FII INSTITUTE
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GLOBAL FUTURE OF WORK REPORT

SERIES 5

THE ASIA ADVANTAGE: HARNESSING TECHNOLOGY AND TALENT FOR A FUTURE-READY ECONOMY

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KNOWLEDGE PARTNER

McKinsey & Company

PREFACE

FII Institute is pleased to launch the fifth edition of the *Global Future of Work Report*, which examines the state of labor markets in Asia and the challenges that the highly diverse region faces as it looks to harness emerging technologies for the future of work.

The first edition, *Preparing Labor Markets in MENA for a New Technological Era*, identified the economic gaps and opportunities between the Global North and Global South, with a focus on the Middle East and North Africa (MENA). The second edition, *The Future of Work in Latin America*, analyzed that region's productivity slowdown, human capital challenges, and readiness to adopt automation and AI. The third edition, *The Future of Work in Europe*, explored how advanced economies are navigating demographic aging, rising automation, and shifting competitiveness. The fourth edition, *The Future of Work in Sub-Saharan Africa*, examined the challenges faced by the world's youngest region as it seeks to transform a bulge in the youth population into a demographic dividend rather than a liability.

This report highlights how Asia has reaped the benefits of a productivity surge over the past three decades that has led to substantial economic and labor market growth. It also delves into how the region can sustain its growth and continue narrowing the gap with more developed economies.

The challenges of AI and automation technologies will be quite different for Asian economies with aging populations and advanced economic structures—such as China, Japan, Singapore, and South Korea—than for those with younger populations but less mature economies, such as India and countries in Southeast Asia. Regardless of where they start, if countries adopt AI and other technologies and adapt them well to the local context, the impact across Asia will be a significant uplift in growth and productivity.

To inform the analysis, we surveyed nearly 1,700 business executives and almost 1,000 young people across nine Asian countries. These surveys captured perspectives on skills, education, technology adoption, and job preparedness. Scenario modeling assessed the potential impact of automation and AI adoption on employment and productivity, while country-level segmentation highlighted the region's diverse economic trajectories.

Taken together, the findings confirm that productivity, human capital, and technological readiness will be decisive in Asia as in MENA, Latin America, Europe, and sub-Saharan Africa. The path forward will include focusing on skills development, not just for youth but also for mid-career employees; building out enabling digital infrastructure; and encouraging more investment from patient capital. Given Asia's importance to the global economy, its ability to manage the transition to an AI-driven future of work will affect not just the region but the whole world.

This report has been developed in collaboration with McKinsey & Company as knowledge partner. McKinsey research and insights have contributed to shaping the analysis and recommendations. We hope the report serves as a valuable guide to policymakers, business leaders, and investors seeking to harness Asia's energy and innovation to build more productive, competitive, and future-ready economies.

EXECUTIVE SUMMARY

The future of work and its implications begin with the workforce—a dynamic ecosystem of education, skills, and experience that is being transformed as technology emerges as the decisive force shaping competitiveness, productivity, and growth across countries and companies alike. By extension, Asia's next era[1] will be defined by its workers' ability to grasp two opposing realities: On the one hand, economies with aging populations and slowing productivity growth need to automate to ensure future growth; on the other hand, youthful economies must create jobs and remain competitive even as AI and automation take hold. The ability of the region's workers to learn new skills and leverage the latest technologies will determine whether Asia remains the world's growth engine or slows as it matures.

Asia's rise as the world's growth engine

The transformation of Asia's workforce over the past three decades, and its adaptability, have rewritten the global economic map. Asia has become the world's primary driver of growth, contributing roughly 44% of total global expansion[2] and lifting hundreds of millions out of poverty.[3] In the past 30 years, the region's GDP grew at nearly 5% a year,[4] with productivity improvements accounting for almost 80% of that growth. Urbanization surged from 32% to 51%,[5] education levels rose sharply, and more than 100 million workers[6] moved from farms to factories, offices, and digital networks, reshaping global labor and supply chains.

Three reinforcing trends have propelled this transformation: a massive accumulation of human capital, most evident in rising educational standards; a relentless growth in competitiveness; and favorable demographics that led to a young and abundant workforce. Tertiary enrollment multiplied, vocational training became more widespread, mid-career skilling efforts began to take root, formal employment expanded, and industrial upgrading fueled productivity gains. Beneath this extraordinary rise lies a deeper reality: There is no single "Asia." Rather, five distinct Asian segments, each with its own economic maturity, demographic profile, and technological readiness, are now evolving along diverging paths.

Diverging segments, shared momentum

Advanced Asia—Japan, Singapore, and South Korea—combines world-class education, deep capital markets, and sophisticated industries. But with some of the world's oldest populations, advanced Asia is challenged to sustain growth as labor pools shrink. Productivity gains have slowed, particularly in services, where output per worker remains only about half that of the United States. Technology adoption is also uneven: Only 64% of Japanese executives responding to our survey[7] expect their companies to deploy AI within five years, and smaller firms lag behind large ones. These economies must accelerate both automation and reskilling to sustain competitiveness and counter the demographic slowdown.

China, the region's industrial and innovation anchor, has achieved one of the most dramatic productivity transformations, growing tenfold over the past three decades. Growth remains robust but has moderated from nearly 8% to about 5% as investment returns decline and the population ages. More than 90% of Chinese youth

1 In this report, "Asia" comprises 32 countries. For the full list of countries, see the technical appendix.

2 Estimated as ratio of absolute change in Asia's GDP to absolute change in global GDP, GDP (constant 2015 $), World Bank.

3 In China alone, 800 million people were lifted out of extreme poverty between 1990 and 2024, with similar patterns in the rest of Asia; see *Data Blog*, "Getting to zero: Focusing on IDA countries for ending poverty," blog entry by Henry Stemmler et al., World Bank, November 21, 2024.

4 1993-2023 compound annual growth rate (CAGR), GDP (constant 2015 $), World Bank.

5 Urban population (percent of total population), World Bank.

6 "Employment by sex and economic activity — ILO modelled estimates, Nov. 2024," International Labour Organization (ILO).

7 FII Future of Work Survey 2025.

> **Asia's next wave of growth will depend not on labor quantity but on labor quality—strong skills, adaptability, and the capacity to work productively alongside technology.**

report a mismatch between education and job requirements, although many bridge the gap through internships and practical experience. From a technological standpoint, China is leading the way with more than 3.5 million STEM graduates each year and roughly 70% of global AI patents. To succeed in its next phase, China will need to spread innovation beyond its major hubs so that smaller firms and regions can benefit from its technological depth.

Emerging Asia—Indonesia, Malaysia, the Philippines, Thailand, and Vietnam—remains the region's manufacturing and export powerhouse. The segment has urbanized rapidly and expanded education access. But the informal economy persists, and many workers remain in low-productivity services roles. Fewer than half of executives in these economies believe their employees have the skills needed to meet business goals, underscoring the urgency of scaling vocational and digital training. Furthermore, tech adoption remains limited in these regions, likely due to the limited scale and capabilities of businesses.

India stands apart as a youthful and digitally confident economy. Its digital public infrastructure has connected millions of households and small businesses to formal finance. With the world's largest working-age population, India's opportunity lies in converting its demographic advantage into productive employment. Yet only 42% of executives consider graduates job-ready, while 72% of youth aspire to work in AI-related fields but lack access to training. For India, technology must become a job creator, spurring formal employment, digital upskilling, and higher-value manufacturing.

Frontier Asia—Bangladesh, Kazakhstan, Pakistan, and Uzbekistan—is still in the early stages of transformation. Education systems and industrial depth vary widely, but innovation is emerging in some sectors. Bangladesh now has more than 200 million mobile financial accounts, and Kazakhstan's digital "super apps" are reshaping consumer ecosystems. Building infrastructure, reliable power, and digital connectivity—and training workers so that they can operate productively in this new ecosystem—will be vital for these economies to move beyond early-stage growth and participate fully in the region's digital future.

Technology, demography, and competitiveness

Together, these subregions illustrate the interplay among demography, technology, and competitiveness that will define Asia's future. Advanced Asia and China must raise productivity to compensate for aging populations, while

younger economies must generate enough high-quality jobs to absorb their expanding labor forces. For the former, automation and AI are essential to sustain output; for the latter, technology must be used to create opportunity—boosting small-enterprise productivity, improving job quality, and expanding participation in global value chains.

Asia's first growth wave was powered by low costs and labor scale; its next will depend on capability, innovation, and adaptability. As traditional advantages erode, the ability to diffuse technology and renew skills will determine which economies lead. Evidence across the region reveals both promise and constraint. Nearly half of business leaders cite cost and cybersecurity concerns as barriers to adopting new technologies, and only one-third believe most of their workers are digitally ready. Among youth, seven in ten say their education is not preparing them adequately for work, even as most aspire to tech-enabled careers. Bridging this gap between ambition and readiness will shape Asia's next competitive frontier.

Across the region, economies align along a spectrum of technological readiness. Advanced Asia and China emerge as "shapers" that drive frontier innovation in semiconductors, robotics, and AI. India and much of Southeast Asia have shown that they, too, can innovate, but they tend to be "adopters," scaling proven technologies such as digital payments, cloud computing, and e-commerce as they translate adoption into productivity and jobs. Frontier economies are still in the process of establishing the infrastructure—broadband, digital identity, and interoperable payments—that enables digital participation. Skill levels vary widely across the region, but a tech skills gap is a common feature everywhere.

Building the foundations for Asia's future of work

Systems that connect technology, talent, and opportunity will be needed to enhance innovation. Education-to-employment pathways will have to incorporate digital and AI literacy early and link universities more closely to industry. Reskilling platforms for mid-career workers can help keep aging workforces productive. Shared digital infrastructure, including open data sets and standardized APIs, can allow smaller firms to compete on ideas rather than on scale.

Such solutions, alongside other broadscale policy interventions, could rewrite Asia's productivity story once again. By aligning demographic realities with technological strategy, the region could sustain an additional one to three percentage points of annual productivity growth, maintain competitiveness even as labor costs rise, and create millions of high-quality jobs. But if mismatches persist—between education and employability, or between technology and inclusion—Asia risks slowing just as it reaches middle-income maturity.

Asia's next wave of growth will depend not on labor quantity but on labor quality—strong skills, adaptability, and the capacity to work productively alongside technology. Economies that combine automation where labor is scarce with human capital investment where it is abundant will not only sustain growth but redefine it. The next chapter of Asia's story is not about machines replacing people; it is about people mastering technology to shape the future of work and competitiveness.

