Innovation-Led Economic Growth

Transforming Tomorrow’s Developing Economies through Technology and Innovation

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A Report of the
CSIS PROJECT ON PROSPERITY AND DEVELOPMENT
AND RTI INTERNATIONAL
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CSIS CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

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Beginning in the fall of 2016, CSIS and RTI International began examining the current challenges facing developing countries as they seek to establish innovation- and technology-driven economies. Innovation and technology are increasingly at the heart of economic growth around the world—and will be crucial tools for addressing emerging issues such as global urbanization and growing demand for food, energy, and water. Unfortunately, how to harness innovation and technology for transformational change is not typically a top-tier topic in the international donor community. As this report demonstrates, that is changing and should continue to do so.

Bilateral and multilateral donors have begun to recognize the broad global demand for programming that specifically targets the creation of innovation- and technology-led economic growth, but change has been halting. Donor agencies have typically focused on issues like basic human needs, infrastructure, and democracy and governance—all worthwhile pursuits but only part of the story. Today, developing countries aspire toward a different kind of cooperation with established Organization for Economic Cooperation and Development (OECD) economies. They want a stake in the global community of science, knowledge, and creation that has fueled twenty-first-century innovation and technology.

Given the breadth and depth of the topic, there was clear recognition that any analysis would have to break the topic down into its constituent parts. On the basis of this recognition, CSIS and RTI chose to host three separate roundtable discussions at CSIS to address different subtopics under the larger research umbrella of innovation- and technology-led economic growth. The first roundtable was held in September 2016 and focused on education and human capital development; the second roundtable held in October 2016 focused on translational research and development and commercialization; and the final roundtable was held in December 2016 and focused on the innovation policy environment.

These roundtables allowed the research team to evaluate how U.S. development agencies, other bilateral donors, multilateral development banks, and the private sector approached each of the...
identified research topics. Following additional interviews with key stakeholders and significant
desk research, CSIS and RTI drafted a memo for each topic summarizing key findings and insights.
In addition, CSIS and RTI identified three case studies—Kenya, Malaysia, and Gujarat, India—that
would be used to highlight best practices and successful examples of international cooperation
around the creation of innovation- and technology-led economic growth. CSIS and RTI sent joint
teams to all three locations to meet with implementers, emerging donor representatives, host
country officials, and the private sector. On the basis of these visits, CSIS and RTI drafted three
case study memos to further validate and support our research.
All of that work has been encapsulated in this report, which represents nearly twelve months of ef-
fort from dozens of people consolidating lessons from across the world. Through this research,
CSIS and RTI hope to create a platform for engaging a broad set of actors to support the creation
of knowledge-based economies and innovation-led economic growth in places where we never
expected to find it before.
The world faces a confluence of changes and technological advances that are fundamentally altering the relationship between individuals, economies, and society. Innovations in a diverse set of fields including robotics, genetics, artificial intelligence, Internet-enabled sensors, and cloud computing are individually disruptive. Collectively they are world changing. Experts around the world have come up with different names and descriptions for this phenomenon: Klaus Schwab calls it the “fourth industrial revolution”; Alec Ross points toward the “industries of the future”; Steve Case recognizes it as the “third wave” of the Internet; and Martin Ford looks toward the “rise of the robots.”

Although these thinkers have slightly different visions for the future, there is a shared recognition that existing assumptions and economic models need adjustment. For both developed and developing countries, the innovation- and technology-driven economy offers significant risks and opportunities. On the one hand, this change offers the potential for increased global prosperity, efficiency, and quality of life. On the other hand, if poorly managed, this transition could disrupt employment models, pathways out of poverty, and stability around the world.

The good news is that the developing world is richer, freer, and more capable than at any other time in history. The center of gravity for the emerging global middle class will be in places like India, China, Southeast Asia, and East Africa. The future of development will not be focused on the basic human needs agenda—although there are critical and pressing human needs still to be met. Meeting the hopes and aspirations of these changing economies will require new forms of cooperation beyond traditional foreign assistance. Today, developing countries are seeking partnerships around trade and investment, education, and science and technology.

This means that it will be critical for developing countries to build the capacity to participate in—and benefit from—the modern innovation- and technology-driven economy. Traditional models of development relied upon agriculture, commodities, and cheap labor as part of an incremental process to build skills, move up global value chains, and increase national income. Although these disciplines will remain important, integration into the knowledge economy...
requires new skills and education to develop a modern workforce, connectivity with global knowledge networks, and a willingness and ability to embrace rapid change.

For developing countries that want to escape the middle-income trap and seize new opportunities in the transforming global economy, the time to look to the future is now. The World Bank recently estimated that up to two-thirds of all jobs in developing countries are susceptible to automation. Similarly, the World Economic Forum estimates that nearly two-thirds of current primary school students will be employed in jobs and industries that do not currently exist. In response to these pressures, developing countries are seeking to change their economic trajectory and industrial mix through innovation and technology. Today nearly half of all developing countries have released national science, technology, and innovation (STI) strategies, and there is a growing global consensus that innovation and technology need not be the sole province of advanced economies. Achieving this diffusion of capability, however, will require effective policy-making and good governance.

The United States can (and should) position itself as the partner of choice for developing countries that want to transform their economies through science, technology, and innovation. It has unique assets that it can offer to help developing countries achieve this goal: American universities, research, and companies are the envy of the entire world. Large foreign student and diaspora populations in the United States could also serve as natural connectors for future partnerships that help build diplomatic and economic ties.

It is clearly in the U.S. interest to assist and partner with countries seeking this kind of transformation. Emerging economies are future markets for trade and investment, and promoting economic growth abroad creates jobs and wealth back home. Helping developing countries meet their hopes and aspirations also strengthens friendships and alliances that help with burden sharing and global public goods. Rich countries do not have a monopoly on innovation, and we need more brain power from around the world focused on solving our shared global challenges.

Education, science, and technology will be a large part of our future engagement with the developing world, and policymakers in the United States need a deeper understanding of how these issues fit in with our global interests. Through effective cooperation, the United States can plug

1. The World Bank notes that:

Since the 1950s, rapid growth has allowed a significant number of countries to reach middle-income status; yet, very few have made the additional leap needed to become high-income economies. Rather, many developing countries have become caught in what has been called a middle-income trap . . . stable, low-growth economic equilibria where talent is misallocated and innovation stagnates.


4. CSIS research found that 66 out of 139 countries the World Bank classified as lower income or middle income have STI policies.
new countries into the liberal rules-based international order. It is this brand of soft power, global network building, and technological leadership that will lead to another “American Century.”

At the crossroads of this critical juncture in human social and economic development, CSIS and RTI International formed a research partnership to examine global trends, best practices, and emerging issues around innovation- and technology-led economic growth.

The findings presented in the following report suggest that there are clear opportunities to accelerate and expand opportunity through innovation and technology around the world. Although the specific nature of the opportunity varies by setting—Kenya, Malaysia, and Gujarat each had very different visions for their respective economic futures—there are common insights and approaches to promoting innovation-led economic growth around the world. Transforming tomorrow’s developing economies through technology and innovation will not necessarily require huge investment but rather catalytic interventions, sustained partnerships, and long-term vision.
Any country that aspires to an innovation- and technology-driven economy must first look to the quality of its human capital, which absorbs and produces technological advances. Improving this fundamental component of the economy has broad positive effects, but as the OECD notes, beginning in the late 1990s there was recognition that high-income economies, “are more strongly dependent on the production, distribution and use of knowledge than ever before.”¹ A large diffusion of skills and knowledge in the economy is the starting point for modern economic competitiveness and critical for achieving sustainable and inclusive growth.

This common-sense assertion is backed by years of economic studies. A recent article found a “positive relationship, statistically significant between GDP per capita and innovative capacity of human capital (evidenced by the number of patents) and qualification of employees (secondary education) as expected according to economic theory.”² An International Monetary Fund (IMF) study indicated that although the macroeconomic impact of patents is understudied, average growth rates are correlated with patents, primarily through their impact on research and development (R&D).³ All this points to the clear value of a well-developed base of human capital.

The key input and determinant of human capital development, particularly in economies looking to move toward upper-middle-income status, is access to quality education. Education can equip a national workforce with the skills, knowledge, and creativity to compete in the knowledge-based global economy. One Stanford researcher noted that “without improving school quality, developing countries will find it difficult to improve their long run economic growth.”

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performance.” Basic literacy and numeracy are starting points, but specialized skills, training, and educational institutions are needed to take full advantage of opportunities in the knowledge economy.

These basic skills can initially be gleaned from effective secondary education. In the economic growth of Asia in the late 1980s and early 1990s as well as in postwar Europe, secondary education was more strongly associated with growth than even higher education. That said, as countries develop and incorporate the best existing technologies into their economy, that is, as they approach the “technological frontier,” tertiary education becomes particularly important as a driver of invention and innovation. As countries seek to move up the ladder economically, there needs to be a system capable of producing the appropriate human capital through effective primary, secondary, and then tertiary education programs.

EXTENDING SKILLS AND ACCESS

Unfortunately, the conversation around education still starts with basic access, literacy, and numeracy. Today, 263 million children and youths are out of school, with 142 million secondary school students between the ages of 15 and 17 excluded from education. Only 1 out of 10 young adults in developing countries will be on track to gain basic secondary skills by 2030 under current trends.

Education quality rather than education access more strongly correlates with economic growth because the quality of an education is a bigger determinant of potential individual earnings. Education access alone can be a misleading indicator. In Ghana and Kenya, for example, even those that graduate from university have lower levels of literacy than OECD residents who have completed primary school. Translating access into quality education requires institutional changes, but the addition of technological resources can serve as an important impetus and driver of change.

Technology as a Tool for Education

Closing the gap on basic education needs will require continued commitment to existing programs, but technology can also be a tool to extend access and improve quality of learning. Today mobile devices are nearly ubiquitous, and by 2020, 70 percent of the world population is expected to have a smartphone. These phones could serve as interactive learning platforms, especially for building basic literacy and numeracy.

Development agencies are already implementing programs to identify innovative uses of mobile technology in education. As part of its Grand Challenges for Development initiatives, the U.S. Agency for International Development (USAID) launched the All Children Reading program in 2011 to provide ongoing grant and prize money for innovators that leverage science and technology to “source, test, and disseminate scalable solutions to improve literacy skills of early grade learners in developing countries.”

