37

Frequency and percentage of respondents indicating connection to AREN through a local provider. Reported local providers: AT&T, Charter Dependent, ITS, Pine Belt, Mediacom, TDS, WOW.

Summary: The majority of interviewed districts provide connection to AREN through a local provider.

Table 9. Variation among districts in opinion about their participation in the Alabama Research and Education Network (AREN)

Response	*Frequency*	*Percent*
A net benefit	16	89
A neutral arrangement	1	6
A net cost	1	6

Frequency and percentage of respondents indicating specified opinion about participation in AREN.

Summary: The overwhelming majority of districts participating in AREN think of their participation as a net benefit.

Table 10. Variation among districts in reasons for positive opinion about AREN

Response	*Frequency*	*Percent*
Provides internet at reduced cost	14	88
Provides manpower for infrastructure	3	19
Allows choice of provider	1	6
Provides convenient internet services and installation	1	6
Provides reliable internet	1	6
Offers simplified application process	1	6

Frequency and percentage of respondents indicating specified reasons why AREN participation is a net benefit.

Summary: The overwhelming majority of districts viewing their participation in AREN as a net benefit cited reduced cost for internet access as their justification.

Table 11. Number and percentage of districts participating in the E-rate program

Response	*Frequency*	*Percent*
Yes	27	100
No	0	0

Frequency and percentage of respondents indicating participation in the E-rate program.

Summary: Every Alabama district interviewed participates in the E-rate program.

Table 12. Number and percentage of districts believing their E-rate participation is mandatory

Response	*Frequency*	*Percent*
Yes	6	23
No	20	77

Frequency and percentage of respondents indicating their belief that participation in the E-rate program is mandatory.

Summary: The overwhelming majority of surveyed districts do not believe their participation in the E-rate program is mandatory.

Table 13. Variations in districts' views on advantages and disadvantages of the E-rate program

Advantages		
Response	*Frequency*	*Percent*
Reduced cost	27	100
Provision of infrastructure	7	26
Access to equipment	6	22
Provision of security	2	7
Disadvantages		
Response	*Frequency*	*Percent*
No disadvantages	10	42
Excessive paperwork	7	29
Limits usage of funds	5	21
Application takes up time	4	17

Frequency and percentage of respondents' cited advantages and disadvantages of participation in the E-rate program.

Summary: All sampled districts find the E-rate program beneficial for reducing cost. While the preponderance of interviewed superintendents explicitly report no disadvantage to the program, the most frequently cited drawback relates to excessive paperwork.

Table 14. Number and percentage of districts owning and operating certain portions of their network

Response	*Frequency*	*Percent*
Inside wiring only	18	67
Inside wiring and pedestal at point of presence	19	70
Wired Ethernet network	22	81
Wireless nodes/hotspots	20	74
None	2	7

Frequency and percentage of respondents indicating ownership and operation of certain portions of their network.

Summary: Roughly two-thirds or more of districts own the internal wiring, the pedestal of point of presence, the wired Ethernet network, or the wireless hotspots in their network.

Table 15. Variation among districts in percentage of instructional classrooms wired to Ethernet

Response	*Frequency*	*Percent*
0%	0	0
1–10%	0	0
11–20%	0	0
21–30%	1	4
31–40%	0	0
41–50%	0	0
51–60%	0	0
61–70%	0	0
71–80%	0	0
81–90%	0	0
91–99%	0	0
100%	26	96

Frequency and percentage of respondents indicating percentage of classrooms within their district that are wired to Ethernet.

Summary: In almost every district, 100 percent of instructional classrooms are wired to Ethernet.

Table 16. Variation among districts in percentage of instructional classrooms having Wi-Fi connection

Response	*Frequency*	*Percent*
0%	0	0
1–10%	0	0
11–20%	0	0
21–30%	0	0
31–40%	0	0
41–50%	0	0
51–60%	0	0
61–70%	0	0
71–80%	0	0
81–90%	0	0
91–99%	2	8
100%	24	92

Frequency and percentage of respondents indicating percentage of classrooms within their district that have a Wi-Fi connection.

Summary: In more than 90 percent of Alabama districts, 100 percent of instructional classrooms have a Wi-Fi connection.

Table 17. Variation among districts of elementary, middle, and high school teachers who regularly use digital resources to support administrative functions

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	0	0	0	0	0	0
21–30%	0	0	0	0	0	0
31–40%	0	0	0	0	0	0
41–50%	0	0	0	0	0	0
51–60%	0	0	0	0	0	0
61–70%	1	4	0	0	0	0
71–80%	1	4	2	8	1	4
81–90%	0	0	0	0	1	4
91–99%	1	4	1	4	1	4
100%	24	89	23	88	23	88

Frequency and percentage of respondents indicating percentage of teachers within each category in their district who regularly use digital resources to support administrative functions.

Summary: Nearly 90 percent of interviewed superintendents indicated that 100 percent of their teachers, regardless of grade span, regularly use digital resources for administrative functions. The usage is also widespread in the remaining districts.