ASIA'S LABOR EVOLUTION AND ITS GLOBAL IMPACT

OVER THE PAST THREE DECADES, Asia has undergone a profound economic transformation that has made it the primary engine of global growth and lifted hundreds of millions out of poverty.[1] Over that period, the region's economy expanded at an average annual rate of around 5%, with productivity improvements contributing nearly 80% of that growth (Exhibit 1).[2] Asia's share of global GDP rose from about 20% to 34%, accounting for roughly 44% of total global growth.[3] Today, Asia accounts for roughly two billion workers , about 57% of the global labor force,[4] making it the world's largest labor market (Exhibit 2).

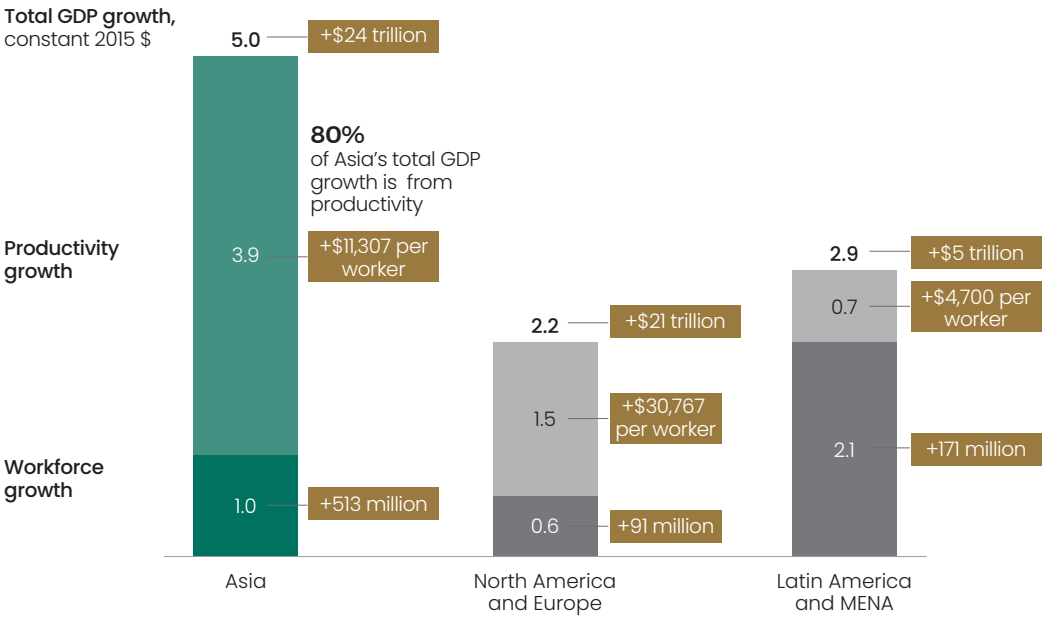
In this report, we look at how Asia's growth has been influenced by three interlinked foundations: human capital capabilities, labor market and business competitiveness, and demographic shifts. Human capital is an indicator of whether education and skills evolve fast enough to stay relevant. Labor market and business competitiveness indicate how economies move up the value chain, creating better, more productive jobs. And demographic trends underpin the future supply of a productive youthful workforce or, conversely, labor shortages stemming from an aging population.

Exhibit 1

PRODUCTIVITY GAINS HAVE DRIVEN ALMOST 80 PERCENT OF ASIA'S GROWTH ALL OTHER REGIONS.

Real GDP growth breakdown,[1] CAGR 1993–2023, %

XX Absolute change, 1993–2023



Note: Figures may not sum to 100%, because of rounding.
[1]Based on data availability, includes 20 countries for Asia, 40 for North America and Europe, and 29 for Latin America and MENA.
Source: Conference Board; World Bank

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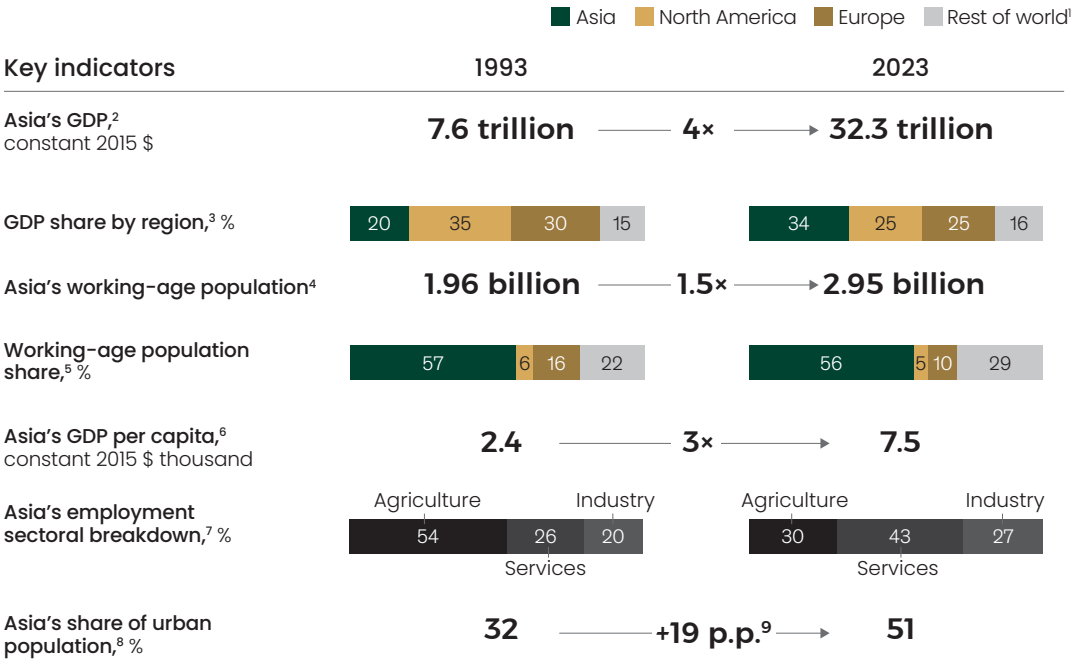
1 In this report, "Asia" refers to all parts of the continent, excluding Western Asia and the Pacific.

2 Based on 20 Asian countries with available GDP (in constant 2015 US dollars) data from the World Bank and employment data from The Conference Board, used to estimate productivity contribution to overall growth. Data not reported for Afghanistan, Brunei, Bhutan, Hong Kong SAR, North Korea, Laos, Macau SAR, Maldives, Mongolia, Nepal, Timor-Leste, and Taiwan, China. For the full list of countries, see the technical appendix.

3 Estimate based on World Bank data for 29 countries that report GDP (in constant 2015 US dollars) for the period 1993 to 2023. Data not reported for Afghanistan, North Korea, and Taiwan, China. For the full list of countries, see the technical appendix.

4 Based on Conference Board data for 21 countries that report the number of people employed. Data not reported for Afghanistan, Brunei, Bhutan, Hong Kong SAR, North Korea, Laos, Macau SAR, Maldives, Mongolia, Nepal, and Timor-Leste. For the full list of countries, see the technical appendix.

Exhibit 2 **ASIA HAS MADE SIGNIFICANT ECONOMIC STRIDES SINCE 1993.**



Note: Figures may not sum to 100%, because of rounding.
[1]Includes Latin America & Caribbean, MENA, Sub-Saharan Africa, and the Pacific.
[2]Based on reported data for the 1993–2023 period. Data not reported for Afghanistan, North Korea, and Taiwan, China.
[3]Based on reported data for 29 countries in Asia, 3 in North America, and 44 in Europe.
[4]Based on reported data for 32 countries.
[5]Based on reported data for 32 countries in Asia, 3 in North America, and 49 in Europe.
[6]Based on reported data for 29 countries. Data not reported for Afghanistan, North Korea, and Taiwan, China.
[7]Based on reported data for 29 countries. Data not reported for Hong Kong SAR, Macau SAR, and North Korea.
[8]Based on reported data for 31 countries. Data not reported for Taiwan, China.
[9]Percentage points.
Source: International Labour Organization; United Nations Population Prospect; World Bank

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These forces have already profoundly reshaped Asia's labor market. Educational attainment has advanced sharply, with average years of schooling and tertiary enrollment rising from 5% to 64%[5] in the past three decades, creating a more skilled and adaptable workforce. Competitiveness has improved as Asia moved up the value chain in several industries and informality inched down (by about five percentage points since 2004),[6] signaling gradual progress toward formal employment. At the same time, urbanization has accelerated (32% of the population lived in cities in 1993; 51% do now),[7] driving a structural shift out of agriculture (down 24 points) and into manufacturing and services (up seven and 17 points, respectively),[8] unlocking higher-quality jobs. From an aggregated view, demographic trends point to a young workforce, reflected in the working-age population expanding at a quicker rate (1.4% per year) than total population growth (1.1%).[9] However, these trends are far from uniform, revealing not one single Asia but multiple, distinct Asian segments that are evolving along different paths.

5 School enrollment, tertiary (% gross); based on World Bank data for 13 countries that report tertiary school enrollment for both 1993 and 2023: Brunei, Cambodia, China, Hong Kong SAR, Indonesia, Kyrgyz Republic, Laos, Macau SAR, Malaysia, Mongolia, Nepal, Tajikistan, and Thailand.

6 Based on ILO regional informal employment rate for East Asia, South Asia, Southeast Asia, and Central Asia, which includes 32 countries. For the full list of countries, see the technical appendix. "Informal employment rate by sex -- ILO modelled estimates, Nov. 2024 (%)," ILO.

7 Based on World Bank data for 31 countries reporting share of urban population. Data not reported for Taiwan, China; for the full list of countries, see the technical appendix. "Urban population (% of total population)," World Bank.

8 Based on ILO data for 29 countries that report employment split by sectors; data not reported for Hong Kong SAR, Macau SAR, and North Korea. For the full list of countries, see the technical appendix. "Employment by sex and economic activity -- ILO modelled estimates, Nov. 2024 (thousands)," ILO.

9 Based on UN World Population Prospects data for 32 countries. See the technical appendix for the full list of countries in Asia.