Mobile phone penetration is also a potential solution to lack of access for marginalized and vulnerable populations, including girls and the disabled. A recent USAID study noted that only “5–15 percent of children in low income countries have access to the assistive technologies they require, thereby hindering their access to school” and limiting their ability to learn. Donors could play a role in helping to provide these assistive technologies, including digital platforms and textbooks for students with visual or audio impairments. Including these populations enhances their ability to participate in the economy and broadens the base of potentially productive human assets.


Early phases of education lead to imitative behaviors while secondary and tertiary education are related to innovation. Although the Millennium Development Goals led to widespread promotion of primary education, secondary schooling enrollment and graduate rates continue to lag. As secondary school often is the final stage of education for most youths before they enter the workforce, it is important for students to make the transition from primary to secondary schooling.

National standards in education that require primary school graduates to take a placement exam for secondary school encourage students toward future education access even as the quality of it may vary. In addition, secondary schooling that incorporates both traditional learning and

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work-based learning ensures that students are not confined to an academic or vocational path in the early stages of their education, something that prevents career mobility.  

Finally, once students have received a secondary education, one that is balanced with academics and vocation, they can specialize for a specific career with market-relevant training through tertiary education. Countries that have experienced a growth in tertiary education seldom end up with an “oversupply.” South Korea, for example, from 1974 to 1990 had a positive return on tertiary education. This was in spite of the fact that South Korea was experiencing many political and economic transitions, showing that tertiary education is a positive development tool for many contexts in the developing world. 

BUILDING SKILLS FOR SCIENCE, TECHNOLOGY, AND INNOVATION

Basic skills are necessary but are not sufficient to propel a country to innovation- and technology-led economic growth. To equip their students to succeed amidst the rapid economic change now known as the “fourth industrial revolution”—characterized by breakthroughs in information technology, artificial intelligence, robotics, energy, and other technologies—developing countries will need to shift the goals and incentives in their education systems or alternative training programs if the education systems are not up to scratch.

This is necessary for effectively adopting and adapting existing technologies to improve factor productivity but also for producing homegrown domestic innovation. In addition, for innovation to increase economic competitiveness, new technologies must be incorporated across various sectors of the economy.

- Science, Technology, Engineering, and Math (STEM): These skills will be increasingly valuable in the future economy and are weaker in developing countries. Developing countries should ensure access to basic STEM education in primary and secondary schools, including through investment in quality education professionals. Programs to fund postgraduate or PhD studies deliver long-term economic value, but so do technical and vocational education programs that provide basic STEM skills for high-wage blue-collar workers. In the United States, which serves as the most common example of an


14. Ibid.

innovation- and technology-driven economy, half of all STEM jobs are available to workers without a four-year degree.16

- **Digital Literacy:** As access to the Internet and mobile technology continues to spread, basic digital literacy skills will open new economic opportunities for the poor and disadvantaged. The World Bank’s 2016 “World Development Report” notes that digital technologies promote “inclusion, efficiency, and innovation.”17 The same report suggests exposing children to basic information and communication technology (ICT) and coding concepts at an early age. This could be achieved through the public education system or outside programs like coding academies to prepare young people for the opportunities and challenges of the digital workforce. Digital literacy reduces the digital divide, a crucial gap in development that quickly closes as younger people are given access to digital technologies for education.

- **Research Universities:** The quality of universities, particularly when it comes to the ability to conduct research and development activities, is also important for countries looking to drive domestic innovation and technology creation. Universities need the capacity to conduct quality research, in terms of qualified and capable professors but also physical facilities. According to the National Bureau of Economic Research, doubling the number of universities is correlated with a more than 4 percent gain in gross domestic product (GDP) per capita. There is also a need for strong linkages and consistent interactions with industry to provide feedback on the “knowledge, skills, and innovations needed to drive their respective national economies.”18 Programs to send top students from developing countries to world-class universities abroad can serve as a way to develop globally competitive talent in the absence of quality domestic universities.

- **Innovative and Entrepreneurial Thinking:** Education systems should encourage their students to think critically, pursue innovative ideas, and believe in their own ability. The necessity of education systems that foster innovation is especially important for middle-income countries. Innovation is a fundamentally disruptive activity and often requires a fairly risk-tolerant approach. This willingness to take risks and challenge established norms is something that can be taught and inculcated. Educational programs should integrate design thinking—an approach that encourages a process to “match people’s needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity”—into their curricula.

Countries that want to spur change in their education systems need to start with a compelling vision of the future and follow that with ambitious goals that will force innovative solutions. The

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World Economic Forum offers Chile as an example of a country that was able to radically improve its basic education through political focus, willingness to experiment, and strong investment in the quality of its teachers. This education system was also linked to a series of key institutions, namely, Fundacion Chile, which provided a feedback loop on the skills and capacities most needed in the national economy.

Perhaps the best example of a country that successfully transformed its education system to achieve technology- and innovation-led growth is the Republic of Korea. In 1945, less than one-quarter of Koreans were literate and only one-fifth of children attended secondary school. Following sustained government focus and investment, “enrolment rates reached 90 percent for primary school in 1964, for middle school in 1979 and high school in 1993.”

In the 1990s, Korea turned its focus to tertiary education, and today 65 percent of Korean young adults complete tertiary education, the highest rate among OECD countries. Korea paired this increase in access to tertiary education with the top global test scores on math and science testing. This allowed Korea to absorb the knowledge, technologies, and capacities that came with foreign direct investment, ultimately driving a high level of domestic capacity and innovation. With this perspective, it is clear that Korea laid the foundation for its success in the knowledge economy through investments and innovations in its education system.

CONCLUSION

The highest value investments in education will come through closing the remaining gaps on access, basic literacy, and quality of instruction. Broad access to basic education is the basis for economic empowerment and productivity, and it remains beyond reach for more than a quarter of a billion children. It can power the leap from low-income into middle-income status. The Internet and mobile technology offer unique opportunities to reach these marginalized populations and provide education tools and access on a broad scale.

For countries that have closed the gap on basic access and skill and want to move from lower-middle-income to upper-middle-income or to upper-income status, the challenge becomes establishing an education system that produces workers with the skills and knowledge to participate in the modern economy. Producing the right kind of human capital requires an education framework that supports a broader economic development plan and aligns with industry needs. This is especially true when it comes to strategies for achieving innovation- and technology-led economic growth. In that sense, in addition to a role in producing human capital, the education system

21. Ibid.
system needs to also be linked to the overall ecosystem that produces innovation; it needs to seek and receive signals from industry and commerce, to have the incentives to react to them, and to know how to react to them. This is an extremely difficult task, and countries have trouble figuring it out on their own.

The donor community, including bilateral development agencies, multilateral development banks, philanthropies, and nongovernmental organizations, are well equipped to support these needs. Donors can support capacity building for national planning on economic development and education strategies. The goal of this work should be to improve the quality of the education system and include better foundational learning outcomes, greater educational attainment, and better graduate preparation for an innovation-led economy.

There is also a clear role for donors in providing expert advice on building linkages between industry and education to facilitate the achievement of national industry and economic objectives. Vocational training has a role to play in closing the skills gap, especially if pursued in partnership with companies that will then provide jobs. Linking industry and academia, however, becomes a primary concern at the tertiary level where universities are a key driver of national innovative capacity.
Research, development, and engineering (RD&E) is the engine that drives innovation and leads to economic growth. To drive innovation and create economic growth, new knowledge and new technology from RD&E must be converted into commercially valuable, need-driven outcomes, that is, new products, new processes, and new services. This conversion step requires its own set of skills and processes (distinct from RD&E) and is often not given adequate attention as a critical element in the “RD&E-to-economic impact” paradigm. Yet it is a common need at all levels of enterprise: from entrepreneurial start-ups to small to medium enterprises to multinational corporations.

The conversion of RD&E outcomes is a challenge for even the most well-run technology-driven enterprises; it requires integration of strategy, technical know-how, market analysis and planning, user-centered design, and business model development. The skills for this conversion are often developed through a fabric of on-the-job training, mentorship, and problem solving inside successful enterprises surrounded by networks of internal and external resources. The problem is significantly magnified in countries where critical components that make up the fabric are underdeveloped or nonexistent.

Developing countries hoping to establish independent pipelines of research, development, and engineering must first identify and strengthen the highest priority foundational skills and resources. This includes the skills and resources necessary to translate research into real-life, commercially viable applications that lead to economic growth. Policymakers should target capacities that will have the greatest impact on the efficiency of RD&E outcome conversion, recognizing that the necessary skills and resources will be different across the diverse range of emerging and developing economies.

The World Bank notes that, even in our increasingly globalized economy, even basic research does not “flow easily or costlessly across borders so developing countries cannot simply rely on what is
being generated in the advanced countries. Translational research that turns the fruits of basic science into meaningful outcomes is arguably even more difficult to transplant across borders. This means developing countries cannot rely on spill-off benefits from R&D conducted abroad and need to spur the growth of domestic R&D activities.

To support the creation of a domestic R&D sector with commercial conversion potential, governments, industry, and academia must work together to strengthen the fabric of the innovation ecosystem. Through a coordinated approach, it is possible to sustainably develop the resources and skills needed to establish strong domestic research, development, and engineering capacities that can be translated into innovation and economic growth.

**FOUNDATIONAL SKILLS AND RESOURCES: INFRASTRUCTURE, EXPERTISE, AND NETWORKS**

To conduct research and development activities that lead to opportunities for commercialization and economic growth requires several foundational skills and resources: physical infrastructure, lab space, and instrumentation; a human capital base with both scientific and entrepreneurial skills; and an institutional framework that links these productive assets with the appropriate networks of mentors, funders, and partners. Strengthening all of these capacities can be challenging, but they are mutually reinforcing. By building a strong base of foundational skills and resources, developing economies can position themselves to better participate in the innovation- and technology-led economy.

In many cases, developing countries are unable to conduct domestic research and development because they lack basic infrastructure, specialized laboratory facilities, or both. Regarding basic infrastructure, it is extremely difficult to conduct R&D activities in a setting without consistent access to basic utilities like power and water. Significant gaps remain on this front—more than 15 percent of the global population lacks access to power, and nearly 10 percent lack access to clean water—and closing those gaps will require continued focus on diminishing the $1 trillion annual global infrastructure investment deficit.

Beyond basic infrastructure, R&D requires specialized laboratory facilities that are often absent in developing countries. In an assessment of sub-Saharan Africa’s university systems, World Bank researchers recommend that urgent measures be taken to increase access to laboratory facilities.