Table 18. Variation among districts of elementary, middle, and high school teachers who regularly use digital resources to develop and update lesson plans

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	0	0	0	0	0	0
21–30%	0	0	0	0	0	0
31–40%	0	0	0	0	0	0
41–50%	0	0	0	0	0	0
51–60%	2	7	1	4	1	4
61–70%	1	4	0	0	0	0
71–80%	1	4	4	15	5	19
81–90%	8	30	7	27	7	27
91–99%	1	4	2	8	1	4
100%	14	52	12	46	12	46

Frequency and percentage of respondents indicating percentage of teachers within each category in their district who regularly use digital resources to develop and update lesson plans.

Summary: All the teachers in around half of interviewed districts regularly use digital resources to develop and update lesson plans. The majority of teachers in the other half of the districts regularly do so.

Table 19. Variation among districts of elementary, middle, and high school teachers who regularly use digital resources to share lesson plans or resources with other teachers

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	1	4	2	8
11–20%	1	4	1	4	1	4
21–30%	3	12	0	0	0	0
31–40%	2	8	4	17	4	17
41–50%	0	0	1	4	1	4
51–60%	2	8	1	4	0	0
61–70%	2	8	1	4	2	8
71–80%	3	12	4	17	4	17
81–90%	6	24	4	17	2	8
91–99%	1	4	2	8	3	13
100%	5	20	5	21	5	21

Frequency and percentage of respondents indicating percentage of teachers within each category in their district who regularly use digital resources to share lesson plans or resources with other teachers.

Summary: In 20 percent of interviewed districts, all the teachers regularly use digital resources to share lesson plans or resources with other teachers. In another 40 percent of the districts, 71 to 99 percent of teachers regularly do so.

Table 20. Variation among districts of elementary, middle, and high school teachers who regularly use digital resources in their delivery of lessons

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	0	0	0	0	0	0
21–30%	0	0	0	0	0	0
31–40%	0	0	0	0	0	0
41–50%	1	4	2	8	3	12
51–60%	1	4	0	0	0	0
61–70%	1	4	2	8	2	8
71–80%	3	11	3	12	3	12
81–90%	6	22	4	15	4	15
91–99%	2	7	3	12	3	12
100%	13	48	12	46	11	42

Frequency and percentage of respondents indicating percentage of teachers within each category in their district who regularly use digital resources in their delivery of lessons.

Summary: All the teachers in nearly half of interviewed districts regularly use digital resources in their delivery of lessons. In another 40 percent of the districts, 71 to 99 percent of the teachers regularly do so.

Table 21. Variation among districts of elementary, middle, and high school teachers who regularly assign students to use digital resources to do coursework

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	1	4	0	0	0	0
21–30%	1	4	0	0	0	0
31–40%	1	4	3	12	3	12
41–50%	2	7	4	15	2	8
51–60%	2	7	0	0	0	0
61–70%	2	7	1	4	1	4
71–80%	2	7	1	4	3	12
81–90%	2	7	3	12	3	12
91–99%	1	4	2	8	2	8
100%	13	48	12	46	12	46

Frequency and percentage of respondents indicating percentage of teachers within each category in their district who regularly assign students to use digital resources to do coursework.

Summary: All the teachers in nearly half of interviewed districts regularly assign students to use digital resources to do coursework. Teachers in the other half of the districts also do so, although with varying percentages.

Table 22. Variation among districts of elementary, middle, and high school teachers who regularly use digital resources to provide extra support to students

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	0	0	0	0	0	0
1–10%	0	0	0	0	0	0
11–20%	0	0	0	0	0	0
21–30%	0	0	0	0	0	0
31–40%	2	8	1	4	1	4
41–50%	1	4	2	8	2	8
51–60%	0	0	1	4	3	13
61–70%	1	4	1	4	2	8
71–80%	7	28	4	17	3	13
81–90%	4	16	6	25	4	17
91–99%	1	4	1	4	1	4
100%	9	36	8	33	8	33

Frequency and percentage of respondents indicating percentage of teachers within each category in their district who regularly use digital resources to provide extra support to students.

Summary: All the teachers in one-third of interviewed districts regularly use digital resources to provide extra support to students. The majority of teachers in the other half of the districts also use digital resources for the same purpose.

Table 23. Professional development opportunities districts offer to elementary, middle, and high school teachers to develop competence in the use of digital resources in teaching and administration

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Training offered by the district	27	100	26	96	26	96
Paying for training offered by external providers	24	89	23	85	23	85
Sharing information about relevant resources for teachers' own use	24	89	23	85	23	85
Other	11	41	10	37	10	37
None	0	0	0	0	0	0

Frequency and percentage of respondents indicating that their district provides the specified professional development opportunities to teachers within each category to develop competence in the use of digital resources in teaching and administration. "Other" responses include outsourcing out of district, sharing among schools, AL Tech in Motion, regional and service centers, Schoology, Google system, in-service centers, training a group of teachers to train in the classroom (referred as instructional coaches), teachers collaborating on technology, tech teacher at the school, state-run technology training programs that all the teachers participate in, training in Google Classroom and Zoom, a specialist with tool kit and office hours, training for Access and Acellus, Amystye, science motion, and other free resources.