DIFFERENCES IN HUMAN CAPITAL, COMPETITIVENESS, AND DEMOGRAPHICS SHAPE ASIA'S DIVERGING LABOR PATTERNS

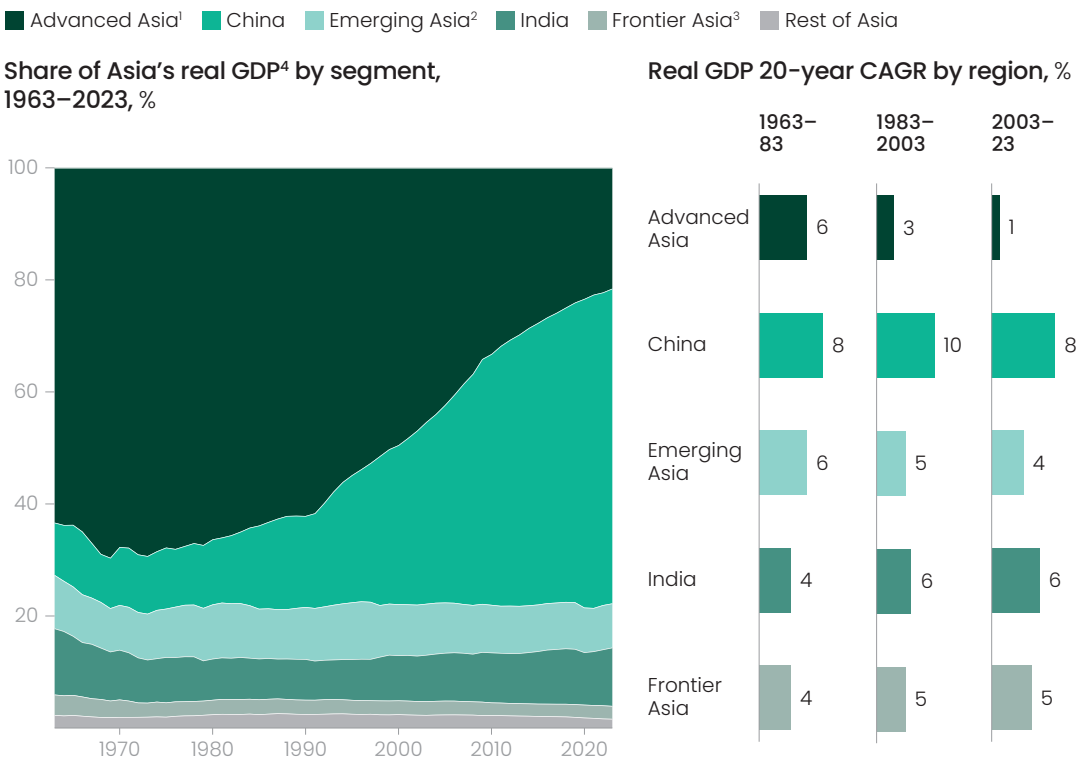
A look at the three trends reveals that Asia's economic landscape is shaped by five distinct segments, at different stages of development, whose growth has been propelled by different players over different periods (Exhibit 3) represented by 14 key economies who act as proxy for these different segments:

Advanced Asia (Japan, Singapore, and South Korea) is home to just 5% of Asia's workforce but contributes 21% of the region's GDP . These economies have a much higher income and educated workforce than other segments and have implemented major structural changes over the years, but they have experienced a slowdown in GDP growth at an average of 1.1% annually over the past decade.

China, home to 38% of Asia's workers, remains the region's economic engine, producing more than half of Asia's GDP. Its economy grew at around 10% from 1993 to 2013, having transformed through industrialization and reform. While China's growth remains relatively robust, it has decelerated to about 6% in the past decade.

Emerging Asia (Indonesia, Malaysia, the Philippines, Thailand, and Vietnam) serves as the region's middle-income powerhouse, propelled by urbanization and integration into global value chains. These countries have thrived by following the Chinese offshore manufacturing model; a notable example is Vietnam, which experienced annual industrial growth of

Exhibit 3 **DIFFERENT PLAYERS HAVE DRIVEN ASIA'S GROWTH OVER THE YEARS.**



Note: Overall GDP CAGR for Asia was derived from 15 Asian countries for which continuous data was available across the 1963–2023 period. The gray-shaded area represents the rest of Asia—countries not included in the data set (eg, Afghanistan; Azerbaijan; Bhutan; Brunei; Cambodia; Hong Kong SAR; Kyrgyzstan; Laos, Macau SAR; Maldives; Mongolia; Myanmar; Nepal; North Korea; Sri Lanka; Tajikistan; Taiwan, China; Timor-Leste; and Turkmenistan), as well as countries within the above segments (eg, Kazakhstan, Uzbekistan, and Vietnam) lacking continuous data since 1963.
[1]Japan, Singapore, and South Korea.
[2]Indonesia, Malaysia, Philippines, and Thailand. GDP data for Vietnam is not reported for the 1963–83 period.
[3]Bangladesh and Pakistan. GDP data for Kazakhstan and Uzbekistan is not reported for the 1963–83 period.
[4]Constant 2015 $.
Source: World Bank

almost eight percentage points from 1993 to 2023.[10] These nations have also made strides in advancing their educational systems while bolstering competitiveness with capital spending. These efforts will have a knock-on effect on their growing populations.

India, with its vast young population and growing services sector, is a rising force that could potentially shape Asia's next growth chapter. Its annual growth in the past decade was 6.1%. Yet it faces educational access challenges and has untapped manufacturing capacity.

Frontier Asia countries (Bangladesh, Kazakhstan, Pakistan, and Uzbekistan) remain in the early stages of development, relying heavily on agriculture and resource-based industries as they begin their industrial transitions. Some countries have severe challenges related to educational access and quality that hinder their human capital.

The evolution of the five Asias has created distinct labor market realities across the region. Exhibit 4 highlights how human capital, competitiveness, and demographic transitions are affecting Asian countries and segments in different ways.

Accumulation and quality of human capital today

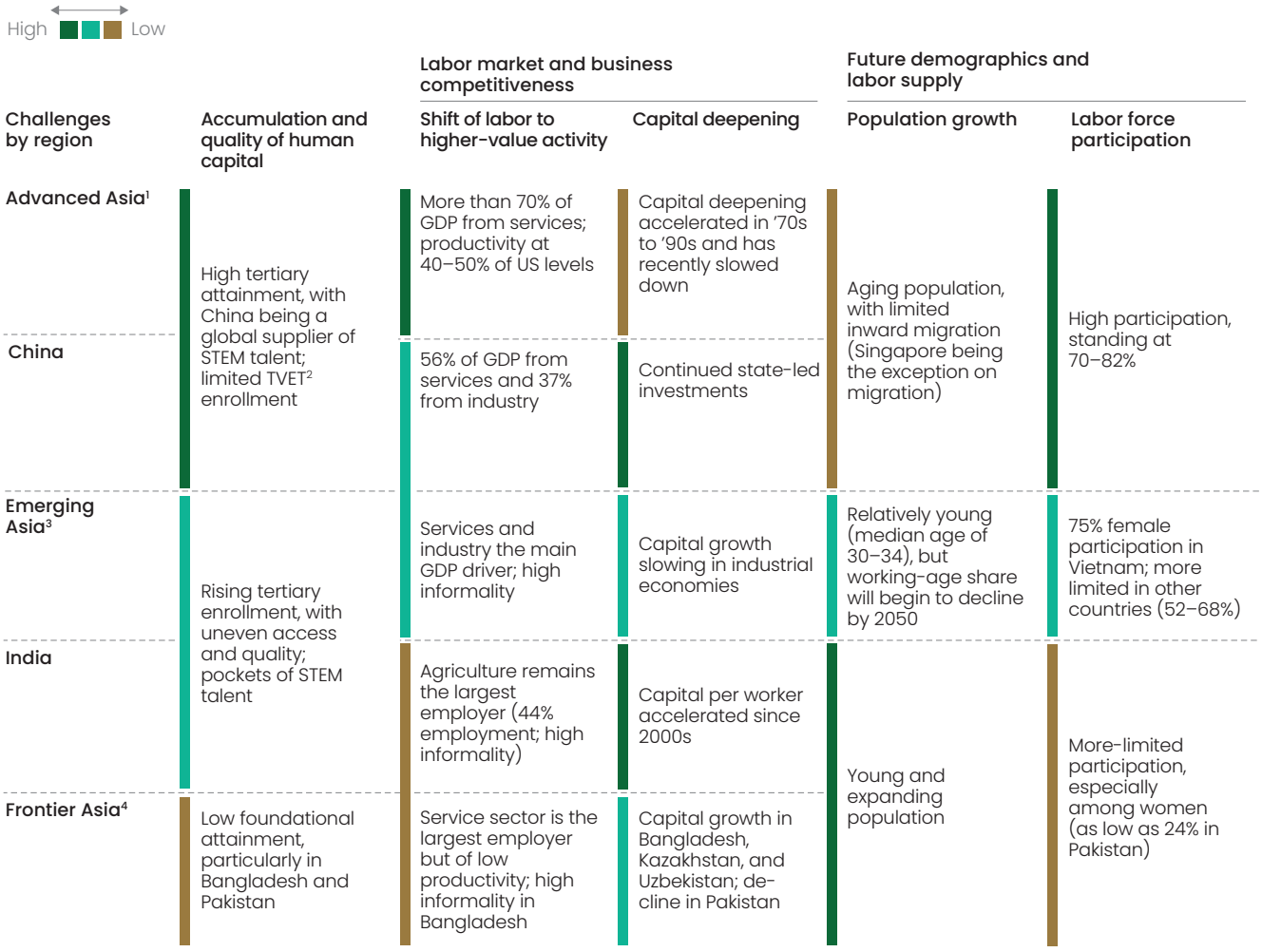
As noted in other reports in this series, education is the clearest determinant of human capital quality. Asia is no exception: Today, the region's roughly 670 million youth[11] have followed a variety of different educational journeys, and these paths largely determine the skills they carry into the workforce. Children in rural India, for example, have very different prospects and life trajectories from those in Tokyo. In today's rapidly evolving economy, skill needs are changing even more rapidly, and the pace of technological change demands continuous adaptation. Automation, artificial intelligence, and digital transformation are reshaping industries, altering

10 GDP contribution from industry (including construction) increased from 28% in 1993 to 36% in 2023 in constant 2015 US dollars.

11 Ages 15 to 24.

Exhibit 4

LABOR MARKETS ACROSS ASIA ARE DIFFERENTIATED ACROSS THREE THEMES.



[1] Japan, Singapore, and South Korea.
[2] Technical and vocational education and training.
[3] Indonesia, Malaysia, Philippines, Thailand, and Vietnam.
[4] Bangladesh, Kazakhstan, Pakistan, and Uzbekistan.