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This kind of gap is common in developing countries, and in response, donors have targeted their programming to increase access to lab facilities. USAID\textsuperscript{6} and the World Bank,\textsuperscript{7} in particular, have worked to support lab facilities in highly underdeveloped countries.

Human capital becomes increasingly salient as countries move up the “technological ladder so as to diversify into higher value, knowledge- and research-intensive activities.”\textsuperscript{8} Of course, research and lab facilities will not be utilized or maintained unless the population is equipped with the proper technical skills. Similarly, R&D activities will not lead to economic growth without the business skills to translate research into profit-earning enterprise.

Generally, secondary and tertiary education systems are weak in developing countries; this is especially true when it comes to the sciences. In a task force report focused on higher education in developing countries, the World Bank identified an acute need to improve “science and technology research and instruction in institutions of higher education.”\textsuperscript{9} The report was released in 2000, but the need for students trained in the sciences has not disappeared.

The importance of building domestic capacity for R&D activities also extends beyond participation in the knowledge economy; capable local researchers can tackle location-specific challenges that foreign researchers would not even consider.\textsuperscript{10} For example, the World Bank sponsored a program to support farmer-led R&D to drive local innovation and problem solving.\textsuperscript{11} Even more important than the ability to conduct research is the cultivation of the business and marketing skills necessary to translate R&D into economic gain. Without this key conversion step, research cannot contribute to economic growth.

Converting or “deploying” research into financially viable businesses can be a major challenge. This is because the very skills, equipment, and facilities that create effective R&D may not be useful for new businesses. To ensure the conversion of research into a business, there must be effective financial conduits, business models, entrepreneurs, and matchmaking mechanisms that connect sellers to buyers of technology. These are complementary but distinct conditions.

In the vast majority of cases, the people conducting research do not have the knowledge or ability to translate their research into a commercial opportunity. In recognition of the importance of entrepreneurial skills, universities are increasingly offering specialized training and programs—the Kauffman Foundation estimates that the number of entrepreneurship courses offered at colleges


\textsuperscript{8} “Accelerating Catch-Up,” xx.


and universities has risen from 250 in 1985 to more than 5,000 by 2008.\textsuperscript{12} That number will certainly continue to grow.

The presence of skilled cadres of researchers and entrepreneurs is an important start but not sufficient to establish an effective research, development, and commercialization process. Researchers need active connections with companies and entrepreneurs that can commercialize their discoveries and focus future research on market-relevant problems. This should include formalized pathways established between universities and industry counterparts.

In some cases, large multinational corporations can internalize these processes and skills and become their own centers for R&D, innovation, and commercialization. Locally based multinational corporations already have at least some of the infrastructure (people and facilities) to drive internal innovative collaboration and in many cases have the resources to view R&D investment as a long-term process. Advances and innovations achieved in these large companies can also deliver spin-off benefits for other local enterprises through demand for competitive supplier routes.

Governments can encourage, catalyze, and formalize relationships between industry and academia. Building these relationships to facilitate feedback loops will ensure that education provides appropriate technical skills and university researchers target market-relevant challenges. Governments also have a clear role in defining a regulatory environment that encourages R&D commercialization. Strong intellectual property rights are critical. The OECD also points to the importance of mechanisms—like the Bayh-Dole legislation in the United States\textsuperscript{13}—that allow the "transfer, exploitation, and commercialization of public research results,"\textsuperscript{14} as a critical element of science, technology, and innovation policy.

**ROLE FOR THE INTERNATIONAL COMMUNITY**

The international community has a clear role to play in supporting developing countries as they seek to improve their capacity for research, development, and commercialization. Many of the activities needed to support this activity—including support for infrastructure and education—are mainstays of traditional development policy. Donors will also need to look toward more specialized forms of support that target science, technology, and innovation capacities.

- *Increase R&D Expenditure:* Developing countries invest far less in R&D than their developed counterparts. Studies suggest that whereas R&D investment in most developed countries is between 1.5 and 3 percent of GDP, developing countries typically invest less than 1 percent


of GDP in R&D activities. R&D activities in OECD countries offer higher returns as the distance from the technological frontier increases; although this may not hold true for middle- or low-income countries, countries with low capacity stand to enjoy large gains from even modest increases in R&D activities.

- **Extend Access to Laboratory Facilities and Infrastructure**: In addition to ongoing work around basic infrastructure development, aid agencies should specifically target the creation of specialized laboratory and science facilities. USAID already supports ongoing projects that aim to develop quality laboratory services in the developing world. The World Bank has funded programs to put modern lab facilities in schools to promote more effective education. These efforts should be assessed and replicated. Although many of these laboratory facilities are located at universities, private actors can also drive progress. IBM Research recently opened a facility in Nairobi, Kenya, as its first industrial research facility on the African continent.

- **Promote Quality Secondary and Tertiary Education**: Improving the quality of and access to education has been a core directive of the development community for decades—specifically, improving the quality of secondary and tertiary education, with a dual focus on STEM and entrepreneurial skills. This dual focus would yield higher-quality research as well as higher commercial conversion rates. Policymakers should also support programs that aim to help developing countries retain their human capital and prevent “brain drain”—for example, one in nine Africans with a tertiary degree live in OECD countries according to a 2013 world migration report.

- **Stimulate Technology Transfer**: Developing countries are latecomers, and most of what they need in the technology and innovation sector is already available somewhere. Rather than creating new technologies, there is an opportunity to identify, reconfigure, and deploy existing technologies for local use. Doing so requires both technical modifications and social considerations to ensure adoption. The international community can play a role in identifying existing relevant technologies that can be transferred and applied to challenges in developing countries. In addition, donors can support learning and capacity building to assist adaptation, adoption, and deployment of new technologies for commercial purposes. This is a significant opportunity for rapid gains in productivity and efficiency and is relatively low-hanging fruit.


• Facilitate Industry–Academia Linkages: The international community should support programs that foster deep connectivity and linkages between industry and academia. This could include placing top industry leaders as professors or offering mentorship programs, formalized internships, industry-sponsored research or student projects, or a wide variety of other activities that serve to connect companies with universities. Deep linkages will encourage technical education that also imparts market-relevant skills and research that targets contextually specific challenges and opportunities. USAID’s Science, Technology, Research, and Innovation for Development Project is a great example of this kind of work.21

• An Effective Regulatory Regime: The international community can play a role in providing advisory services for regulatory frameworks that ease the formation of a business, prevent undue tax burdens, and improve access to capital. It is also important to establish specialized policies for supporting innovation and entrepreneurship, including programs that facilitate access to finance, mentorship, or other professional resources.

CONCLUSION

Although there is no one model, there are common assets and attributes to which countries seeking to improve their RD&E outcome conversion can refer. In some countries, basic infrastructure is still a significant issue, but even in middle- and upper-middle-income countries, infrastructure remains a deficit. This is particularly true when it comes to specialized lab infrastructure. However, to ensure RD&E is translated into innovations that can be scaled, investments in infrastructure should be made with the consideration that they must be a component part of a larger innovation ecosystem. Given that RD&E are not always deployable, they must be supplemented with human capital and tertiary education institutions that produce specialized talent.

Highly developed human capital and strong pipelines of research, development, and engineering are a few of the necessary ingredients for achieving innovation- and technology-led growth. Neither factor, however, serves as the indispensable junction in the knowledge-to-economic-growth continuum. Without processes and capacities to link specialized knowledge to market needs, neither improved human capital nor high levels of R&D spending will translate into economic growth. Commercial opportunities are generated when knowledge is translated into new products, processes, or services that are undergirded by a sustainable business model and effective management structures.

Generally, there are not enough global fora for establishing international dialogue on approaches to translating RD&E work into commercial opportunity and economic growth. Although specific models cannot be copied wholesale, there are clearly opportunities for multistakeholder discussion that bring together different regional and functional perspectives and experience in innovation-led economic growth. Developing countries can draw upon lessons learned in established economies, but likewise, solution and approaches that are effective in the world’s “disadvantaged” economies may yield insights that can be useful in the OECD context.

Technology- and innovation-led economic growth is supported by a broader ecosystem of conditions. Effective regulation, a modern intellectual property regime, a technology-based infrastructure, education and training programs that equip a workforce with appropriate skills, and a culture that values and celebrates the risk taking inherent in innovation are all important elements in an effective innovation ecosystem.

Constructing a policy environment conducive to innovation requires effective cooperation from a diverse group of stakeholders—government, private industry, and academia, all of which play a role. Developing countries that aspire to participate in the innovation economy need to enunciate a vision that brings together these disparate actors in support of economic transformation and growth.

What role can the government have in the innovation economy? At what level—local, state, or federal—will it have the most impact? Government can both help create a base of human capital capable of participating in the innovation economy and later support these innovators once they enter the market. A country must look at its domestic laws and regulations to ensure they support innovation while simultaneously understanding and assessing its position in the broader global economy.

A country’s needs still dictate its future innovations, and the proverbial “necessity is the mother of all inventions” must continue to influence how a country translates its research into innovation. Thus, although innovations typically follow from inventions, innovation in the developing world must alternate between production and innovation, allowing critical needs to be met while also investing in emerging technology and other cutting-edge innovations.

Given the enormous disparity of needs and capabilities around the world, it is difficult to give uniform, one-size-fits-all policy prescriptions. Some developing countries have the human capital, education systems, and global firms in place to begin competing at the high end of the global innovation and high-technology economy. Other countries have a contribution to make in one or two sectors, often the agribusiness or biotechnology sectors as derivatives of agricultural activities. Still others have not begun to move up the curve.
Countries should play to their strengths when it comes to their innovation strategy and target sectors where they can build off their existing endowments or specialties. Although there are universal components for creating an innovation policy environment, it is a recipe that needs to be adapted to fit country-specific contexts.