Summary: Districts provide a variety of professional development opportunities for teachers to develop competence in the use of digital resources in teaching and administration. Almost all interviewed districts offer training themselves; most districts also pay for training outside the district and share relevant information for teachers' use.

Table 24. Availability of district-wide IT support to help elementary, middle, and high school teachers use digital resources in teaching and administration

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Training classes	22	81	21	78	20	74
Specialized Q&A channels	6	22	5	19	5	19
On-site instruction and/or troubleshooting by IT staff	27	100	26	96	25	93
Other	7	26	7	26	7	26
None	0	0	0	0	0	0

Frequency and percentage of respondents indicating availability of district-wide IT support to help elementary, middle, and high school teachers use digital resources in teaching and administration. "Other" responses include training from local school tech coordinator, experts down the hall, a help-desk ticketing system to get an assigned school technician to respond, calls to a real person via help desk Zoom call with IT, Apple professional development for educators, and development through regional in-service centers.

Summary: All interviewed districts have IT staff who provide on-site instruction and troubleshooting. The majority of the districts also offered training opportunties. Some districts provide various channels to address specific issues.

Table 25. Number and percentage of districts offering any courses that rely primarily on broadband for instruction

	Frequency	*Percent*
Yes	25	93
No	2	7

Frequency and percentage of respondents indicating whether the district offers any courses that rely primarily on broadband for instruction. Further probing of the results indicates that the two districts not offering any online courses are small (with two to twelve schools).

Summary: Most districts offer at least one course that relies primarily on broadband for instruction.

Table 26. Variation among districts of percentage of courses in elementary, middle, and high schools that rely primarily on broadband for instruction

Response	*Elementary*		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
0%	14	58	11	46	1	4
1–10%	1	4	1	4	9	39
11–20%	2	8	2	8	1	4
21–30%	1	4	2	8	1	4
31–40%	0	0	0	0	0	0
41–50%	2	8	1	4	1	4
51–60%	0	0	1	4	0	0
61–70%	0	0	0	0	2	9
71–80%	0	0	0	0	0	0
81–90%	1	4	2	8	2	9
91–99%	1	4	0	0	0	0
100%	2	8	4	17	6	26

Frequency and percentage of respondents indicating percentage of courses within each category of their district schools that rely primarily on broadband for instruction.

Summary: The percentage of courses that rely primarily on broadband for instruction varies across districts and by grade span. The number of primarily online courses offered increases with the grade span. Close to 60 percent of districts do not provide such courses in elementary schools, whereas the other districts vary in the percentage of online courses offered in elementary schools. Nearly half of the districts do not provide online middle school courses, while 17 percent of the districts offer all middle school courses online. About 26 percent of the districts offer all high school courses online, but nearly half of the districts provide less than 30 percent of the courses online for high schools.

Table 27. Variation among districts of courses offered exclusively online for elementary and middle school students

	Elementary		*Middle*	
	Frequency	*Percent*	*Frequency*	*Percent*
Literacy	6	22	8	30
Math	6	22	8	30
Science	6	22	8	30
Other courses	5	19	7	26
None	17	63	13	48

Frequency and percentage of respondents indicating that classes within specified subject areas are offered exclusively online for elementary and middle school students. This question was asked only of the twenty-five districts that offer at least one course that relies primarily on broadband for instruction. "Other courses" for elementary schools include history, social studies, career prep, health, electives, computer course. One district responded "every class." "Other courses" for middle schools include history, social studies, remediation/credit recovery/intervention, career prep, health, electives, and computer science. One district responded "every class."

Summary: Over 60 percent of the districts do not provide any courses offered exclusively online for elementary schools. Around half of the districts do not do so for middle schools. Courses offered exclusively online for elementary and middle schools include both core and other courses.

Table 28. Variation among districts of courses offered exclusively online for high school students

	Frequency	*Percent*
Advanced placement (AP) courses	17	63
Career and technical education (CTE) courses	12	44
Foreign languages	19	70
Elective courses (e.g., economics, psychology)	18	67
Other courses	12	44
None	0	0

Frequency and percentage of respondents indicating that classes within specified subject areas are offered exclusively online for high school students. This question was asked only of the twenty-five districts that offer at least one course that relies primarily on broadband for instruction. "Other courses" for high schools include dual-enrollment courses, every class, remedial/intervention/credit recovery, science, computer science, career prep, health, electives, state-mandated courses, core courses (math, English, science, history classes that are required for graduation), access courses, higher math (cal 2).

Summary: Courses offered exclusively online for high schools are concentrated on noncore courses, although a couple of districts mentioned core courses in the "Other courses" category.

Table 29. Variation among districts' level of reliance on online instruction to fulfill instruction plans for elementary, middle, and high schools

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Very large	1	4	1	4	3	13
Somewhat large	2	8	4	17	4	17
Neither large nor small	2	8	2	9	4	17
Somewhat small	2	8	7	30	9	39
Very small	17	71	9	39	3	13

Frequency and percentage of respondents' indication of their district's level of reliance on online instruction to fulfill instruction plans within each category.

Summary: The reliance of the majority of the districts on online instruction to fulfill instruction plans for elementary and middle schools is somewhat small or very small. Around half of the districts feel so for high schools.