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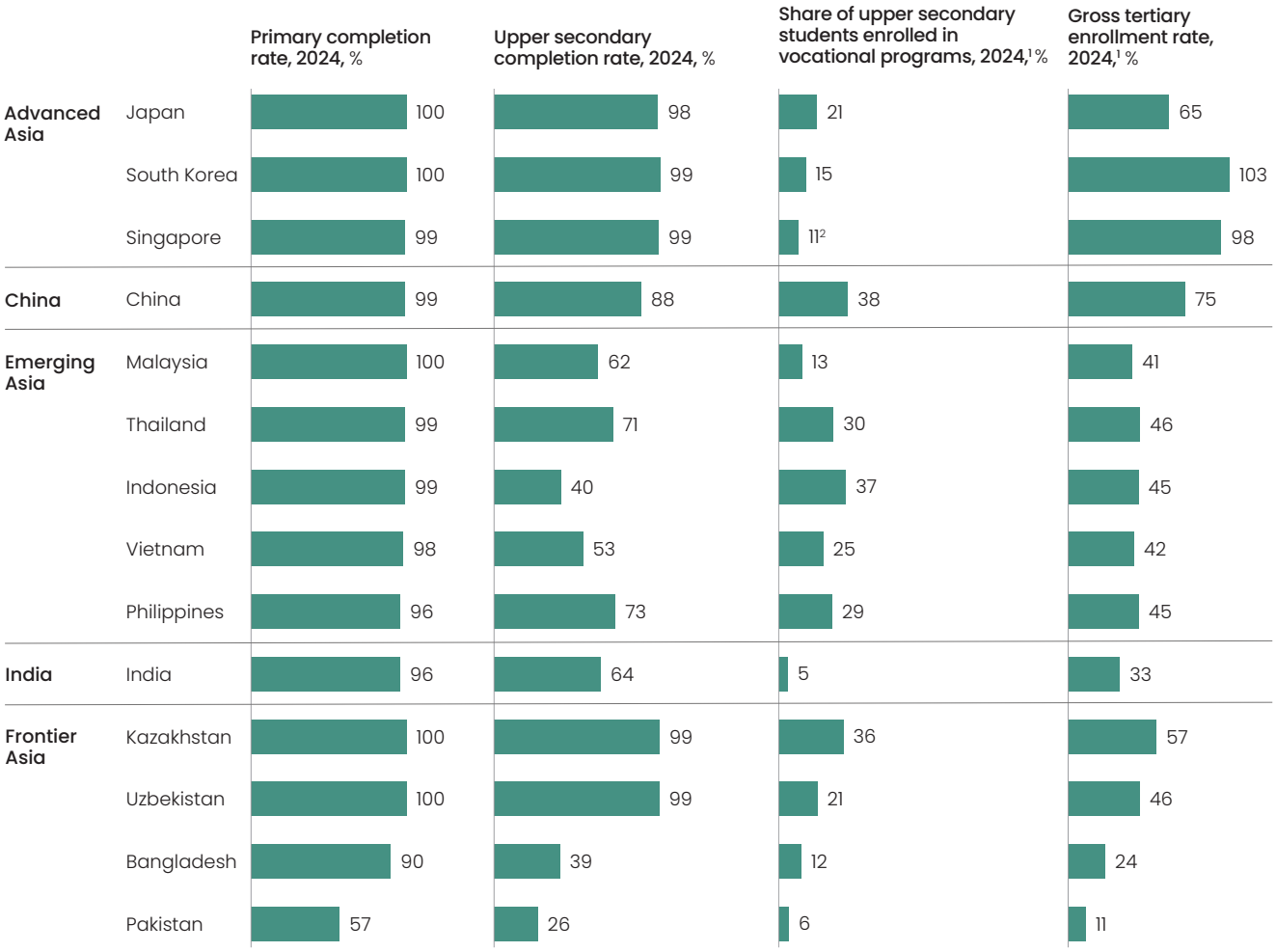
job profiles, and creating occupations that did not exist a decade ago. In this environment, the ability to reskill and upskill throughout one's career is no longer optional—it is a prerequisite for employability and growth.

Advanced Asia: A strong human capital base but uneven adaptation to lifelong skill needs. Economies in advanced Asia combine near-universal access to basic education with consistently strong learning outcomes. Decades of investment in teacher quality, curriculum design, and institutional coherence have yielded systems that produce high levels of foundational literacy and numeracy. These countries have also achieved high tertiary enrollment, exceeding 60% in 2022 (Exhibit 5). Furthermore, many recent job placements have been in high-skill roles,[12] reflecting a well-aligned educational base despite employer reports of skill shortages.

12 "Employment by sex and occupation (thousands), ILO," accessed November 12, 2025. In Japan and South Korea, 100% of net employment growth between 2000 and 2022 came from high-skilled jobs (ILO skill levels 3 and 4), as the number of mid- and low-skilled positions declined over the same period. Similarly, in Singapore, 93% of new jobs created during this time were in high-skill occupations.

Exhibit 5

TERTIARY ENROLLMENT LAGS IN DEVELOPING ASIA, WHILE VOCATIONAL UPTAKE REMAINS LIMITED, LIKELY DUE TO CULTURAL AND PERCEPTIONAL BARRIERS.



[1]Or latest available data.
[2]The latest available data for Singapore is from 2009.
Source: Department of Statistics Singapore; National Center on Education and the Economy; UNESCO; World Bank

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Participation in vocational and technical education remains modest, at about 15% and 21% of upper-secondary students (for South Korea and Japan, respectively)[13] compared with the OECD average of 42%,[14] reflecting a continued bias toward academic pathways. Japan and Korea maintain long-standing TVET (technical and vocational education and training) systems, but they are relatively less integrated with industry than dual-track models in countries such as Germany. Lifelong-learning ecosystems vary as well: Singapore's SkillsFuture initiative is a globally recognized model that provides citizens with learning credits and encourages firms to reskill workers. As of 2024, more than 40% of employed Singapore residents had participated in job-related training.[15] In contrast, Japan's firm-based training remains specific to individual companies and jobs, limiting their transferability.

13 "Share of all students in upper secondary education enrolled in vocational programmes, both sexes (%)," UNESCO.

14 "Vocational education & training (VET): Education GPS," OECD, accessed November 13, 2025.

15 Labour force in Singapore 2024, Manpower Research & Statistics Department, 2024.

A strong human capital foundation positions these economies well for technological transition, although broader participation in portable upskilling may be needed to sustain workforce flexibility.

China: Broad education gains but uneven transition to higher-value skills. China's education system has expanded at unprecedented scale over the past two decades. Access to primary and secondary education is nearly universal, and learning outcomes remain strong by international standards.[16] Massive public investment has helped significantly raise tertiary enrollment, from just 3% in the 1990s to 75% in 2023.[17] In 2020, China produced more than 3.5 million STEM graduates annually,[18] more than anywhere else in the world.

China's large, technically trained workforce forms the backbone of its industrial strength and innovation momentum. The combination of scale, technical expertise, and a continuous pipeline of skilled graduates allows China to stay competitive in manufacturing while accelerating growth in high-tech and digital sectors. As we discuss later in this report, China has also made exemplary moves to connect universities with employers to ensure graduates have the skills they need for a tech-powered future.

More improvements are still needed. China is experiencing rising youth unemployment (Exhibit 6). And in our survey of almost 1,000 young people in Asia, 91% of respondents in China said a gap remains between what they learn at school and what they need for work.[19] At the same time, as we detail in chapter 2, 69% of China's youth report gaining skills through internships or part-time work, reflecting how these practical experiences are becoming complements to formal education.

Emerging Asia: Expanding education systems but uneven learning outcomes and employability. These economies have substantially expanded education access over the past three decades. Primary education is now nearly universal across the segment, though learning outcomes remain uneven.[20] Vietnam stands out in this segment for achieving strong foundational outcomes despite modest public spending, showing how coherent policy design and teacher quality can compensate for limited resources.[21] At the tertiary level, enrollment has surged from single digits in the 1990s to about 40 to 45% today.[22]

However, education expansion has not fully translated into better job matches: A large share of graduates work in routine or mid-skill service roles,[23] highlighting persistent misalignment between academic programs and labor market needs. Participation in vocational education and training remains well below international benchmarks, limiting pathways to acquire practical, industry-aligned skills. Lifelong-learning systems are still at an early stage with limited reach, constrained by high informality and limited incentives for firms to invest in workforce training.[24]

16 China's participating mainland jurisdictions (Beijing, Shanghai, Jiangsu, and Zhejiang) ranked first PISA 2018 for reading, math, and science out of 79 countries; see "Programme for International Student Assessment (PISA) results from PISA 2018," OECD, 2019.

17 School enrollment, tertiary (% gross), World Bank.

18 Julie Heng and Yutong Deng, "Innovation lightbulb: Not just attracting but retaining international STEM students," Center for Strategic & International Studies, April 11, 2025.

19 The Future of Work Survey 2025 was conducted in China, India, Indonesia, Japan, Pakistan, the Philippines, South Korea, Thailand, and Vietnam. For details, see the technical appendix.

20 Participation in lifelong skills development remains highly unequal across the segment; learners from disadvantaged backgrounds (for example, low-income households and remote areas) face limited access at every stage of education. *OECD skills strategy Southeast Asia: Skills for a post-COVID recovery and growth*, OECD, March 22, 2023.

21 Vietnam's Harmonized Learning Outcomes (HLO) score is among the highest in the region (except advanced Asia) and exceeds that of higher-spending peers, such as Malaysia, which spend $4,000 to $6,000 per student. Research attributes this success to a mix of policy coherence and cultural factors: The government's sustained prioritization of foundational learning, teacher quality, and assessment systems has been reinforced by a deep-rooted pro-education culture among students, parents, and teachers, creating a virtuous cycle of high expectations and strong outcomes. *Spark & Sustain: How all of the world's school systems can improve learning at scale*, McKinsey, February 12, 2024; Sachiko Kataoka et al., *Vietnam's human capital: Education success and future challenges*, World Bank, August 3, 2020. HLO scores are standardized, comparable achievement scores for K–12 students. They are based on international assessments such as the OECD's PISA.