INNOVATIONS BASED ON COUNTRY COMPARATIVE ADVANTAGE

Differences in population, development indicators, capacity, and national wealth affect the innovation decisions of countries around the world. Developing countries should seek to leverage their comparative advantages and identify industries and opportunities for innovation- and technology-led growth. Kenya, for example, might not be a suitable location for semiconductor innovation, but it is a noted innovation center for mobile payment systems because it was the first mover with the creation of M-Pesa. Kenya leads the world in mobile money, and M-Pesa—Kenya’s mobile-money system that enables people to transfer cash using their phones—is the most successful platform of its kind in the world, according to the Economist.1

Although not every country is suited to Silicon Valley–style innovation, it is possible to identify distinct areas of potential strength in almost every market. Once these opportunities are identified, catalytic seed funding can promote high-tech innovation and growth, especially among small and medium enterprises. The U.S. Small Business Innovation Research Program has done this successfully within the United States, and similar national seed funds can be used in the fields of sciences, engineering, and medicine.2

For many low-income countries, leveraging agriculture and animal husbandry for agricultural sciences and biotechnology is a clear opportunity. By enabling technology transfer, university research and training, and reliable infrastructure, governments can quickly improve productivity and increase the potential for innovation in the agricultural sector. Former president of Ghana John Kofi Agyekum Kufuor noted that when he came into office in 2001, the government “made a deliberate decision to put agricultural transformation at the heart of our ambitions to transform and tackle poverty.”3 In 2011, Ghana transitioned to middle-income country status,4 an achievement President Kufuor credits to “an abiding commitment to mobilize science, technology and innovation.”5

In some instances, a context-specific “crisis” can serve as the impetus for innovation. In the case of India, many mobile payment firms took advantage of the “demonetization” decision of Prime Minister of India.6

Minister Narendra Modi to promote digital currencies, which moves India toward a cashless society. Following the currency decision in November 2016, the mobile payment platform Paytm has seen a huge increase in transaction flow and users: the number of daily transactions is approaching 6 million, and almost half a million users add the service each day. Similarly, the ubiquity of the mobile payment system M-Pesa in Kenya can be traced to a deep distrust of banks combined with lack of access to the formal financial sector.

Although promoting specific industrial clusters is a mainstay of innovation policy, it is also important for governments to recognize that innovation is a fundamentally organic process. Government can help control the inputs but cannot dictate what will grow once the environment is established. Although policymakers can plan and promote certain types of activity, they should also be prepared to adapt based on market realities. In Kansas City, for example, policymakers hoped to promote an innovative biotech industry. Instead, what developed was the Kansas City Animal Health Corridor, which accounted for 56 percent of total worldwide animal health, diagnostics, and pet food sales in 2015. Retrospectively, given Kansas City’s historical legacy in agriculture and animal husbandry, the area was clearly uniquely suited to innovate in the animal health sector.

Countries that ignore their context-specific circumstances, endowments, and capacities will find it challenging to establish and optimize domestic innovation ecosystems, even with significant financial backing. Saudi Arabia, for example, has placed innovation at the center of its long-term economic vision. Despite having the capital to invest in innovation, Saudi Arabia has thus far failed to create an environment for vibrant domestic innovation.

In an article for Middle East Policy, the former secretary general of the Steering Committee for Saudi Innovation Ecosystem pointed out that Saudi Arabia has a lack of qualified people in science, technology, and engineering, low student enrollment, a problem with brain drain, and low public funding of education. In addition, he noted that, “despite the oil boom and financial fluidity, Saudi Arabia offers limited specialized loan and risk capital to innovation-oriented companies,” and that Saudi investors tend to be risk-averse with young ICT companies. An innovation economy cannot be purchased “off the shelf”; it requires long-term investment and commitment to shift education, regulation, and investment to support sectors with unique potential.

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EXPANDING THE BENEFIT OF INNOVATION GROWTH TO THE POOREST POPULATIONS

Improving technology and economic efficiency over the last century have undoubtedly raised standards of living, strengthened public health outcomes, and resulted in the most concentrated period of progress in human history. That said, for innovation-led economic growth to be fully realized as a broad-based force for economic empowerment, policymakers need to be clear eyed on its potential to widen inequality gaps and concentrate wealth. It is generally accepted by economists that technological development has led to greater demand for highly skilled workers and that the benefits of technological innovation have been concentrated in this group.11

Countries such as India are divided among groups that have benefited from globalization and those that live on less than a dollar a day. The beneficiaries include software graduates of some of the world’s finest technical universities that often leave the country, while the bottom 60 percent of the Indian population have still not experienced income or development gains from the technology boom.

In any given country in the developing world, there are groups that continue to face steep barriers to improving their education levels, which, in turn, limits their household income. These groups include women, ethnic minorities, and populations residing in rural or remote parts of a country. Even groups that have educational opportunities are often not being educated in fields of study that are suited for a globalized economy. Closing the gap in education is the most direct route for empowering low-income workers, including through the provision of “blue-collar” technology skills.

INNOVATION GARDENING: MACRO, MICRO, AND LOCAL POLICIES MATTER

Innovation policy environments must be fostered at the city, state, and national levels. Sound innovation strategy begins with what the OECD calls core “framework conditions”—effective macroeconomic policy, market competition, openness to international trade and investment, and functioning tax and financial systems.12 It is crucial that countries enforce laws and create incentives—including in firm formation and dissolution, land rights, and intellectual property—that empower innovators to succeed not just in their home country but in the international market.

The World Bank describes the role of government in promoting innovation as that of a gardener, supporting innovators by “providing appropriate financial and other measures ("watering the plant"); by removing regulatory, institutional, or competitive obstacles to innovation ("removing the weeds

and pests”); and by strengthening the knowledge base through investment in education and research (“fertilizing the soil”).

- **Human Capital:** This is the first necessary ingredient for any innovation- and technology-driven economy—without “fertile soil” there can be no growth. Most developing countries should start by improving access and quality in basic education to strengthen elementary literacy and numeracy. Building on this, there is an opportunity to develop specialized education programs that deliver STEM skills, digital literacy, and entrepreneurial thinking to a young cadre of innovators. These technical skills can be taught at community and vocational colleges, via programs that prepare students for future schooling as well as future employment.

At the high end, governments are responsible for encouraging and enabling private universities or developing public domestic universities that are not only capable of training world class students but also able to conduct commercial research and product development activities in partnership with the private sector. Universities can serve as key drivers of economic growth by providing the skills and knowledge needed in industry while also supporting the specific process of research and commercialization, both of which drive innovative domestic activity. For many developing countries, building connections to members of their diaspora communities is an effective way to infuse new knowledge and capital into the market. Innovation ecosystems and educational infrastructure can take time to develop, and diaspora groups can hasten the process. Diaspora members can also facilitate connections to global markets and are uniquely positioned to navigate the cultural and institutional barriers present in this process.

- **Hard Infrastructure:** Functioning infrastructure remains a major barrier in many developing countries. Transportation infrastructure improves the flow of goods, people, and ideas within a country. Consistent access to utilities like water, power, and broadband Internet also lowers the barriers to innovative entrepreneurial activity. In particular, ICT investments can serve as “general-purpose platforms for innovation and knowledge sharing.”

By ensuring broadband network availability, government will support the private sector to create “other platforms . . . and enable the development of digital content, including local content.” Federal frameworks should encourage ICT investments in private and public infrastructure, such as transport, health, and energy, to effectively modernize social services. Although the private sector has taken a larger role in ICT infrastructure development in advanced industrial economies, in developing countries government still has a role to play in ensuring access to quality and effective infrastructure as a foundational building block of the innovation ecosystem.

16. Ibid.
• **Openness to Trade and Foreign Investment:** Trade and investment are ways to accelerate knowledge and technology absorption. The OECD notes that by reducing trade barriers with a rules-based international framework, developing countries “increase the size of markets available to innovators and consumers and facilitate the spread of knowledge, technologies, and new business practices.” Countries that liberalize their economy are often rewarded with a growth in exports. Exports are an impetus for transitioning to an innovation economy because they give local innovators a large market of consumers. Given that local industries are hesitant to make any economic changes that would disrupt a planned economy, exports are a way for companies in developing countries to freely innovate in new sectors.

• **Labor Fluidity within Markets:** This characteristic is often noted in the creation myths around Silicon Valley. As a result of the Gold Rush in 1872, California decided not to enforce “non-compete” laws, which prevent employees from leaving an employer and founding or joining a competing firm. Generally, these types of regulations are seen to suppress workers’ wages by inhibiting job mobility. Since then, California has favored open competition and employee mobility, conditions that helped support the creation of Silicon Valley nearly a century later. This decision has influenced the long-term economic trajectory of the state by increasing the fluidity of human capital as talent could leave one company easily and join another start-up or start a competitor company. Silicon Valley was the beneficiary of this fluke of history.

Lowering barriers to trade and the exchange of labor and capital will not increase prosperity within the developing world unless the domestic business climate is conducive to growth. The World Bank’s *Doing Business* surveys are useful tools for identifying hurdles within the regulatory framework, including in terms of business formation and dissolution, property registration, access to credit, and contract enforcement. Although improvement in all of these areas is a long-term challenge, policymakers can utilize “a sequence of finely tuned, small, specific reforms and successful outcomes” to achieve broader transformation.

• **Incubators/Accelerators and Sources of Funding:** Incubators and accelerators also play an important role in bringing together innovation actors by providing a venue and space to engage, collaborate, and strengthen ideas. This type of platform can be hard to find in developing countries and is especially important for sectoral innovation. The top incubators have a diverse array of supporters, including for-profit companies and universities. One common area where incubators are housed is at universities, where developing countries can better capitalize on university-academia linkages.

17. Ibid., 14.
19. Ibid.
Overall, incubators and accelerators both help companies in their early launch and ensure they contribute value to the innovation ecosystem. Thus, they are responsible for maintaining both the present and future needs of innovation in the developing world. Latin America has benefited from accelerators, which have created a healthy environment of competition in the region. For example, the success of Start Up Chile, a seed accelerator, led to the launch of Start Up Peru. The Pacific Alliance, a Latin American trading bloc, has a chapter in the pact dedicated to innovation. In addition, countries in Latin America are assisted by the Inter-American Development Bank, which contributes loans and technical assistance for innovation projects in the region.

CONCLUSION

The OECD suggests that one can view regulatory reform for innovation through three lenses: economic regulation to improve market efficiency, social regulation to protect the environment and health of society, and administrative regulation to govern bureaucratic function and norms within both public and private sectors. Although each economy and society needs to determine its own specific approach to regulation in accordance with its goals and values, there are general outcomes to which regulators seeking to drive innovation should aspire. Policymakers should look to understand how regulation affects technological change, introduces competition, streamlines the regulatory process by removing duplicative requirements, and harmonizes with international regulation to encourage cross-border flow of ideas and economic activity.

Transitioning countries toward higher levels of development requires investments in innovation and technology. Human capital, infrastructure, trade, and labor fluidity all play a role in improving innovation. These various avenues of opportunity require policymaking at the micro and macro level, with local and national authorities complementing one other. The government can be effective in reducing regulations and providing policy prescriptions for local and national governments to work together on this goal.