Table 30. Number and percentage of districts citing particular reasons to offer online courses

	Frequency	*Percent*
To fill in a shortage of educators	14	52
To augment the work of long-term substitutes	1	4
To augment the work of employed teachers	5	19
To make the courses available to more students	19	70
To make high-quality courses available to students	18	67
Other reasons	11	41

Frequency and percentage of respondents indicating specified reasons to offer online courses. "Other reasons" include students/parents preferring flexibility and virtual options, helping students be career ready, preparing tools for lifelong learning, emphasizing soft skills, preparing students for graduation, allowing students to explore more of their interests, mandatory virtual option in all Alabama high schools, hybrid learning for certain courses, remediating or accelerating students, and scheduling purposes.

Summary: The most common reasons for districts to offer online courses are making courses available to more students and making high-quality courses available to students. Half of the districts fill in a shortage of educators by offering online courses.

Table 31. Variation among districts of percentage of vacant teacher positions

Response	*Frequency*	*Percent*
0%	9	33
1–10%	16	59
11–20%	1	4
21–30%	0	0
31–40%	0	0
41–50%	0	0
51–60%	0	0
61–70%	0	0
71–80%	0	0
81–90%	0	0
91–99%	0	0
100%	1	4

Frequency and percentage of respondents indicating percentage of vacant teacher positions within their districts.

Summary: Nearly 60 percent of districts have 1 to 10 percent of teacher positions vacant. Another two districts have higher vacancy rates.

Table 32. Variation among districts of percentage of teacher turnover

Response	*Frequency*	*Percent*
0%	0	0
1–10%	16	62
11–20%	9	35
21–30%	1	4
31–40%	0	0
41–50%	0	0
51–60%	0	0
61–70%	0	0
71–80%	0	0
81–90%	0	0
91–99%	0	0
100%	0	0

Frequency and percentage of respondents indicating percentage of teacher turnover within their districts.

Summary: Around 62 percent of districts have teacher turnover rates of 1 to 10 percent. Another one-third of districts have teacher turnover rates of 11 to 20 percent.

Table 33. Variation among districts of expectation of change in the share of online education in instruction in district elementary, middle, and high schools in the next five years

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Greater share	11	41	13	50	17	65
Similar share	13	48	10	38	7	27
Smaller share	3	11	3	12	2	8

Frequency and percentage of respondents indicating their expectation of change in the share of online education as a part of total instruction in each category of school in their districts.

Summary: Most districts expect to include the same or a greater share of online education in instruction in the next five years. The expected share increases with the grade span.

Table 34. Variation among districts' plans to provide synchronized instruction in elementary, middle, and high schools post-pandemic

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Yes	4	15	6	23	6	23
No	23	85	20	77	20	77

Frequency and percentage of respondents indicating whether their districts plan to provide synchronized instruction post-pandemic for each category of school. "Synchronized instruction" means the same class that some students attend in person and other students attend online.

Summary: The majority of interviewed districts do not plan to provide synchronized instruction for any grade span, particularly elementary schools, post-pandemic.

Table 35. Variation in districts' options for providing underserved students with access to the internet during out-of-school hours

	Frequency	*Percent*
Extended hours for students to stay in school	19	70
School buses with Wi-Fi hotspots	20	74
District coordination with local public libraries	14	52
Other	15	56
None	0	0

Frequency and percentage of respondents indicating specified option for providing underserved students with access to the internet during out-of-school hours. "Other" responses include Wi-Fi hotspots that can be checked out and taken home, access points in parking lots outside of school, online help, summer literacy camps, working with local internet service providers to provide free internet access to disadvantaged students, Alabama Broadband Connectivity program for students, additional days added to school calendar.

Summary: Districts employ a variety of ways to help underserved students access the internet during out-of-school time, primarily through providing Wi-Fi hotspots in different venues, extending time for students to stay in school, and working with local libraries.

Table 36. Number and percentage of districts subsidizing broadband internet at home for students from low-income families

	Frequency	*Percent*
Yes	7	26
No	20	74

Frequency and percentage of respondents indicating that they subsidize broadband internet at home for students from low-income families.

Summary: The majority of districts subsidize broadband internet at home for students from low-income families.

Table 37. Variation in methods of assistance offered by districts to underserved students in elementary, middle, and high schools to develop skills in using digital resources for their learning

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Specialized classes/sessions for a group of students together	14	52	14	52	15	56
Extra support by the teacher of a course using digital resources in instruction	23	85	22	81	22	81
Support by individual tutors	13	48	13	48	12	44
Sharing information about relevant resources for students' individual use	15	56	16	59	15	56
Other	6	22	4	15	4	15
None	1	4	1	4	1	4

Frequency and percentage of respondents indicating specified method of assistance to underserved students by category of school for the development of skills in using digital resources for learning. "Other" responses include core classes, credit-bearing classes for high schools, troubleshooting tips on website; sessions to help parents understand, digital support to students prior to classes; a media platform, getting digital help in the Acellus lab or from the librarian.

Summary: The majority of districts help develop underserved students' skills in using digital resources for learning through classes, support by educators, and resource sharing.