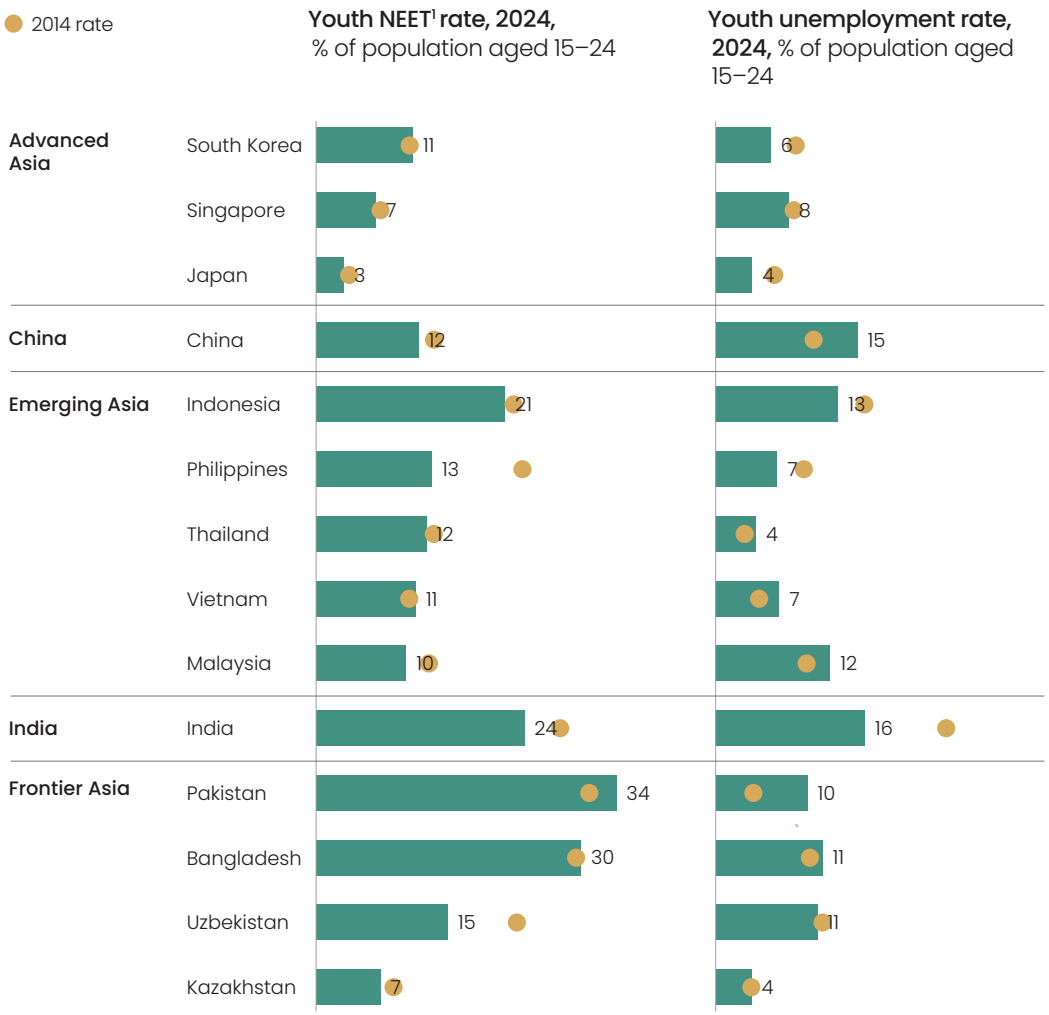
22 Indonesia's, Malaysia's, and Vietnam's gross tertiary enrollment rates were 3% to 8% in 1990.

23 In Indonesia and the Philippines, 41% to 51% of workers with bachelor's degrees were in low- or mid-skilled roles. "Employment by sex, occupation and education," ILO, 2023.

24 Among the working-age population, access to training opportunities remains limited: Only 48.8% of large firms, 36.1% of midsize firms, and 16.8% of small firms provide training for their employees; *OECD skills strategy Southeast Asia: Skills for a post-COVID recovery and growth*, OECD, March 22, 2023.

Exhibit 6

MANY ASIAN ECONOMIES, INCLUDING CHINA AND INDIA, FACE HIGH YOUTH UNEMPLOYMENT AND NEET RATES.



[1]NEET = not in education, employment, or training.
Source: International Labour Organization; World Bank

The segment has built a broad education base, but uneven learning outcomes and limited skill alignment suggest that parts of the workforce may struggle to capture productivity gains from automation and digital transformation.

India and frontier Asia: Expanding access, but foundational gaps limit readiness. Bangladesh, India, Kazakhstan, Pakistan, and Uzbekistan have made major strides in expanding access to education. Primary enrollment now exceeds 90%, except in Pakistan, where the enrollment rate remains at 82%.[25] Yet learning quality and retention remain key challenges. Upper-secondary completion stands at just 64% in India and 39% in Bangladesh,[26] and there are foundational learning gaps: More than half of Indian fifth graders in government schools and

25 "School enrollment rate, primary (% net)," World Bank, accessed November 13, 2025.

26 "Completion rate, primary education, both sexes (modelled data) (%)," UNESCO.

40% in private schools cannot read a second-grade text,[27] with similar patterns in Bangladesh. [28]

At higher levels, tertiary enrollment has expanded from single digits three decades ago in Pakistan, Bangladesh, and India to 11%, 24%, and 33%, respectively. Adult tertiary attainment is particularly high in Kazakhstan (74%) and Uzbekistan (62%),[29] reflecting the Soviet legacy of mass higher education and continued system expansion. In 2020, India alone produced more than 2.5 million STEM graduates.[30] However, about 90% of new jobs in India since 2000 have been in low- or mid-skill occupations,[31] underscoring weak alignment between education and labor market demand.

Uneven foundational learning and weak employability indicate that without stronger skill relevance, technological disruption may amplify existing inequalities in labor market outcomes.

Labor market and business competitiveness

At the heart of Asia's growth story lie labor market flexibility and business competitiveness—the ability of economies to sustain productivity growth, attract investment, and translate it into broad-based improvements in income and employment. Yet the drivers of competitiveness differ markedly across the region. Advanced, emerging, and frontier economies are at very different stages of structural transformation—

27 "ASER 2024 national findings," *Annual Status of Education Report*, ASER, accessed November 13, 2025.

28 Fifty-one percent of children at late-primary age in Bangladesh are not proficient in reading; "Bangladesh learning poverty brief," World Bank, April 2024.

29 "Educational attainment, at least completed short-cycle tertiary, population 25+, total (%) (cumulative)," World Bank, accessed November 13, 2025.

30 Julie Heng and Yutong Deng, "Innovation lightbulb: Not just attracting but retaining international STEM students," Center for Strategic & International Studies, April 11, 2025.

31 Of jobs created between 2000 and 2024, 88% have been in low- and mid-skilled occupations (ILO).

each facing distinct challenges in reallocating labor and capital deepening (Exhibits 7 and 8).

Advanced Asia: Mature, high-productivity economies facing slowing momentum and service sector bottlenecks. Economies in advanced Asia reached high labor productivity levels ahead of peers, but maintaining momentum has become increasingly difficult. Overall labor productivity is much higher in Japan (about $67,000)[32] and South Korea (about $62,000)[33] than in other Asian countries, but it remains below that of global leaders such as the United States (about $139,000 per worker). Moreover, productivity gains have slowed, averaging 0.0% in Japan,[34] 1.3% in South Korea,[35] and 2.0% in Singapore[36] over the past decade.

Employment structures have shifted decisively toward services. Services now account for about 66%[37] of output (up from 55% in 1991) and 73% of jobs (up from 56% of employment). Service sector productivity in Japan, at about $65,000 per worker, and South Korea (about $50,000 per worker) stands at only 50% and 40% of US levels , respectively, constrained by limited R&D intensity in services,[38] regulatory barriers, and weak competitive pressures.[39] Enhancing productivity in these sectors could in turn sustain growth and make labor markets more competitive, even as traditional industrial drivers slow.

Extensive capital deepening in the 20th century supported the segment's growth, but it is now diminishing; over the past two decades, growth in gross fixed capital formation (GFCF) per worker in advanced Asia decelerated at about 0.2%[40] per year, compared with 2% annual average growth between 1973 and 1993 . Capital per worker now ranges from about $16,000 to $24,000, below the US level of more than $29,000.[41] The slowdown in pace has been particularly pronounced in South Korea, where capital per worker grew nearly 10% a year at the height of the country's industrial growth phase between 1973 and 1993 but has since fallen to about 1%. Despite this slowdown, investment is shifting toward higher-quality and innovation-oriented spending. R&D spending in Japan (approximately 3%) and South Korea (approximately 5%) is on par with OECD economies, and investment is rising in areas such as AI; South Korea, for example, increased its R&D budget in AI by about 10% between 2023 and 2024, reaching about 777 billion South Korean won (about $530 million).[42] Such trends underscore that future competitiveness will depend on knowledge, technology, and productivity spillovers across sectors.[43]

China: Transitioning from investment-driven to innovation-driven growth amid slowing returns. China's growth has been defined by one of history's most dramatic productivity transformations. Until 1978, China had a lower income base than peers such as Bangladesh, India, and Pakistan. Today, its GDP per capital has reached five to eight times higher than those economies, driven by deliberate industrial policy and massive capital investment. Output per worker has climbed to about $25,000 from about $5,500[44] in 20 years. Productivity growth continues but at a slower pace, declining from

32 Calculated as GDP per worker. GDP (in constant 2015 US dollars) from World Bank; workforce data from the Conference Board.

33 2023 number given data availability.

34 2014–24 CAGR, labor productivity (in constant 2015 US dollars).

35 2014–23 CAGR for South Korea due to data availability.

36 2014–24 CAGR, labor productivity (in constant 2015 US dollars).

37 In constant 2015 US dollars.

38 In Japan, the service sector invests little in R&D—less than 10% of business R&D in recent years, compared with an OECD average near 38%—which limits innovation and process upgrading; see Edda Zoli, *Korea's challenges ahead—lessons from Japan's experience*, IMF working paper number 2, January 2017.

39 In South Korea, competitive pressures are weak in upstream network industries such as electricity, gas, and transport, as well as in some professional services, where strict product market regulations hold back efficiency gains; see Edda Zoli, *Korea's challenges ahead—lessons from Japan's experience*, IMF working paper number 2, January 2017.