In addition, investments in higher education that prepare graduates for technologies of the future as well as sector-specific industries that offer job guarantees are crucial. The primary goal of innovation must be to ensure that future generations of developing country workers are able to contribute substantially to economic growth and prosperity. Innovation, although concentrated in certain sectors, cannot be dominated by a few businesses, and its impact must extend to the poorest residents of a country.

26. Ibid.
Developing countries will begin their transitions at different starting points and will focus on different industries to achieve this transition. For topical areas of interests within a country, catalytic seed funding is one way to spur development while protecting the risk of development innovators. Particularly with technology in a globalized world, there are ample opportunities to see quick progress. However, the rapid change of a globalized world means that innovation is not an end but rather an ongoing component of economic and business development.
Innovation and technology have become priorities for Kenya in its quest to achieve middle-income status, a process it calls Kenya Vision 2030. In many regards, Kenya shows great development promise, including in the digital economy, noncapital intensive agriculture, and social enterprise. Kenya is also in a period of political and social mobility after a history of electoral instability and violence. Following widespread violence in the wake of the 2008 presidential election, the country rewrote its constitution; the country is scheduled to hold its second election under the new constitution in August 2017 and has projected economic growth rates of around 6 percent for the coming years. Kenya has also served as the global birthplace for digital payments for over a decade, driving mobile phone penetration and opening unique opportunities for leapfrog development.

Despite this promise, Kenya will also face significant challenges in the coming years. Rapid population growth and urbanization are stretching Kenya’s infrastructure and resources, and its overall government capacity remains relatively low. Educational achievement remains an area of weakness despite reforms and improvements over the last decade, with significant gaps at both the primary and secondary levels. Kenya has sought partnerships and strategies to assist with education reform, particularly in the fields of science and technology, and is now beginning to reap the rewards of this investment through higher rates of university enrollment.

Although Nairobi has been the epicenter of major innovations in the East Africa Community, there is still a limited support structure in place to assist burgeoning innovators. Systemic changes to research funding would yield greater economic, health, education, and agriculture outcomes,

benefiting innovators, policymakers, and citizens. All of these will be critical areas for Kenya in the coming decades. Although university enrollment has grown in recent years, this has not necessarily translated into higher-quality skills or research coming out of Kenyan universities. Generally, the quality of university research remains low, and there is limited connectivity between universities and industry—a feedback loop that is typically seen as critical for promoting market-appropriate skill acquisition and relevant research.

Despite the significant challenges across a broad array of issues—including government capacity, institutional development, infrastructure, and human capital—Kenya has developed a vibrant entrepreneurial sector with a keen interest in innovation and technology. The innovation ecosystem is still somewhat fractured—although many individual pieces are present, there is a lack of connectivity between the constituent components—but there is a great deal of optimism and activity. Empowering this cadre of disrupters to succeed through an enabling policy environment, training and education, and access to funding will be the key for Kenya as it looks to operationalize its economic transformation. Innovation and technology have the potential to open leapfrog opportunities to address social issues and drive economic growth.

**EDUCATION AND HUMAN CAPITAL DEVELOPMENT**

Kenya faces one of the largest youth bulges in the world, and the country’s ability to deliver skills and knowledge to this group will have a huge impact on its national future. Today, those under the age of 35 years represent approximately 80 percent of Kenya’s population.\(^5\) To secure Kenya’s economic future, youths must be enticed to participate in skills building and employment and then continually be trained as they participate. Donors—including the African Development Bank, which committed to significant spending on skills development in Kenya during its current five-year strategy\(^6\)—have targeted the education space with their funding.

This need has been clearly recognized by the Kenyan government, and delivering on education reform is one of the nation’s top political priorities. In 2003, the government initiated a program that extended free primary education to all citizens and followed that with a similar program targeting secondary education in 2008.\(^7\) The benefits of these programs are beginning to be felt within the university system, which has seen massive growth in enrollment in recent years as the first cadres of students offered free primary and secondary education reach college age—university enrollment grew by 28 percent between 2013 and 2014 alone.\(^8\)

Unfortunately, Kenya still has enormous issues regarding quality of and access to education. With one of the highest rates of nonattendance in the world, Kenya has high illiteracy rates even among

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7. Clark, “Education in Kenya.”
8. Ibid.
those who have at least six years of primary schooling. To address this, one well-publicized government program, launched by the Kenyan Ministry of Information, Communications, and Technology, has promised one laptop per elementary-school child in Kenya—one million laptops at a cost of over $600 million—as part of a push toward e-teaching and e-learning. The initiative is known as the Digital Literacy Programme, and the delivery of the laptops to over 20,000 public schools is set to be complete by the end of 2017.

Digital learning has been utilized as a means of bringing education to rural areas as well as slum dwellers from Kibera, the country’s largest informal settlement. Part of the push around digital learning has come as Nairobi tech companies such as BRCK have developed Wi-Fi hot spots and small servers to rural areas, much needed given that only one-third of Kenyans have Internet access. Another impetus for promoting digital learning is that historically a huge percentage of all publication in Africa, approximately 60 to 70 percent, goes toward textbooks; digitizing this part of the learning process offers cost and process efficiencies. In Kibera, young students use software called eLimu, where educational videos and courses are available on mobile phones and tablets. Given that 80 percent of Kenyan parents were paying for tuition courses for their children, there is still possible cost cutting that can result if ed-tech programs are widely adopted; for example, eLimu used micropayments per download for its courses.

The one laptop per child program has been criticized as wasteful and not directly addressing the core issues of attendance and quality. However, existing education programs are similarly criticized for wastefulness. Kenya spends twice as much money on education relative to other developing countries. Failing to deliver on digital education programming threatens the legitimacy of the current government, demonstrating the core importance Kenyans place on continuing to improve their education system. This process also suggests that strategic planning around priority setting is not strong; this could be traced to a capacity issue or lack of evidence based policymaking.

Technical and vocational education also has the potential to deliver large impacts in Kenya. In 2013, the current Kenyan administration launched the Technical and Vocational Education and Training (TVET) Act of 2013, and the Treasury Department has responded to this push by allocating KSh6 billion in funds to support the 60 technical and vocational schools as well as the 70 that are

9. Ibid.
12. Ibid.
to be constructed in the future.\textsuperscript{16} Chief executive of the Kenya Association of Manufacturers Phyllis Wakiaga pointed out that continued investment in TVET centers in Kenya will help boost Kenyan manufacturing.\textsuperscript{17}

The Alliance for a Green Revolution in Africa (AGRA) has worked with national research institutions, industries, farmers, and universities to provide trainings on new agricultural techniques. Many of these trainings are through pilot projects that encourage mechanization to cut costs and reduce harvest losses.\textsuperscript{18} These have been attractive for the growing population of youth farmers—a trend in Kenya that runs counter to the global trend toward aging farmers—who are very interested in applying new technologies, including mechanization, to farming. In addition, AGRA has connected supply companies with agro-dealers, improving the creditworthiness of “middle men” or “middle women” that, instead of being able to farm, either supply seed or fertilizer inputs or buy harvests.\textsuperscript{19} Encouraging some of these young people to stay in agriculture rather than seeking urban jobs will be important but will require large-scale investments in electricity, water resources, and agricultural technology in rural areas.

At the same time, for those seeking blue-collar jobs that are more technologically oriented, there may be opportunities to build skills to participate in the new digital economy. Training around modern technical skills like coding, for example, may be one way to provide employment in a digital, globalized future. Although coding has historically been regarded as a high-end skill, it is increasingly viewed as a potential avenue for blue-collar employment\textsuperscript{20}—a twenty-first-century equivalent to a mechanic, plumber, or electrician. In 2014, Moringa School became the third school to launch code classes in Kenya.\textsuperscript{21} Subsequently, the school received the attention of the World Bank ICT Innovation Team, which is examining the impact of the new programming and coding boot camp.\textsuperscript{22}

At the higher-education level, Kenyan universities still do not meet the highest international standards when it comes to quality of instruction and skill development. There has been widespread suspicion that universities increased their enrollment to earn higher tuition fees by accepting more applicants who failed to meet education standards. Experts have noted that the decline of Kenyan

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universities has worsened over the past 20 years. Increased university enrollment has also come at a time when Kenya is cutting funding for its higher-education system; funding fell by 6 percent in the 2015 national budget. Despite the funding cuts, there has been a growth in the number of Kenyan universities over the last decade. Today there are 22 public universities, up from 5 in 2005.

Ensuring that local universities prepare students for employment is paramount. Kenya, relative to its African neighbors, has universities that specialize in technology careers. Daystar University is well known for offering “the world’s first smartphone-based degree program for teachers.” By preparing future educators, Kenya is taking the lead on improving its education system at both the primary and university level. Other private universities, such as Strathmore, have focused on study areas outside of communications, including intellectual property, disaster management, and tools for starting businesses. These examples show that higher education can continue to promote both entrepreneurship and development in Kenya.

Graduates of both the University of Kenya and the University of Nairobi are well educated and qualified for advanced jobs but often leave for better-paying jobs abroad. To attract these highly skilled members of the diaspora, Kenya needs funding, outside linkages, and networks of collaboration. Unfortunately, a lack of high-quality teachers affects students, and the university system is not geared toward high-end jobs. Graduates are absorbed into administrative bureaucracies where they neither teach nor do research.

**TRANSLATIONAL R&D AND COMMERCIALIZATION**

Kenya’s current gross domestic spending on research and development is quite low, reflecting both its current priorities as well as a lack of capacity to conduct effective research activities. As a percentage of GDP, Kenya spends just 0.786 percent, below the world average of over 2 percent. Despite the current low levels of funding, targeted tech transfer and research and development focused on specific local challenges have the potential to deliver large gains in Kenya. Health and agriculture are two areas where Kenya faces future challenges that should serve as catalysts for innovation- and technology-led approaches to problem solving.

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26. Ibid.
27. The OECD defines gross domestic spending on R&D as the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, university and government laboratories, and so on, in a country. It includes R&D funded from abroad but excludes domestic funds for R&D performed outside the domestic economy. This indicator is measured in millions of U.S. dollars and as a percentage of GDP.
Generally, Kenyan universities have a weak capacity to conduct research and development activities. At the postsecondary level, there is a wealth of evidence about the relationship between research intensity at universities and institutes and educational outcomes for students. So, boosting knowledge and research intensity at universities makes them more competitive and productive, but it also makes for higher-quality experiences for students, better positioning them for the workforce, and therefore (if they can be retained) feeding industry a pipeline of highly qualified personnel with valuable education experiences. That, in turn, would improve industry competitiveness and change.