Table 38. Variation in methods of web-based support offered to low-performing students in any courses in elementary, middle, and high schools

	Elementary		*Middle*		*High*	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
Remedial classes	21	78	20	74	21	78
Individual tutoring	19	70	18	67	19	70
Sharing of relevant resources for students' individual use	17	63	17	63	18	67
Other	3	11	3	11	3	11
None	2	7	2	7	1	4

Frequency and percentage of respondents indicating specified method of web-based support to low-performing students in any courses by category of school. "Other" responses include intervention classes, content based of standardized testing for that student (curriculum-driven content), Iready, USA test prep (all students), IXL (middle school), and Acellus (middle and high school).

Summary: The majority of districts provide web-based support to help low-performing students learn through classes, tutoring, and information sharing.

APPENDIX B: ESTIMATING THE NET ECONOMIC BENEFIT OF THE ALABAMA BROADBAND FOR EDUCATION PROPOSAL

Assessing broadband infrastructure expansion as a policy instrument to improve education outcomes in Alabama requires a cost-benefit calculus from the perspective of the state. To facilitate the policy valuation, we provide an estimate of the economic benefit and the return on investment associated with access to broadband internet for all Alabama students.

Access to broadband internet is likely to have a positive impact on a wide array of value-generating activities in Alabama. Our economic benefit estimation focuses on the direct benefits linked to higher earnings of students who for the first time would have broadband internet at home during their school years.

Our cost-benefit analysis requires the following ingredients:

1. *An estimate of the number of students in a cohort with access to broadband at home.* Our survey directly asked district superintendents about students' access to broadband at home. Using the weighted midpoint average response method, we infer that 71.1 percent of students in the average Alabama school district have access to broadband internet at home. This suggests that 28.9 percent of students in the average district do not have broadband at home.

   In 2019, 57,276 students graduated from high school.[1] Our survey results suggest that 16,553 (28.9 percent × 57,276) students in a given graduating cohort may not have access to broadband at home.

2. *An estimate of the additional number of students pursuing tertiary education because of access to broadband internet at home.* Occupational projections in Alabama show that future jobs will require college or university education at a minimum.[2] Researchers at Michigan State University have found that students with broadband-quality internet at home are roughly 15 percentage points more likely to plan to complete any college or university beyond high school compared with students who do not have internet at home or have cell phone access only.[3] This finding implies that providing access to broadband at home to all Alabama students would lead to an additional 2,483 (15 percent × 16,553) students in a graduating cohort pursuing tertiary education.

3. *An estimate of the college education premium in lifetime income.* Tamborini, Kim, and Sakamoto find that college graduates have higher earnings than high school graduates in a lifetime (until age 69).[4] In particular, the authors estimate that the lifetime earnings premium of a college degree compared with high school diploma is

$765,000.[5] This suggests that the 2,483 Alabama students in a high school graduating cohort who may attend college because of broadband access at home could earn a total of $1,899,495,000 in additional income in their lifetime.

4. *An estimate of tax collected by the state of Alabama per additional dollar of income generated.* The Tax Foundation estimates tax burden for 2019 in the state of Alabama at 9 percent.[6] This means that for every dollar of value produced in Alabama, the state receives nine cents through various taxes (e.g., income, property, or sales taxes). The Alabama tax burden estimate suggests that the 2,483 Alabama students in a cohort who may pursue college education and earn a higher lifetime income due to access to broadband at home could contribute a total of $170,954,550 to their state through taxation.

5. *An estimate of the useful life of broadband infrastructure.* We use 20 years as a conservative estimate of how long a newly deployed broadband network could last before requiring substantial replacement.[7] This means that 20 cohorts of students would benefit from the new broadband infrastructure. This suggests that the state of Alabama would collect $3,419,091,000 (20 × $170,954,550) in additional tax revenue associated with broadband network expansion through increased lifetime earnings.

   In a sensitivity analysis, we consider an extended useful life for the broadband network of 30 years rather than 20 years. Considering the potentially extended use of the new infrastructure, the state's additional tax revenue rises to $5,128,636,500.

6. *An estimate of the state's contribution to the cost of broadband infrastructure.* CTC Technology and Energy has estimated the cost of developing broadband infrastructure across Alabama's underserved areas at $4 billion to $6 billion.[8] We use the midpoint of that range as an estimate of the total infrastructure cost (i.e., $5 billion).

   In our calculation, we consider that the Alabama Department of Economic and Community Affairs could subsidize 35 percent of the broadband network cost.[9] Services closer to existing networks or those associated with positive net benefits for developers may require lower subsidization than the average service connection. Higher levels of subsidization may be needed for service connections located away from existing infrastructure or those that may be financially unattractive to developers. Using 35 percent as an indicative subsidy rate, we estimate the state's contribution to broadband infrastructure cost at $1,750,000,000 (35 percent × $5,000,000,000).