40 In constant 2015 US dollars.

41 In constant 2015 US dollars.

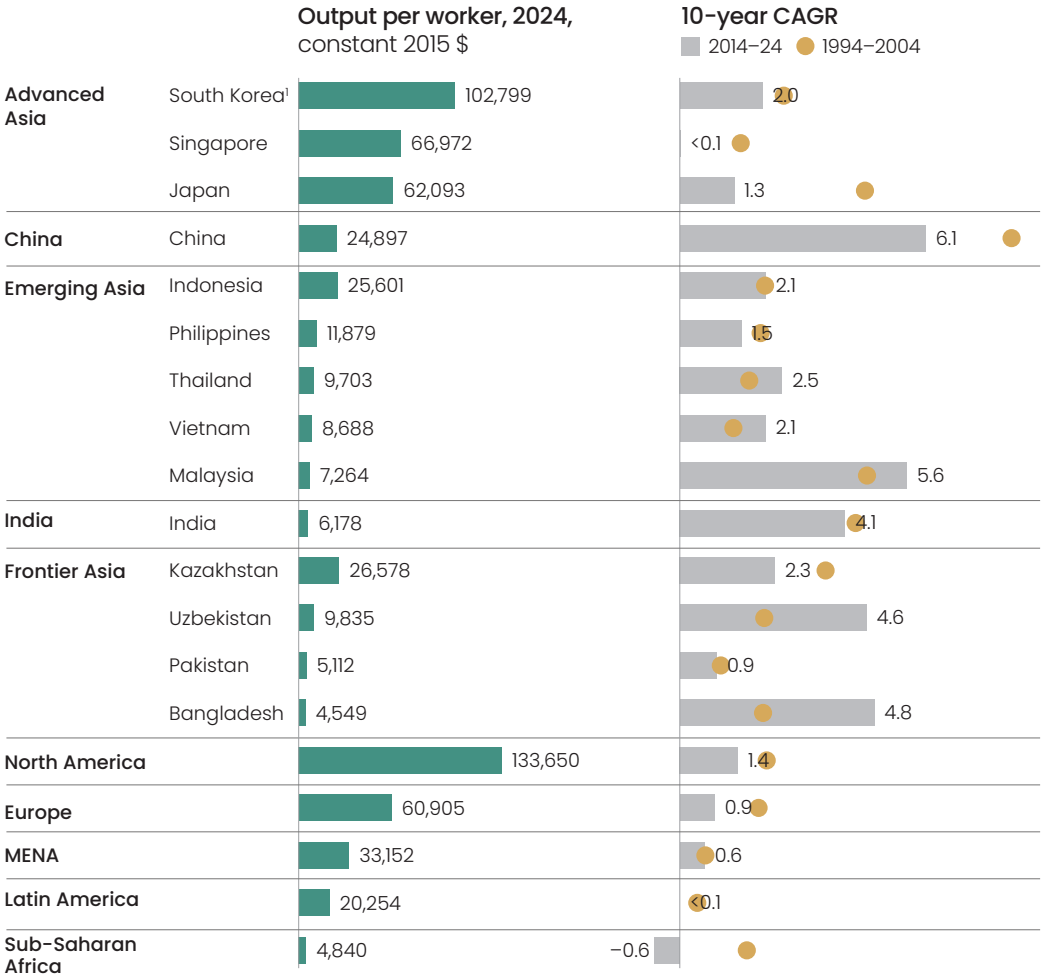
42 "2024 R&D budget to focus on CETs to aim for global technological dominance," Ministry of Science and ICT, accessed November 13, 2025.

43 Further analysis of technology investment patterns and innovation capabilities is presented in chapter 2 of this report.

44 Calculated as GDP per worker. GDP (in constant 2015 US dollars) from World Bank; workforce data from the Conference Board.

Exhibit 7

PRODUCTIVITY GROWTH HAS SLOWED ACROSS ASIA, THOUGH A FEW ECONOMIES CONTINUE TO SHOW STRONG MOMENTUM.



Note: Number of countries by region: North America, 2; Europe, 39; Latin America, 14; MENA, 14; and sub-Saharan Africa, 26.
[1]The latest available data for South Korea is from 2023.
Source: Conference Board; World Bank

about 10% in 2004–14 to about 6% in the past decade. China remains the fastest-growing economy in the region.

A sweeping structural shift—from agriculture to manufacturing and, increasingly, to services—has been central to China's productivity gains. The share of agricultural employment has fallen sharply from about 60% in the 1990s to about 22% today.[45] Since 2011, the service sector has been China's largest employer, now accounting for 46% of jobs.[46] The value added of the service sector has risen to 55%[47] of GDP, below the advanced economy's average of 66%,[48] suggesting that the sector has scope to contribute more to growth and job quality. Rapid urbanization—the urban population has risen

45 "Employment by sex and economic activity -- ILO modelled estimates, Nov. 2024 (thousands)," ILO.

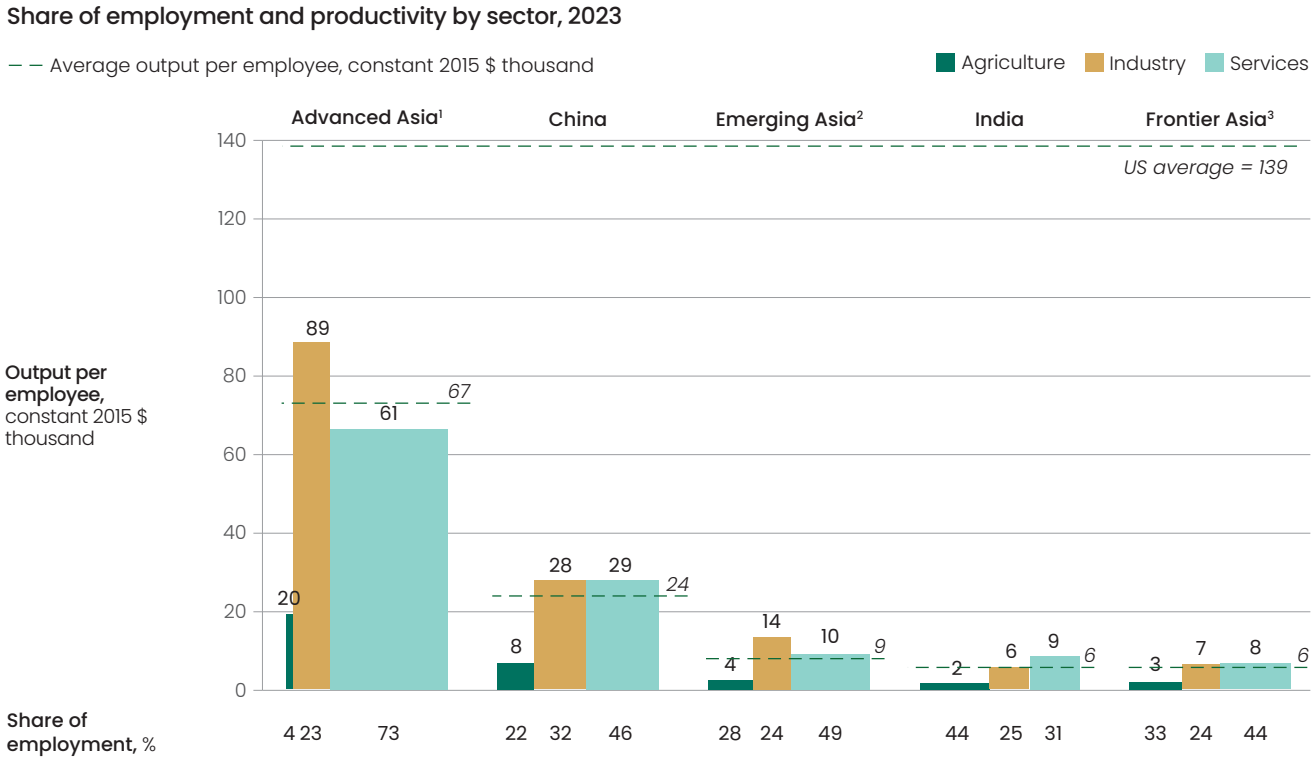
46 "Employment by sex and economic activity -- ILO modelled estimates, Nov. 2024 (thousands)," ILO.

47 Services, value-added (in constant 2015 US dollars), World Bank.

48 Weighted average of Germany, Japan, Singapore, South Korea, and the United States; services, value-added (in constant 2015 US dollars), World Bank.

Exhibit 8

SOME ECONOMIES HAVE MOVED THEIR WORKFORCES LARGELY OUT OF AGRICULTURE AND NOW FACE THE TASK OF BOOSTING PRODUCTIVITY IN SERVICES.



Note: Figures may not sum to 100%, because of rounding.
[1]Japan, Singapore, and South Korea.
[2]Indonesia, Malaysia, Philippines, Thailand, and Vietnam.
[3]Bangladesh, Kazakhstan, Pakistan, and Uzbekistan.
Source: Conference Board; International Labour Organization; World Bank

from 26% of total population in 1990 to 66% in 2024[49]—has reinforced this shift by concentrating capital, infrastructure, and talent in productive hubs. Shenzhen exemplifies this transformation. Deliberate planning, through special economic zones, infrastructure investment, and openness to global capital, turned a small coastal settlement into a manufacturing and innovation hub of more than 17 million people.[50]

China's growth has been powered by high investment, with GFCF averaging 40 to 45% of GDP since the mid-2000s, well above advanced-economy levels, delivering rapid capital deepening. As returns on investment have diminished, however, rising capital intensity has produced slower growth. At the same time, China's drive for technological self-reliance has intensified, reflected in R&D spending reaching 2.6% of GDP.

Emerging Asia: Rapid structural transformation but uneven movement into higher-value sectors. In emerging Asia, productivity levels remain between $7,000 and $12,000 per worker,[51] except for Malaysia,

49 Urban population (% of total population), World Bank.

50 *Urban China: Toward efficient, inclusive, and sustainable urbanization*, Work Bank, July 8, 2014; Jiafan Cheng, Mingxing Chen, and Shujuan Tang, "Shenzhen – A typical benchmark of Chinese rapid urbanization miracle," *Cities*, September 2023, Volume 140.

51 Calculated as GDP per worker. GDP (in constant 2015 US dollars) from World Bank; workforce data from the Conference Board.

which exceeds the others by a large margin at about $26,000 per worker.[52] Vietnam has led productivity growth within the segment, expanding by 5.6% annually over the past decade,[53] while others have grown at about 1.5 to 2.5%.

Structural change has continued, but not always toward higher-value activities. The urban population has risen by more than 20 percentage points since the 1990s, and agricultural employment has dropped from about 53% in 1991 to 28% in 2023, yet many workers have shifted into low-productivity services rather than modern industry. Services now employ nearly half of all workers, with much of this expansion in retail, trade, and hospitality, offering limited productivity uplift. Vietnam, Thailand, and Indonesia—countries where one-third of workers still depend on agriculture —have the potential to move workers into higher-value manufacturing and services.

High informality further constrains productivity and job quality. Across Indonesia, Thailand, and Vietnam, informal employment still accounts for 60 to 80% of total jobs and more than 90% of jobs in agriculture.

Capital accumulation has also contributed to growth in this segment, although it has decelerated in recent years. GFCF per worker grew by 2%[54] per year in the past decade compared with 5% in the previous decade (2003 to 2013). Here, Vietnam stands out, with capital deepening growing at about 7% annually over the past decade and GFCF reaching 30% of GDP. Public investment in industrial parks and export zones continues to attract strong inflows from foreign direct investment (FDI), highlighting opportunities to further strengthen linkages between domestic companies and foreign enterprises to enhance productivity spillovers.[55] However, most countries[56] in this segment spend less than 1% of GDP on R&D, underscoring persistent gaps in innovation and technology upgrading relative to advanced peers.

India: Service-led growth model with limited labor absorption and deep informality. Over the past three decades, India's GDP has grown from about $0.55 trillion in 1994 to approximately $3.5 trillion in 2024,[57] an expansion of about 6% annually.[58] In per capita terms, it has risen nearly fourfold to about $2,400[59] in the same time period—an impressive feat but not at the same scale as China, which has a comparably sized population. These changes have not translated to labor productivity increases, however. Labor productivity remains modest at roughly $6,000 per worker. The productivity growth rate, which has averaged 4.9% per year since 1994, reached 6.3% in 2004 to 2014 but decelerated to 4.1% in the past decade.