Typically, Kenya does not have strong industry-academia linkages, meaning that both the skills imparted and research conducted are not necessarily what the market requires. At a Linkage of Industry with Academia (LIWA) conference, Devit Desai, chair of LIWA, noted that “we need to strengthen the linkage between industry and academia from the gains we are reaping so far.” By some estimates, recent young graduates in sub-Saharan Africa are three times as likely to be unemployed as those with just a primary school education because they do not end up in careers within the informal sector, which is still widespread. Further gains in commercial innovation depend on improved industry-academia linkages.

There are examples of private-sector research collaborations with universities as well as nonprofit cooperatives with universities. Safaricom has partnered with Strathmore University to provide skills and training for entrepreneurs in the telecommunications space. Similarly, AGRA is working to build entrepreneurship capacity by collaborating with universities to provide trainings. Partnerships allow AGRA to advance goals even when they lack the capital.

IBM has made significant investments in Kenya, opening its first industrial research center on the African continent in Kenya in 2012. It has sought to use this center for specific, targeted research that will have a significant impact on the continent. In launching the Nairobi THINKLab, IBM noted that Kenya’s facility would allow clients and partners across both the Middle East and Africa to get more exposure to IBM analytics. Nairobi’s tech culture as well as its geographic presence appeared to be a factor in IBM’s investment. For example, IBM has entered the education space by utilizing Watson as a learning companion, utilizing open technology, and teaching at universities. IBM’s Seed Investment Management Program within the University of Nairobi is focused on agriculture.

Kenya does have some inherent resources and advantages that it can leverage to drive innovation-led growth. The Natural Products Industry Initiative, which targets the innovative use of natural

products, has made strides in biodiversity and the marketing of health products found in Kenya.\textsuperscript{35} A focus on drug production and new molecules has meant that countries come to Kenya to do clinical trials. In addition, Safaricom’s M-Pesa serves as the global leader in the mobile payments space and has made Kenya the destination of choice for entrepreneurs working on mobile-based payment systems.

The translation of research and development into multidisciplinary policy has remained a challenge. Government investment in technology and infrastructure is needed even though it may be 10 to 15 years until the country sees successes. Although some technological innovations exist in Kenya, primarily driven by frugal innovation, they are not yet capable of being scaled in the current environment. There are many technology startups in the agriculture sector, and some of these enterprises are getting funding from abroad. A challenge is that the Kenyan venture financing apparatus is not sufficiently developed to support start-ups through the full funding life cycle.

Technology transfer may be a logical approach for the government given limited resources and capacity, as well as the clear gains that could be had in terms of agricultural productivity and health outcomes, to name a few impacts. The government should continue to work constructively with companies that supply technology via foreign direct investment. Kenya’s own government has had a history of using ministerial engagement with foreign enterprise.\textsuperscript{36} This can be seen in IBM’s recent efforts to improve Kenya’s Ease of Doing Business Index, which involved a partnership with Kenya’s Cabinet Secretary for Industry, Trade, and Cooperatives.\textsuperscript{37} To improve this ranking and break the top 50, Cabinet Secretary Adan Mohamed, admitted that technology would be a crucial input.\textsuperscript{38}

\textbf{INNOVATION POLICY ENVIRONMENT}

Kenya’s innovation policy environment remains in a nascent stage, with core challenges remaining in terms of individual institutional development as well as connectivity of these institutions within the broader ecosystem. NACOSTI was created by an act of Parliament to advance STI in Kenya and serves as the pillar institution in Kenya’s attempt to develop an innovation- and technology-led economic growth trajectory. Assigning this core responsibility is a good start as the government seeks to purposefully promote innovation- and technology-led economic growth.

In many cases, the most important contributions that can be made to Kenya’s innovation ecosystem involve improving basic inputs. Infrastructure, for example, remains a significant gap in Kenya and serves as a fundamental hurdle to innovation. One of the key sectors targeted in Vision 2030

\begin{itemize}
\item \textsuperscript{36} Goel Cohen, \textit{Technology Transfer: Strategic Management in Developing Countries} (New Delhi: Sage Publications, 2004).
\item \textsuperscript{38} Ibid.
\end{itemize}
is infrastructure, with a focus on energy and transport infrastructure. Basic policy around business formation, bankruptcy, and intellectual property could also be strengthened to provide a more business-friendly environment. There is progress being made on this front—Kenya rose 21 spots in the Doing Business 2017 report to 91 out of 180, ranking as the world’s third most reformed country.

Power Africa has been very popular in Kenya, with Kenyan stakeholders expressing interest in it, continuing to deepen trade relationships, and raising the Overseas Private Investment Corporation lending limit. Despite the success of Power Africa, most infrastructure and power providers within Africa do not have much faith in larger political projects, and there is an interest in translating the financial power of larger projects into things that are more bankable.

Incubators and accelerators have begun to grow on the African continent. Within the region, the biggest challenge has been the lack of mentors and entrepreneurs that can utilize the “tech hub” space. There is a supply of incubators but a deficiency in start-ups that need services. Fortunately, this is less of an issue in Kenya. Ushahidi, a company that provides open-source software, gained a foothold in Kenya in 2008, and in 2010 Nairobi spawned iHub, a globally noted technology incubation center. In 2015, 150 start-ups were responsible for 1,300 jobs, and many of them used iHub to exchange ideas, practices, and financial support. In addition, start-up support has come from the University of Nairobi’s Fab Lab, a global initiative that provides machinery access and online training to new ventures.

Aside from closing obvious infrastructure gaps, there is also a need for forums and networking functions to bring together the diverse community of entrepreneurs, funders, mentors, academics, and donors that are operating in Kenya’s innovation space. Although there are pockets of interesting activity, there seems to be a lack of coherence and connectivity between the core actors in the ecosystem. There are some incubators and accelerators that seek to bridge this connectivity gap—the most prominent example would be iHub, which serves as an unofficial capital for the Nairobi technology community. Notably, iHub helped start Gearbox, “a design and rapid prototyping facility” located in Nairobi’s industrial area.

43. “About Safaricom Academy.”
45. “African Universities Recruit Too Many Students.”
46. “About Safaricom Academy.”
47. Ibid.
CONCLUSION

Kenya is a country that is simultaneously undergoing massive change and progress while still struggling with basic challenges, including education, infrastructure, and access to finance. Some of these challenges will take decades to address; in the meantime, there are specific areas on which Kenya can focus to deliver short- and medium-term results while setting itself up for long-term economic transformation. A key starting point would be strengthening its national capacity to act and operationalize its existing STI strategies. This is an issue the government recognizes it must correct.

Another priority area for improvement is Kenya’s education system, with a clear focus on primary and secondary education, where enormous gaps in both quality and access persist. Improving the quality of basic education will have a broad-based effect on the overall human capital in Kenya, driving both economic productivity and disruptive innovation that Kenya needs to address pending challenges. As Kenya continues to grow and urbanize, it will face rising demands for food, energy, and water as well as new and emerging health challenges.

Kenya’s significant reform efforts, including in education, business regulation, and infrastructure development, can help position it as the destination of choice for African innovators and entrepreneurs. Combined with unique competencies in mobile payments and telecommunication broadly, Kenya could serve as the epicenter for a grassroots form of innovation that provides leapfrog advances in industries ranging from finance to health and agriculture.
Malaysia Case Study

Malaysia went through several decades of high economic growth that resulted in poverty reduction and improved human development. In particular, Malaysia moved up the value chain in manufacturing and translated commodity wealth into economic growth—the result was that total income rose at a rate of 6 to 7 percent every year from 1970 until 2000.1 Despite this success, Malaysia also faces a series of challenges that have prompted the national government to strongly promote innovation- and technology-led economic growth.

One of the key goals of the current political coalition headed by Prime Minister Najib Razak is to achieve high-income status by 2020,2 and innovation-led economic growth will play a critical role in realizing this aspiration. Prime Minister Razak has explicitly addressed the imperative for Malaysia to continue its economic growth trajectory, noting that Malaysia “cannot and will not be caught in the middle-income trap.”3 Promoting innovation has become a key issue “in a context of low farm productivity, increasing health-related problems, natural disasters, environmental problems, and even monetary inflation.”4 A shift away from commodity exports fueled Malaysia’s previous economic transformation; Malaysian policymakers think that innovation will fuel the next transformation.

The government of Malaysia is uniquely positioned to pull the appropriate economic and political levers to instigate this change and has embarked on a purposeful process to strengthen the

4. “Can Malaysia Avoid the Middle-Income Trap?”
innovation ecosystem. This process involves creating specific agencies to manage and oversee key sectors, issues, and challenges. For example, the Performance Management and Delivery Unit (PEMANDU) was created in 2009 to spearhead the national Government Transformation Programme and Economic Transformation Programme in support of Malaysia’s goal of becoming a high-income country by 2020; the Agensi Innovai Malaysia (AIM) was established in 2010 to jump-start the creation of a Malaysian innovation ecosystem; and the Malaysian Global Innovation and Creativity Centre was launched in 2014 to support aspiring entrepreneurs in the technology and innovation space.

The government also chose to target specific sectors, products, and materials where it perceived potential opportunity, including biomass and biotechnology, electronics, and graphene. Graphene, an advanced material, is an especially interesting example of Malaysia directing resources to a key area of opportunity. Not only is graphene potentially useful in a broad array of applications and industries, it is also derived from a production process that could rely on locally sourced Malaysian biomass. The choice to focus so specifically on a discrete opportunity where Malaysia believes it has a competitive edge demonstrates the purposeful and targeted approach the government has taken in attempting to spur innovation and growth.

For Malaysia to achieve its goal of reaching upper-income status by 2020, it needs to raise its projected growth rates from about 4 percent up to approximately 6 percent in the coming years. To reach these higher rates of growth, innovation will be absolutely necessary. Interventions that target education and human capital development, university capacity, and research and development will play a large role in realizing Malaysia’s ambitions. So, too, will programs that seek to improve productivity in Malaysia’s large small- and medium-sized enterprise (SME) sector to drive scalability and international competitiveness. Malaysia has also focused on an effort to modernize the palm oil sector as it celebrates the industry’s 100th anniversary. Malaysia’s ability to realize its national vision for an innovation-led transformation will hinge on the effectiveness of these interventions over coming years.