Putting together the ingredients for our cost-benefit analysis, we find that the tax revenue gains associated with broadband infrastructure for education are estimated at $3,419,091,000 (point 5) under standard infrastructure useful life. At the same time, the state's contribution to the cost of broadband infrastructure development is estimated at $1,750,000,000 (point 6). Comparing the $3,419,091,000 of additional tax revenue because

of broadband network expansion with the state's contribution of $1,750,000,000 to the cost of that network development, we estimate the state of Alabama's return on investment at 95 percent and its investment multiplier at 1.95. When an extended infrastructure useful life is considered, the state's return on investment increases to 193 percent, and its investment multiplier becomes 2.93.

It is important to highlight the large amount of additional income potentially generated through broadband for education. Part of it may be collected by the state through taxation, but the remainder is likely to be spent and invested in the Alabama economy, creating cascading benefits in the society. Comparing the additional income generated due to broadband network expansion with the state's contribution to infrastructure cost, we

Table 1. Parameters used in cost-benefit analysis

Parameter	*Value*
Students affected	
High school graduating cohort size [1]	57,276
Share of students without broadband at home [2]	28.9%
Number of students in a cohort without broadband at home [3]	16,553
Rate increase in college attendance because of broadband at home [4]	15.0%
Number of additional students pursuing college because of broadband [5]	2,483
Benefit	
College degree lifetime income premium (until age 69) [6]	$765,000
Tax burden [7]	9.0%
Cost	
Total broadband infrastructure cost [8]	$5,000,000,000
Subsidy rate [9]	35.0%
State's costs of broadband infrastructure [10]	$1,750,000,000

[1] *"The Condition of College & Career Readiness 2019: Alabama Key Findings," ACT, https://www.act.org/content/dam/act/unsecured/documents/cccr-2019/Alabama-CCCR-2019.pdf.*
[2] *Source: Authors' calculation based on survey interviews of Alabama district superintendents.*
[3] *Calculation: 57,276 × 28.9%.*
[4] *Source: Keith N. Hampton, Laleah Fernandez, Craig T. Robertson, and Johannes M. Bauer, "Broadband and Student Performance Gaps," James H. and Mary B. Quello Center, Michigan State University, March 3, 2020, https://doi.org/10.25335/BZGY-3V91.*
[5] *Calculation: 16,553 × 15.0%.*
[6] *Estimation assumes equal gender representation. Source: Christopher R. Tamborini, ChangHwan Kim, and Arthur Sakamoto, "Education and Lifetime Earnings in the United States,"* Demography *52, no. 4 (August 2015): 1383–1407.*
[7] *Source: Erica York and Jared Walczak,* State and Local Tax Burdens, Calendar Year 2019*, Tax Foundation, Washington, DC, 2021, https://files.taxfoundation.org/20210322135318/State-and-Local-Tax-Burdens-Calendar-Year-20192.pdf.*
[8] *Source: Caroline Beck, "Broadband Expansion to Underserved Areas Could Cost $4B–$6B,"* Alabama Daily News*, February 1, 2021, https://www.aldailynews.com/broadband-expansion-to-underserved-areas-could-cost-4b-6b.*
[9] *Source: Alabama Broadband Accessibility Fund,* 2021 Annual Report*, Alabama Department of Economic and Community Affairs, January 28, 2021, https://adeca.alabama.gov/maps-plans-and-reports.*
[10] *Calculation: $5,000,000,000 × 35%.*

Table 2. Cost-benefit analysis of broadband infrastructure development

Time outlook after infrastructure development	*Initial state investment*	*Cumulative additional income*	*State's social return on investment*	*State's social investment multiplier*	*Cumulative additional tax revenue*	*State's return on investment*	*State's investment multiplier*
Standard infrastructure use (useful life: 20 years)							
10 Years	$1,750,000,000	$848,710,532	–52%	0.48	$76,383,948	–96%	0.04
20 Years	$1,750,000,000	$5,496,411,064	214%	3.14	$494,676,996	–72%	0.28
38 Years (break even)	$1,750,000,000	$19,803,245,745	1,032%	11.32	$1,782,292,117	2%	1.02
50 Years	$1,750,000,000	$29,502,794,681	1,586%	16.86	$2,655,251,521	52%	1.52
Full outlook	$1,750,000,000	$37,989,900,000	2,071%	21.71	$3,419,091,000	95%	1.95
Extended infrastructure use (useful life: 30 years)							
10 Years	$1,750,000,000	$848,710,532	–52%	0.48	$76,383,948	–96%	0.04
20 Years	$1,750,000,000	$5,496,411,064	214%	3.14	$494,676,996	–72%	0.28
35 Years (break even)	$1,750,000,000	$20,005,319,681	1,043%	11.43	$1,800,478,771	3%	1.03
50 Years	$1,750,000,000	$38,191,973,936	2,082%	21.82	$3,437,277,654	96%	1.96
Full outlook	$1,750,000,000	$56,984,850,000	3,156%	32.56	$5,128,636,500	193%	2.93