The country's growth has been powered by modern tradable services, particularly IT and business-process outsourcing, which now contribute nearly half of GDP. This shift was likely enabled by regulatory reforms[60] and a legacy of investment in engineering and management education, creating a large pool of English-speaking technical talent that allowed India to capture the global wave of outsourcing and offshoring. These sectors are globally competitive, but they absorb only a small share of India's vast labor force.[61] As technology begins to automate even knowledge work, the country's dependence on lower-end service exports faces new risks, underscoring the need to move up the value chain on advanced IT services, broaden job creation, and create learning pathways for reskilling.

Despite rapid growth in services, structural transformation remains incomplete. In 2023,

52 Calculated as GDP per worker. GDP (in constant 2015 US dollars) from World Bank; workforce data from the Conference Board.

53 GDP per worker, CAGR 2014–24.

54 In constant 2015 US dollars.

55 *OECD economic surveys: Viet Nam 2025*, OECD, June 20, 2025.

56 Malaysia and Thailand are the exceptions, with each spending 1.0% and 1.2% of GDP, respectively.

57 GDP (in constant 2015 US dollars), World Bank.

58 GDP (in constant 2015 US dollars), CAGR 1994–24.

59 In constant 2015 US dollars.

60 The 1991 liberalization resulted in dismantling of licensing restrictions, opening of FDI inflows, and easing of foreign exchange controls.

61 Only 31% of the workforce is employed in the service sector. See "Employment by sex and economic activity -- ILO modelled estimates, Nov. 2024 (thousands)," ILO.

agriculture continued to employ about 44% of workers . Urbanization has progressed gradually, with 63% of the population still living in rural areas. Where it has taken hold, growth has often been concentrated in a few high-value hubs such as Bengaluru, now recognized as India's technology and innovation capital. The city's information and communications technology (ICT) boom has spurred local high-tech manufacturing activity and supporting services, but the benefits have largely accrued to skilled workers, with limited spillovers to mid- and lower-skill employment.[62]

These patterns are compounded by persistent labor market duality. Informality continues to dominate India's labor market, accounting for about 88% of total employment and almost 100% in agriculture. Women are disproportionately affected: 92% of female workers are in informal jobs, reflecting both occupational concentration (about 60% in agriculture versus 36% for men) and persistent barriers to formal employment, including care burdens and limited mobility.

Frontier Asia: Uneven productivity growth driven by labor reallocation, capital accumulation, and resource dependence. Productivity varies widely across frontier Asia. Bangladesh and Pakistan remain at lower productivity levels—about $4,500 and $5,000 per worker,[63] respectively—while Uzbekistan has reached about $9,800, and Kazakhstan, the region's outlier, stands near $26,000 per worker.[64] Over the past decade, Bangladesh and Uzbekistan have grown fastest, at roughly 4.8% and 4.6%[65] respectively, while Kazakhstan's productivity gains have slowed to about 2.3% and Pakistan's stagnated at 0.9%.[66]

In Bangladesh, strong GDP and export growth have not been matched by equivalent labor market transformation. Agriculture now contributes only 12% of GDP[67] (down from 22% in the 1990s) yet still employs 35%[68] of workers, while industry generates 33% of output[69] but provides only 21% of jobs. The remaining workforce (about 44%) is in services, but more than half of them are in low-productivity services such as retail, land transport, and hospitality.[70] Informality is high in both agricultural and nonagricultural sectors.[71] Overall, 84% of employment is informal,[72] limiting wage growth and skill accumulation across sectors. Productivity gains are largely concentrated among a small group of frontier firms, leaving a long tail of enterprises that capture little of the country's growth.[73] As a result, the shift of workers from agriculture to urban services has yet to yield a meaningful rise in job quality or income mobility.

In Kazakhstan, productivity levels are higher but driven largely by resources. About two-thirds of workers are in services, and service sector productivity is around $20,000 per worker, comparable to Malaysia and higher than many emerging Asia peers. In the 2000s, most productivity gains came from within-sector improvements, especially in nontradable services, which were boosted by domestic demand during the commodity boom.[74] Since 2010, these gains have weakened, and overall productivity

62 Bengaluru's urban economy points to the coexistence of a high-end corporate or IT enclave and a large informal or low-wage local economy; Solomon Benjamin, "Governance, economic settings and poverty in Bangalore," *Environment & Urbanization*, April 2000, Volume 12, Number 1.

63 Calculated as GDP per worker. GDP (in constant 2015 US dollars) from World Bank; workforce data from the Conference Board.

64 Labor productivity is calculated as GDP per employee. GDP (constant 2015 US dollars) is sourced from the World Bank, and number of employed persons is sourced from the Conference Board.

65 GDP per worker, CAGR 2014–24.

66 GDP per worker, CAGR 2014–24.

67 Sector GDP contribution is sourced from the World Bank; "Agriculture, forestry, and fishing, value added (% of GDP) - Bangladesh," World Bank, accessed November 13, 2025.

68 Sector employment share sourced from ILO.

69 In constant 2015 US dollars.

70 "Employment by sex and economic activity - ISIC level 2 (thousands)," ILO.

71 Informal employment by ILO sector.

72 Analysis of ILO data.

73 Frontier firms in Bangladesh are more productive, and accordingly pay higher wages, hire more skilled workers, and use more capital, but they employ only about 15% of formal workers. Most workers remain in non-frontier firms that operate far below the productivity frontier, rely on basic technologies, and offer lower-skill, lower-wage jobs. See Rami Galal et al., *Frontier firms and job creation in Bangladesh*, World Bank, 2025.

74 *Kazakhstan: Reversing productivity stagnation*, World Bank, January 1, 2019.

growth has slowed even without major shifts in employment.

Uzbekistan, by contrast, has experienced rapid capital deepening, averaging 11% growth per year over the past decade. GFCF has risen to 37% of GDP,[75] second in the region only to China. Economic liberalization since 2017 has helped attract greater capital inflows and diversify industrial activity.

R&D spending remains minimal across the region, at 0.1 to 0.2% of GDP,[76] suggesting that capital accumulation has yet to translate into stronger innovation capacity or productivity spillovers.

75 Analysis of World Bank data; constant 2015 US dollars.

76 Analysis of World Bank data.

Future demographic shifts and labor supply

While Asia is projected to remain the world's largest supplier of labor through mid-century, this aggregate picture conceals a profound demographic divergence across the region. Some economies—such as China, Japan, and South Korea—are already grappling with shrinking working-age populations, aging societies, and tightening labor markets that threaten to constrain growth. In contrast, others—particularly in South and Southeast Asia, including India, Indonesia, and the Philippines—continue to enjoy expanding, youthful labor forces that could propel economic dynamism for decades to come.

This demographic split will have far-reaching implications for the region's economic trajectory. Economies facing labor shortages will need to rely more heavily on automation, productivity gains, and migration to sustain output. Meanwhile, countries with surplus labor must focus on job creation, skills development, and industrial transformation to absorb their growing workforces amid rapid technological disruption. Together, these divergent trends will shape Asia's evolving productivity landscape, influencing everything from wage competitiveness and innovation potential to social stability and regional integration.

Advanced Asia and China: Aging economies confront a tightening labor supply. Advanced Asia and China are entering a period of sharp demographic transition that will reshape labor supply over the coming decades. Currently, the working-age population (ages 15 to 64) accounts for 63% of the total population in advanced Asia and 69% in China, but these shares are projected to fall to 52% and 59%, respectively, by 2050. The youth cohort (ages 15 to 24) has already shrunk to historic lows and now represents only 10% of the population[77] in advanced Asia (down from 16% in 1994) and 11% in China (down from 19%). With fertility rates between 0.7 and 1.2 live births per woman, far below the replacement level of 2.1, fewer young people will enter the workforce in the coming decades.[78]

As a result, aging and dependency ratios are rising rapidly. Japan already has 51 people aged 65 and above per 100 working-age adults,[79] the highest in the world after Monaco. South Korea, Singapore, and China currently range between 18 and 28 over-65s per 100 working-age adults, but these ratios are expected to climb sharply, to 42 to 76 per 100 by 2050. Combined with limited inward migration, this dynamic means that these economies face an increasingly tight labor supply.[80] Some governments have begun experimenting with cross-border mobility arrangements, such as the India–Japan agreement to exchange more than 500,000 personnel, including 50,000 skilled workers from India,[81] but it is unclear whether such initiatives will make a sizable difference given cultural, linguistic, and other barriers.

Labor force participation remains high, exceeding 70% across the segment and reaching 82% in Japan.[82] Rising female participation, particularly in Japan (where it rose to 76% in the past two decades from 60%), reflects several factors, including shifts in family choices (more women opting not to have children), expanded childcare provision, and stronger maternity-leave policies.[83] Advanced Asia also benefits from a larger share of older adults continuing to work—a trend not fully captured by conventional participation rates.[84] In Japan, for example, employment among those aged 65 and above has been increasing steadily for two decades[85]

77 World Population Prospects 2024, United Nations, 2024.

78 Replacement-level fertility refers to the average number of children needed for a population to replace itself from one generation to the next (about 2.1 per woman), assuming no migration; "Total fertility rate," United Nations, accessed November 13, 2025.

79 World Population Prospects 2024, United Nations, 2024.

80 International migrant stock as share of total population in China is 0.1%, in Japan is 2.8%, and in South Korea is 3.5%, as compared with 15.0% in the United States, 22.0% in Canada, and 30.0% in Australia. "International Migrant Stock 2024," United Nations, 2024.

81 "Action plan for India - Japan Human Resource Exchange and Cooperation," India Ministry of External Affairs, August 29, 2025.

82 Analysis of World Bank data.

83 Labor force participation among married women has risen sharply, including in their 30s, when participation usually declines due to child-rearing responsibilities, suggesting that supportive childcare and family policies are enabling more mothers to return to work. See Rui Xu, "Japan's economy would gain with more women in science and technology," IMF News, November 13, 2023.

84 Labor force participation rates typically only include population aged 25 to 64.

85 In 2023, the employment rate was 25% in Japan and 35% in South Korea, compared with less than 20% for OECD peers.

as longer life expectancy and financial pressures encourage continued work.[86]

As the labor pool contracts, maintaining economic competitiveness will depend on raising productivity through automation and technology adoption. These economies will need to leverage automation to offset shrinking labor supply while channeling existing workers into higher-value, skill-intensive roles.