EDUCATION AND HUMAN CAPITAL DEVELOPMENT

Malaysia’s education system is a by-product of its colonial past and has meant that the country is generally English proficient in writing. A nationalization push that occurred in the 1980s led to a decline in spoken English. However, some fracturing has occurred in national education.

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9. “Can Malaysia Avoid the Middle-Income Trap?”
country currently has five types of schools. Two of these, the Chinese and English, focus on rote memorization. The 11 years of primary and upper secondary education is free, and primary education is compulsory. Investments in basic and primary education offer a high return for countries like Malaysia that are not overburdened with the type of health dangers that affect cognitive learning for youths.

In the last decade, Malaysia has seen large increases of preschool enrollment (51 to 67 percent of eligible children) and has maintained primary school enrollment rates upward of 95 percent since 2005. Malaysia lags on secondary education enrollment when compared with similar countries in the region. Secondary education enrollment in Malaysia has held steady at around 69 percent for the past decade; Japan and the Republic of Korea both have secondary education enrollment rates upward of 95 percent.

Beyond extending access, there have also been efforts to change curricula and learning approaches to foster greater creativity and critical thinking. Education changes, in the form of design thinking and International Baccalaureate, are meant to prepare students for university and workforce training. The response to these changes has been positive for students. However, adults need to adapt to these changes and realize their impact can lead students toward high-earning careers that are outside of traditionally acceptable occupations like medicine, law, and accounting. Shifting cultural attitudes toward pedagogy at the primary and early secondary school level is as important as investments in higher education.

Since the mid-1990s, central planning by the Malaysia government has restructured higher education in response to globalization and increased economic competition worldwide. The Ministry of Higher Education was created in 2004 and quickly put into place new strategies to transform higher education as part of the national transition toward a knowledge economy. In large part, these reforms served to broaden access. Malaysia reached a higher education enrollment rate of 48 percent in 2012, representing a 70 percent increase over 10 years. Advanced degree programs have grown at an even faster rate, with master’s and PhD program enrollment increasing tenfold between 1990 and 2010. Despite this growth, Malaysia’s tertiary education enrollment

14. Ibid.
16. Ibid.
18. Ibid.
rate still trails other advanced economies in region. In addition, the quality of higher education needs improvements even as progress is being made in higher education access.

Relative to its peers, Malaysia invests an extremely high share of GDP in tertiary education. Its expenditure to GDP was 1.5 percent in 2013, which was higher than that of more advanced economies such as South Korea and Singapore. This has translated into improved quality: the World Economic Forum ranked Malaysia 14th globally on “quality of the educational system,” but there is still progress to be made. Malaysia still does not have a top 100 Asian university per the QS World University ranking: Hong Kong, India, Singapore, and Saudi Arabia all have universities that have been rated in the top 100 institutions in recent years. Identifying investment inefficiencies and reallocating these funds to continue to drive higher tertiary education quality will be a crucial next step in Malaysia.

TRANSLATIONAL R&D AND COMMERCIALIZATION

Malaysia is working hard to improve the economic and social returns on its R&D spending to strengthen domestic innovation capacity as well as localized problem solving. Improved domestic innovation capabilities often result in productivity and economic output growth. A strong national pipeline of R&D is one way to improve innovative capacity, but Malaysia is still below the global average in R&D spending. As a percentage of GDP, Malaysia’s R&D spending was 1.26 percent in 2014, below the world average of 2.12 percent. This is a significant improvement, however, from the 0.2 percent R&D expenditure in 1996.

The core problem, however, extends beyond total spending. Although Malaysia should seek to raise its total spending, it also needs to target the efficiency of research funding allocation. In a 2015 assessment of Malaysia’s innovation ecosystem, the World Intellectual Property Organization found that Malaysia had a poor performance on the efficiency of its innovation investments and suggested that this indicated “a need to review government policies concerning the implementation of government sponsored R&D funds in the country.”

The clear majority of R&D spending goes through higher education institutions, which are responsible for 80 percent of R&D funding in the country. Given this trend, improving the quality of R&D outcomes coming out of the university systems, with a particular focus on the translation of

this research into commercial opportunities, should be a clear priority for Malaysia. An easy step toward operationalizing this change would be improved industry-academia linkages; not only would this align the education and skills imparted by universities with market needs, it would also result in an allocation of research funding that was more relevant and high impact. Malaysia has made a series of efforts to improve the quantity and quality of industry-academia collaborations, including the Collaborative Research in Engineering, Science, and Technology, which brings together, industry, academia, and government around R&D projects.27

Large companies can also drive forward in-house innovation as they internalize capacities and resources needed for effective R&D. More than that, these businesses can drive efficiency gains at their periphery when they source services and products from other local businesses. Unfortunately for Malaysia, its neighbor Singapore offers some of the most favorable business conditions in the world, including a 400 percent tax deduction on R&D spending that encourages companies to choose to locate to the smaller city-state over Malaysia.28 Competition from Singapore, a neighbor that is highly developed, should motivate Malaysia to ease regulations and strengthen intellectual property laws, streamline the research process, and provide incentives for companies to locate research facilities in Malaysia.

In Malaysia’s case, structural challenges inhibit more efficient R&D processes as many of the largest firms are directly or indirectly controlled by the government. Although these are the most advantaged businesses in Malaysia in many regards, they are often required to give their profits back to the state rather than engage in forward-looking, risk-taking activities such as R&D. AIM is seeking to change this, encouraging larger companies to copy the example of Korean conglomerates in helping launch start-ups and universities as part of a broader cultivation of the innovation ecosystem.

Many of the largest enterprises in Malaysia are classified as government-linked companies (GLCs), and GLCs account for more than a third of the Malaysian stock exchange’s capitalization.29 This means that key decisions at many of Malaysia’s most influential companies are still made by corporate boards heavily populated by public officials. Historically, this has led to risk-averse investment, but moving forward it represents an opportunity for the government to change cultural norms around R&D in the country. The government could decide to direct the G20 companies—a selection of the largest GLCs—to lead by example and engage in higher-risk investments in R&D. This example could change the business climate of the country and lead to nonstate-backed companies making similar changes to their R&D practices.

Malaysia has launched the Public Private Research Network (PPRN) to examine various models on university-academia collaboration and improve Malaysia’s approach.30 The Ministry of Higher Education, which administers the PPRN, also sits on the Steinbeiss board, a German model where the government matches a private-sector company with an academic to solve an unmet

need. The newly established Research Management Agency can play a coordinating role for providing advice to SMEs. This function is supported by SME Corp., which manages policy, strategy, and assistance schemes for SMEs in Malaysia.

INNOVATION POLICY ENVIRONMENT

With its centralized government, Malaysia can engage in top-down planning to address long-term needs. So far, this has entailed a purposeful approach with policy experimentation aimed at promoting a distinct form of Malaysian innovation. Its own history as a multiethnic society has led to a clear willingness to draw on pieces and segments of innovation systems that have been effective elsewhere around the world, including in Asia and the OECD. Malaysia is a “cash-rich” country with a competent government willing to make long-term investment to promote innovation and evolve its economy.

From a regulatory perspective, Malaysia has one of the most effective and business-friendly regimes in the world. The World Bank’s Doing Business index ranks Malaysia 23rd out of 190 countries on the overall ease of doing business, with notably high rankings on getting electricity, protection for minority investors, access to credit, and dealing with construction permits. These are key indicators for foreign investment and business formation. The challenge for Malaysia, in this regard, is that Singapore ranks in the top five in virtually every Doing Business category. Successful investors, entrepreneurs, and businesses in Malaysia will always be tempted to hop the border to Singapore, applying a perpetual pressure on Malaysia to continue to improve its business environment.

Malaysia has a broad constellation of institutions that seek to provide support for the various actors operating in the innovation space. The new Research Management Agency was created to more effectively manage the allocation of research funding; the National Science Council was also recently created to provide long-term strategic focus and facilitate government coordination. AIM, as previously mentioned, was created with the explicit goal of providing a cross-cutting perspective on innovation needs throughout the Malaysian economy. PEMANDU, an entity that brings together the public and private sectors and oversees AIM, has highlighted social innovation and strategic sectors as means to streamline growth and development.

Although many of these are well-respected and capable organizations, the result has been an STI governance system characterized by “a multiplicity of advisory committees and councils as well as ministries, agencies, etc.,” each engaged in separate but often overlapping functions. An OECD assessment of Malaysia’s innovation ecosystem concluded that this atomization of government governance system characterized by “a multiplicity of advisory committees and councils as well as ministries, agencies, etc.”

bodies in the innovation space has harmed coordination and that a clarification or consolidation of some of these agencies would lead to higher impact at lower cost.36

CONCLUSION

Malaysia’s history of economic diversification and steady progress toward higher per capita income was the result of careful investment and stewardship of natural resource–derived wealth. It is an enormous success story: in 1970, roughly half of Malaysia’s population lived on less than the equivalent of $1 per day;37 today, less than 4 percent of the population falls below the national poverty line.38 Now Malaysia needs to drive forward a similarly dramatic shift to launch itself into a higher income bracket.

There are select areas where Malaysia is uniquely competitive, such as plastics, rubber, and palm oil. Malaysia has also looked to build off these traditional strengths and move up global value chains. Malaysia has leveraged many of its largest corporations to drive forward this kind of innovative R&D work but also sees opportunities to integrate SMEs more effectively into the innovation process.

Malaysia has both the ambition and capacity to vault itself toward innovation-led economic growth and has placed this goal at the center of its future economic strategy. The effectiveness of this strategy will come down to effective implementation of the broad changes and reforms and the ability of government agencies to coordinate and provide a coherent and supportive innovation ecosystem. Much like its focus on strategic sectors, Malaysia’s governing agencies must have clear roles and mandates.

36. Ibid.
37. Yusof and Bhattasali, “Economic Growth and Development in Malaysia.”
38. Ibid.
Gujarat is known throughout India for its business-friendly environment, a reputation and reality fostered carefully through targeted infrastructure investment, limited regulation, and efficient government. Its challenge today is how to turn its business-friendly climate into one conducive to driving innovation. Gujarat has enjoyed economic growth rates that averaged 10 percent annually from 2004 to 2014, exceeding the Indian national average for that period.\(^1\) Although much of this growth has been driven by large-scale industrialization in the state—some of India’s largest companies, including Tata Group and Reliance Industries, have a large presence in Gujarat—small and medium enterprise plays a key role in driving growth and employment.