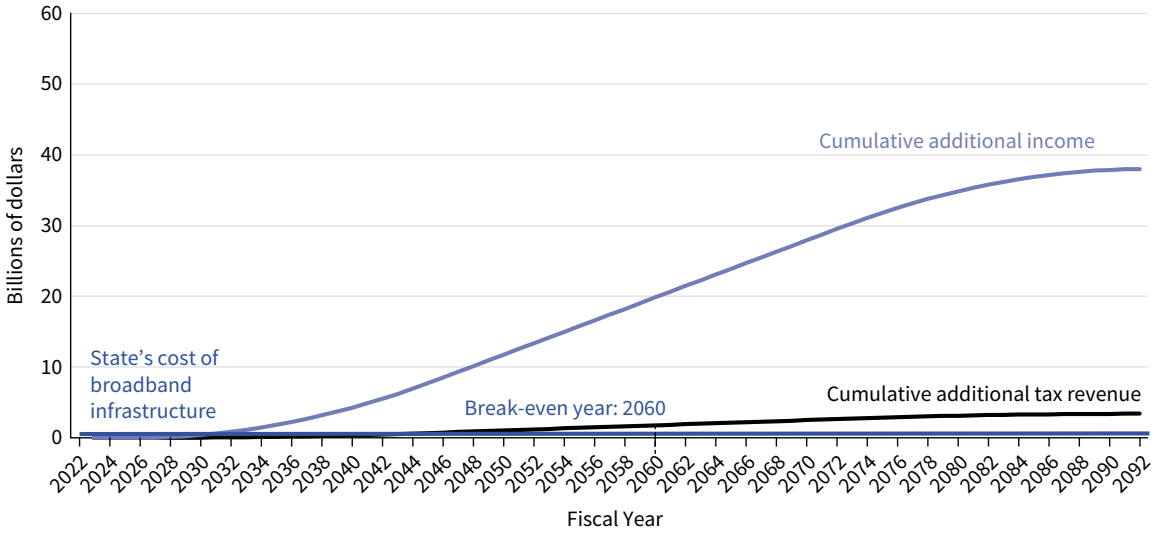
Cumulative additional income (tax revenue) represents the total flow of additional income (tax revenue) in a given time frame. For simplicity, we assume students benefit the same regardless of the number of years of access to broadband at home during school years. We also assume smooth earnings distribution across fiscal years between college graduation and age 69. Tamborini, Kim, and Sakamoto (see n4) use age 69 as an endpoint of productive life. Return on investment (social return on investment) is calculated by subtracting the initial investment value from the cumulative tax revenue (income) in a given time frame, then dividing this new number by the initial investment value. The investment multiplier (social investment multiplier) is the ratio between the cumulative tax revenue (income) in a given time frame and the initial investment value.

estimate the social return on investment at 2,071 (3,156) percent and the social investment multiplier at roughly 22 (33) under standard (extended) infrastructure longevity.

Table 1 outlines the parameters used in our estimation of net economic benefit of broadband infrastructure development. Table 2 presents a cost-benefit analysis using the smoothed distributed-benefit method. Our projections show that twenty years after infrastructure development, the total new income generated is estimated at $5,496,411,064 and the associated additional tax revenue is estimated at $494,676,996. These projections correspond to a 214 percent social return on investment and a financial return that covers 28 percent of initial state investment at the end of twenty years.

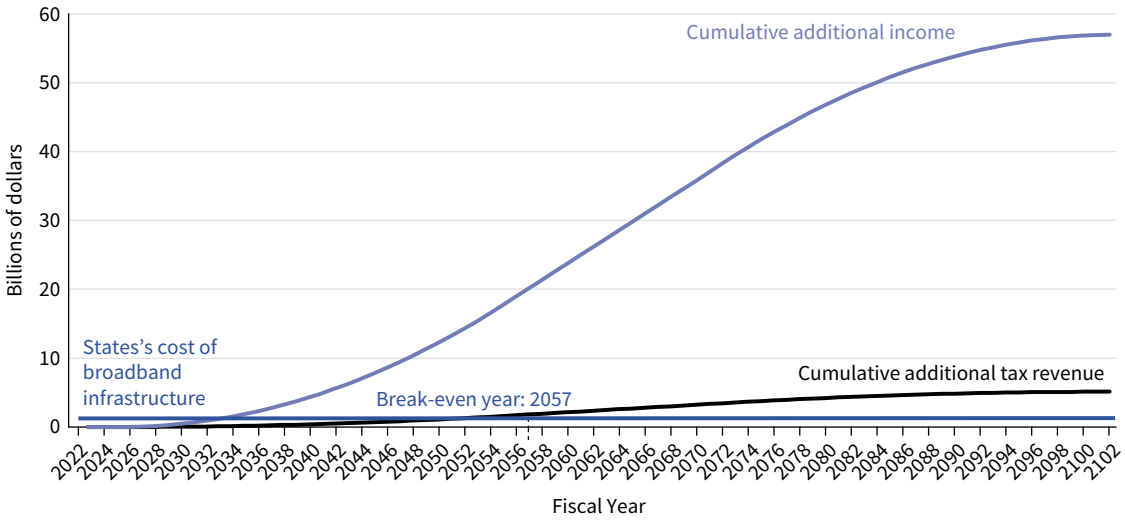
Figure 1 plots the cumulative tax revenue at different times, assuming twenty years of useful life for the broadband network. The year 2023 is used as the year of first broadband infrastructure use. Our projections suggest that the state's contribution to the infrastructure cost will be fully paid (break even) through tax revenue gains in 2060. Figure 2 plots the cumulative

Figure 1. Cumulative additional income and tax revenue from broadband for education under standard useful life



Note: 2023 is used as year of first broadband infrastructure use. Standard useful life corresponds to twenty years of infrastructure use.