Prime Minister Narendra Modi served as the chief minister of Gujarat from 2001 to 2014. His success in building a technocratic government and driving economic progress helped propel him to higher office. Prime Minister Modi is extremely popular in Gujarat, and his party, the Bharatiya Janata Party (BJP), has retained a strong grip on the Gujarat Legislative Assembly as well as other levers of political power for over a decade.\(^2\) This continuity created the opportunity for a unified and long-term economic vision that was pursued at nearly all levels of government.

The resulting “Gujarat Model” has been so successful that it has, at least in part, been copied at the national scale as part of the prime minister’s new economic plan. A core part of this economic vision has been the promotion of innovation and entrepreneurship. Historically, Gujaratis have been highly entrepreneurial. For centuries Gujarat has been a trade hub with strong economic connectivity to the rest of India and the region. A strong network of interlocking institutions supports this ecosystem, including through government-funded programs, specialized training institutes, universities, and business incubators and accelerators. These institutions are interconnected to an impressive degree and form a coherent ecosystem for enabling

entrepreneurship and economic activity that is paired with an enabling legal and regulatory environment.

Although there is a high level of entrepreneurship, it is not clear to what extent this has translated into truly innovative or disruptive business activity. Anecdotally, most of the small and medium businesses in Gujarat fit a traditional mold—providing an existing product or service to meet a perceived market need. There is a clear ambition—on the part of both government and nongovernment actors—to push for higher value-added economic activity, and accordingly, many of the institutions in Gujarat are steering entrepreneurs toward technology- and innovation-driven sectors and ideas. As increased human capacity and readily available start-up funding continue to decrease the availability of “low hanging fruit”—that is, simple variations on existing or traditional businesses or products—there is a clear opportunity for Gujarat to take the next step toward technology- and innovation-led economic growth.

EDUCATION AND HUMAN CAPITAL DEVELOPMENT

Overall, India has one of the largest and most capable human capital endowments in the world. This is true within the domestic population but also within the Indian diaspora, which is the largest such population in the world. Education has been a key focus of the Indian government for decades, and the Indian higher education system, particularly the twenty-three Indian Institutes of Technology, is held in high esteem around the world and has engaged in collaboration with top private-sector companies such as IBM.

Although this is true at an aggregate level, India also boasts significant education gaps, particularly at the primary and secondary education levels. Extending access and quality at the primary level would be a significant force for broad-based economic empowerment and growth. India still ranks relatively low on human development indicators, including with regards to education. Particularly given Gujarat’s rural nature when compared with many other major states, extending access and improving quality to all students is a significant challenge. A 2015 survey found that Gujarat has roughly 34,000 primary schools across more than 14,000 villages in the state, but the high number of schools has not translated into positive educational outcomes.

Despite this impressive number of schools, Gujarat still ranks poorly even within India when it comes to the provision of basic and secondary education. One of the few criticisms of the Gujarat government during Modi’s tenure as chief minister was its lack of improvement on education

5. In 2015 Human Development Index rankings, India ranks 130th.
metrics. Gujarat ranked in the bottom half of all states when it comes to providing primary education, a ranking that holds true across gender and age groups.\(^7\) Enrollment rates for the age group of 15 to 19 are very poor, indicating a challenge to transition primary students into secondary enrollment.\(^8\)

Although there is clearly a need to expand the provision of basic and secondary education, Gujarat has an impressive set of top-tier higher education institutions that produce highly capable graduates with a cross-disciplinary set of skills. In addition to hosting two of the signature Indian universities—the Indian Institute of Technology Gandhinagar and the Indian Institute of Management Ahmedabad—the government of Gujarat recognizes a total of 50 universities and research institutions in the state.\(^9\) This concentration of human capital is impressive and leads to a diverse and deep pool of highly capable talent. Many of the universities specifically funnel their students toward entrepreneurship and innovation-centric activities. A 2014 study determined that there were over 80 incubators and accelerators in India, many of which are located at research institutes within universities.\(^10\)

**TRANSLATIONAL R&D AND COMMERCIALIZATION**

India is one of the global leaders in research and development spending on aggregate and has a clear opportunity to continue building on that leadership through improved quality of research, higher spending, and continued investment from global companies. India accounted for $13.4 billion in globalized engineering and R&D spending, representing some 40 percent of the global total.\(^11\) Given the rate at which India produces engineers—80 percent of Indian 16-year-olds identified engineering as their top career choice in a recent survey\(^12\)—the proliferation of engineering R&D is no surprise.

As chief minister, Narendra Modi had a clear focus on attracting investment from large industrial actors as a means of stimulating growth. One key issue that then minister Modi tackled was infrastructure, particularly through power-sector reforms and road spending. When he was elected in 2001, the power sector in Gujarat was inefficient and failing to meet demand; by 2012, Gujarat was producing a surplus of over 2,000 megawatts.\(^13\) Similarly, he drove reform in the road

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8. Ibid.
sector—shifting the government from provider to manager of road infrastructure—that the World Bank has pointed to as a global example.\(^{14}\)

These investments, along with broad regulatory reform, quickly made Gujarat the darling state for several of India’s largest firms. One example is Gujarat’s famous wooing of Tata—India’s most successful and influential company\(^ {15}\)—which led to large-scale infrastructure investment and the establishment of an auto industry in the state.\(^ {16}\) Tata’s Nano project, which focused on the building of small cars, was moved from West Bengal to Gujarat in 2008, with Ratan Tata describing Gujarat’s “reputation” and “speed” of provisions as key reasons for the move.\(^ {17}\) These large companies have the internal capacities and resources to conduct their own research and development and can deliver spin-off benefits to the larger community by developing a concentrated pool of talent while also procuring additional goods and services from local enterprise.

Another area of opportunity for Gujarat lies in technology transfer, particularly in the agricultural space. Although Gujarat is urbanizing rapidly—the urban population grew by 36 percent between 2001 and 2011\(^ {18}\)—agriculture is still a significant contributor to economic output and employment. Gujarat’s rural development commission has several programs that aim to provide modern technology to agricultural producers throughout the state, and there have been positive results—Gujarat’s agricultural growth has far outstripped the national average.\(^ {19}\)

**INNOVATION POLICY ENVIRONMENT**

Gujarat has a very well-developed ecosystem of institutions and individuals that form a coherent and interconnected network for promoting innovation and entrepreneurship. Favorable business regulation is the foundation for Gujarat’s economic success, and throughout Narendra Modi’s tenure as chief secretary, Gujarat steadily improved on state rankings for economic freedom within India. Starting in 2012, Gujarat was ranked the highest on economic freedom among all Indian states, on the basis of “economic governance, state level reforms, and inclusive economic growth.”\(^ {20}\)

The state also boasts an impressive cadre of institutions focused specifically on promoting entrepreneurship and innovation in Gujarat. The Entrepreneurship Development Institute of India (EDII) has been operating out of Gujarat for more than 30 years and serves as the backbone institution for entrepreneurial training in India.21 With the launch of the Startup India campaign in 2016,22 institutions like EDII took on an elevated national importance; there has been a proliferation of similar institutions in recent years.

Gujarat is unique in its concentration of top-tier institutions across the disciplinary spectrum. In addition to the Indian Institute of Technology Gandhinagar and the Indian Institute of Management Ahmedabad, Gujarat is also home to the National Institute of Design,23 which aims to bring design thinking and approaches to a series of sectors and challenges. One observer in the higher education space noted that Gujarat is the only state with top-tier management, engineering, and design schools.

These institutions of higher learning are complemented by a series of incubators, accelerators, and entrepreneur networks that specifically target early-stage entrepreneurship. Through the Department of Science and Technology, the government of India provides a multitiered funding system that supports start-up and scale-up for Indian entrepreneurs. Rather than distribute this funding directly, the government provides the funding to partner with incubators and accelerators that leverage their expertise and local networks to identify and develop promising ideas and entrepreneurs. The government has also been relatively willing to accept that not every business emerging from these programs will be a commercial success; this is a long-term and enlightened approach to start-up funding.

Although many of the incubators and accelerators in Gujarat are housed within universities, there has also been a proliferation of private networks and institutions to support innovation and entrepreneurship in the state. The National Institute of Design, Ahmedabad University, and Indian Institute of Management Ahmedabad all boast their own incubation centers: the National Design Business Incubator, Venture Studios, and the Center for Innovation Incubation and Entrepreneurship, respectively. The International Centre for Entrepreneurship and Technology (iCreate) was also recently formed as an autonomous center to specifically promote high value-added “next-generation” entrepreneurship.24

These institutions work together through both formal and informal networking mechanisms. For example, the Indus Entrepreneurs Ahmedabad explicitly serves to connect Gujarati entrepreneurs with funders, mentors, and business partners in Gujarat and around the world.25 The network of

linked institutions is also growing; in 2016, Gujarat had 20 incubators officially recognized under the Startup Scheme of Gujarat, with another 18 proposals under consideration.26

CONCLUSION

Gujarat has a compelling story of economic transformation that brings together competent and forward-looking government, effective management of public resources, and the development of nongovernmental networks of entrepreneurs and innovators. The narrative of economic development in Gujarat was strong enough to propel Narendra Modi into the prime minister’s office and has subsequently become the model for India’s broader economic vision.

Despite this impressive storyline, there are gaps in Gujarat’s development. The growth in Gujarat has been far from inclusive, and Gujarat continues to struggle on key human development indicators, including basic education and poverty. The HDI, a composite index of three indicators (consumption, education, and health), shows that 10 states, particularly in south and central India, have higher HDIs.27 The rural poverty rate in Gujarat stands at about 21 percent, whereas the urban poverty rate is lower, at roughly 10 percent.28 This is a significant improvement from the early 2000s when rural poverty approached 40 percent, but closing the gap on the urban rural income divide will take continued time and effort.29

It is also not clear that Gujarat’s focus on entrepreneurship is leading to innovation- and technology-led economic growth. Although there has been success in promoting entrepreneurship, so far most entrepreneurs in Gujarat pursue conventional-type businesses—continuation of family businesses and the expansion of existing stores and shops selling well-known products and services to people in new areas.

Encouraging entrepreneurs and investors to tackle larger challenges through innovative products, processes, and business models—and doing so in an inclusive way—will be the next step for Gujarat as it looks to continue its arc of development and progress. Addressing coming challenges in the medical space as the Indian population begins to age, for example, would be a logical and forward-looking step toward innovative, high value-added economic activity.

29. Ibid.
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Innovation-Led Economic Growth
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