Figure 2. Cumulative additional income and tax revenue from broadband for education under extended useful life



Note: 2023 is used as year of first broadband infrastructure use. Extended useful life corresponds to thirty years of infrastructure use.

tax revenue when an extended useful life of thirty years is considered for the infrastructure. The extended useful life is associated with an earlier financial break-even time of 2057.

The net economic benefit of broadband infrastructure for education is substantial for both the state and the overall economy in Alabama. In the long-term horizon, benefits channeling through education fully pay off the state's cost of broadband infrastructure development. In addition to education, broadband benefits are likely to flow in through other channels such as commerce, health care, public services administration, civic engagement, skills development, and entertainment production. Economic benefits through those channels could exceed the education-related benefits of broadband. Additional wealth and tax revenue generated from broadband expansion through sectors besides education render the investment more attractive and the state's support more justifiable.

NOTES

1 "The Condition of College & Career Readiness 2019: Alabama Key Findings," ACT, https://www.act.org/content/dam/act/unsecured/documents/cccr-2019/Alabama-CCCR-2019.pdf.

2 "State of the Workforce Report XIV: Alabama, 2020," Alabama Department of Labor, http://www2.labor.alabama.gov/WorkforceDev/WorkforceReports/Alabama.pdf.

3 Keith N. Hampton, Laleah Fernandez, Craig T. Robertson, and Johannes M. Bauer, "Broadband and Student Performance Gaps," James H. and Mary B. Quello Center, Michigan State University, March 3, 2020, https://doi.org/10.25335/BZGY-3V91.

4 Christopher R. Tamborini, ChangHwan Kim, and Arthur Sakamoto, "Education and Lifetime Earnings in the United States," *Demography* 52, no. 4 (August 2015): 1383–1407.

5 Estimation assumes equal gender representation; see Tamborini, Kim, and Sakamoto, "Education and Lifetime Earnings." Researchers at Georgetown University estimate a higher college degree premium at $964,000: Anthony P. Carnevale, Stephen J. Rose, and Ban Cheah, "The College Payoff: Education, Occupations, Lifetime Earnings," Center on Education and the Workforce, Georgetown University, https://cew.georgetown.edu/cew-reports/the-college-payoff.

6 Erica York and Jared Walczak, *State and Local Tax Burdens, Calendar Year 2019*, Tax Foundation, Washington, DC, 2021, https://files.taxfoundation.org/20210322135318/State-and-Local-Tax-Burdens-Calendar-Year-20192.pdf.

7 PPC, a major broadband network developer, estimates the likelihood of a fiber network failure after twenty to forty years of use at one in one hundred thousand. Various components of the network equipment may have shorter useful lifetimes than fiber optic. https://www.ppc-online.com/blog/4-factors-that-influence-how-long-your-fiber-network-will-last.

8 Caroline Beck, "Broadband Expansion to Underserved Areas Could Cost $4B–$6B," *Alabama Daily News*, February 1, 2021, https://www.aldailynews.com/broadband-expansion-to-underserved-areas-could-cost-4b-6b.

9 Alabama Broadband Accessibility Fund, *2021 Annual Report*, Alabama Department of Economic and Community Affairs, January 28, 2021, https://adeca.alabama.gov/maps-plans-and-reports.

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Hoover-Alabama Innovation Initiative

In July 2020, Alabama governor Kay Ivey established the Alabama Innovation Commission (AIC), aimed at building the state's competitiveness in the technology sector, inspiring entrepreneurship, and educating a twenty-first-century workforce. The AIC serves as a platform for innovators to engage policy makers, exchange ideas, and identify policies that promote innovation in the state.

Governor Ivey asked Hoover Institution director Condoleezza Rice, a member of the AIC Advisory Council, if the Institution would lend its expertise on state and local politics to the initiative. Hoover's involvement in the project consists of two components, led by senior fellows Stephen Haber and Joshua Rauh. Haber led a team of Hoover fellows in conducting data-driven research to assess the components—educational, legal, financial, governance, and physical infrastructure—necessary to transform Alabama into an innovation hub. Rauh led Hoover's first Policy Lab, a collaboration between the Hoover Institution, Stanford Graduate School of Business, Stanford Law School, and several of Alabama's leading universities. The Policy Lab constitutes a new model for engaging students in public policy research: teams of Stanford MBA students and undergraduates from Alabama's universities built substantive knowledge and created data sets necessary for the Hoover fellows to write their report to the AIC.

The focus on state and local issues represents a pivot from Hoover's traditional focus on policy making at the federal level. As such, it presents a unique opportunity. One-size-fits-all solutions tend not to work in a nation as diverse as the United States. Hoover's engagement at the state and local levels has increased its potential to impact policy making in a meaningful way, thereby improving the lives of Americans.

For more information about the Hoover-Alabama Innovation Initiative, visit us online at www.hoover.org/research-teams/hoover-alabama-innovation-initiative.

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