Emerging Asia: A young workforce facing a gradual demographic shift. Emerging Asia remains relatively young, with median ages of 30 to 34 years and a working-age population that accounts for about 68% of total population[87] (and is projected to fall modestly to 65% by 2050). While many economies still enjoy a demographic dividend, this is beginning to narrow as fertility rates decline and populations age. By 2050, the working-age share will start to contract in Indonesia, Malaysia, Thailand, and Vietnam. The youth share of the population, now around 16%, is also expected to fall to 12% by mid-century.[88]Thailand is furthest along this path: With fertility at 1.2 births per woman and a median age range of 40 to 44 , its old-age dependency ratio already stands at 22% and is projected to more than double to 50% by 2050.

Despite these emerging pressures, labor force participation remains strong, ranging from 60 to 80% across the segment.[89] Vietnam stands out with one of the highest overall participation rates and a female participation rate of 75%, comparable to advanced economies. This reflects not only the legacy of women's economic importance during the Vietnam War era[90] but also the influence of market liberalization, gender-equal education policies, and family-friendly labor legislation. The Philippines sits at the lower end, with female participation at just 52%, constrained by social norms and childcare responsibilities.[91]

As the demographic dividend narrows, technology and automation will play a growing role in sustaining productivity and easing labor constraints. For many economies in emerging Asia, automation is not yet a substitute for labor but a complement to boost productivity.

India and frontier Asia: Youthful population with untapped potential. In frontier Asia and India, among the region's youngest segments, the working-age population accounts for 62 to 68% of total population[92] and is expected to stay stable, or even increase, over the next few decades. The youth share stands at 14% in Kazakhstan and Uzbekistan and 18 to 20% in Bangladesh, India, and Pakistan, supported by fertility rates of 2.0 to 3.6 live births per woman, the highest across the segments. Consequently, old-age dependency ratios remain low, reflecting a demographic structure that still offers the potential for continued labor supply growth.

However, this advantage is tempered by low labor force participation, averaging 55 to 65%[93] in India and frontier Asia, with the exception of Kazakhstan at 79%. Inclusion remains a persistent challenge: India, Pakistan, and Uzbekistan record some of the lowest female participation rates globally.[94] In lower-income economies such as Bangladesh, high youth participation

86 The Japan Institute for Labour Policy and Training's 2019 Survey on Employment and Daily Life of the Elderly in their Sixties found that when men and women in their 60s were asked about their ideal retirement age, the most common response was "to work as long as possible, regardless of age" (32.1%). The survey also found that economic motives were dominant, cited by 76.4% of respondents as the primary reason for wanting to continue working. Among those who cited economic reasons, more than 80% said they worked to maintain their current standard of living.

87 World Population Prospects 2024, United Nations, 2024.

88 UN World Population Prospects 2024.

89 Analysis of World Bank data.

90 The Vietnam War reduced the male working-age population, pushing women into the workforce out of necessity; Angana Banerji et al., "As women advance in Asia's labor force, Vietnam is a standout," IMF, September 2018.

91 For mothers of young children (aged 0 to 2), the likelihood of joining the labor force is seven to 14 percentage points lower unless domestic help is available; Nadia Belhaj Hassine Belghith and Francine Claire Fernandez, *Women, childcare, and social norms in the Philippines*, World Bank, December 2021.

92 World Population Prospects 2024, United Nations, 2024.

93 Analysis of World Bank data.

94 India has a female labor participation rate of 35%, Pakistan a rate of 26%, and Uzbekistan a rate of 44%. "Labor force participation rate, female (% of female population ages 15-64) (modeled ILO estimate)," World Bank.

> **Equipping young workers with relevant digital and technical skills while expanding access to quality, productive employment is crucial to mitigate tech-driven job disruptions and losses.**

often reflects early school leaving and a higher concentration of informal, low-productivity work.[95]

Looking ahead, these economies face the twin challenge of absorbing a growing youth cohort while managing the disruption from automation. Without adequate job creation, a youthful workforce could turn into an employment burden rather than a demographic asset. Equipping young workers with relevant digital and technical skills while expanding access to quality, productive employment is crucial to mitigate tech-driven job disruptions and losses.

Asia's labor landscape is entering a new phase. The demographic divergence among countries is beginning to redefine regional competitiveness, tightening labor supply in some economies while amplifying job-creation pressures in others. The implications reach far beyond the region: Given that Asia is the world's largest source of growth and productivity gains, its next transition will shape global growth itself. Sustaining momentum will depend on how effectively economies deploy technology, automation, and continuous skill development to offset demographic drag, raise productivity, and create high-quality jobs.

95 Youth labor participation rate of 53%, the highest across the segments. "Labor force participation rate for ages 15-24, total (%) (modeled ILO estimate)," World Bank.

2

HARNESSING THE NEW TECHNOLOGICAL ERA IN ASIA

TECHNOLOGY IS POISED to reshape economies and workforces around the world. Its impact across Asia will be deeply uneven, shaped by the region's stark demographic contrasts and varying levels of technological maturity. For the economies of advanced Asia and China, automation, robotics, and artificial intelligence (AI) are strategic tools that are sorely needed to sustain productivity growth in the face of an aging-related workforce decline. These countries' well-developed technology ecosystems—characterized by high R&D intensity, sophisticated digital infrastructure, and innovation-driven industries—position them to integrate new technologies rapidly and effectively. Japan and South Korea lead globally in industrial robotics; China is advancing in AI adoption, digital platforms, and green technologies; and Singapore's Smart Nation initiative exemplifies how governance can leverage digital transformation to maintain competitiveness amid demographic headwinds. The challenge for these countries now is to embrace and adopt the new technologies, and to do so rapidly to reverse the trend of lower productivity growth and the impact of aging populations.

Younger economies with expanding and youthful labor forces, such as India, Indonesia, the Philippines, and Vietnam, face a different challenge: They need to harness technology to create meaningful employment to advance inclusive growth. Automation and AI will complement human labor in these countries rather than replace it, and they are needed in part to ensure that companies remain competitive in global value chains. The priority is to invest in digital skills, reskilling programs, and innovation ecosystems, with the aim of creating sufficient employment opportunities to absorb millions of new entrants each year. While these nations are experiencing rapid digitalization—particularly in fintech, e-commerce, and mobile-based services—their industrial and technological bases are still developing. Moving too slowly on the skills front could create serious challenges with underemployment and unemployment in the future.

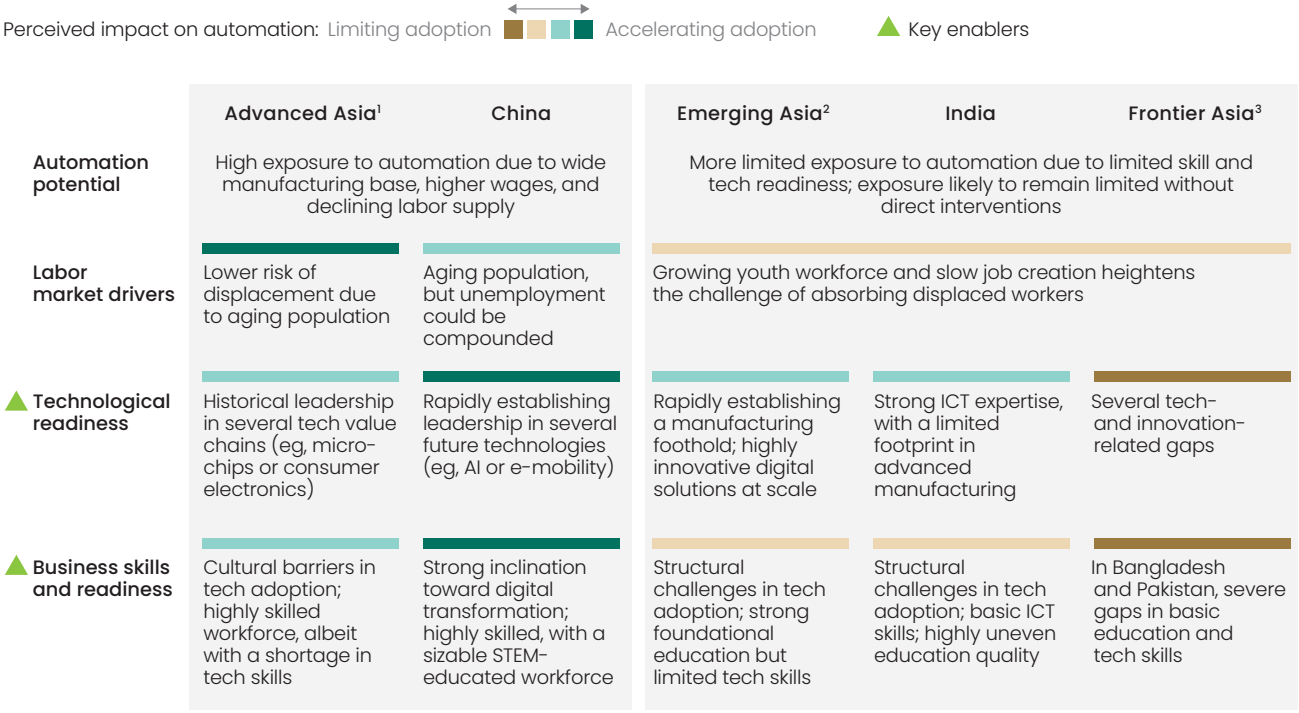
This dual reality—aging advanced economies using technology to fill labor gaps, and younger economies using it to create jobs and expand opportunity—defines Asia's next phase of economic transformation. The region's growth and social cohesion will depend on how effectively each economy aligns its demographic trajectory with its technological strategy. Countries that manage this balance, deploying automation where labor is scarce and fostering human capital where it is abundant, will shape the region's productivity frontier and determine Asia's role in the future global economy.

This chapter examines these contrasting realities and the broader implications of this automation potential on Asia's productivity. Asia's readiness in its technological capabilities and depth of innovation, along with business and talent preparedness, will determine the limits on adoption and impact (Exhibit 9).

“Countries that manage this balance, deploying automation where labor is scarce and fostering human capital where it is abundant, will shape the region's productivity frontier and determine Asia's role in the future global economy.”

Exhibit 9

WHEN COUPLED WITH KEY ENABLERS, LABOR MARKET DRIVERS WILL INFLUENCE THE LIKELIHOOD OF ACHIEVING A COUNTRY'S FULL AUTOMATION POTENTIAL.



[1]Japan, Singapore, and South Korea.
[2]Indonesia, Malaysia, Philippines, Thailand, and Vietnam.
[3]Bangladesh, Kazakhstan, Pakistan, and Uzbekistan

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AUTOMATION ADOPTION: PATHS AND IMPACT DIVERGE ACROSS ASIA

As technology reshapes the future of work worldwide, Asia stands at a particularly dynamic crossroads. The region's five distinct segments—each with unique demographic and economic characteristics—will experience the forces of automation and AI in markedly different ways.

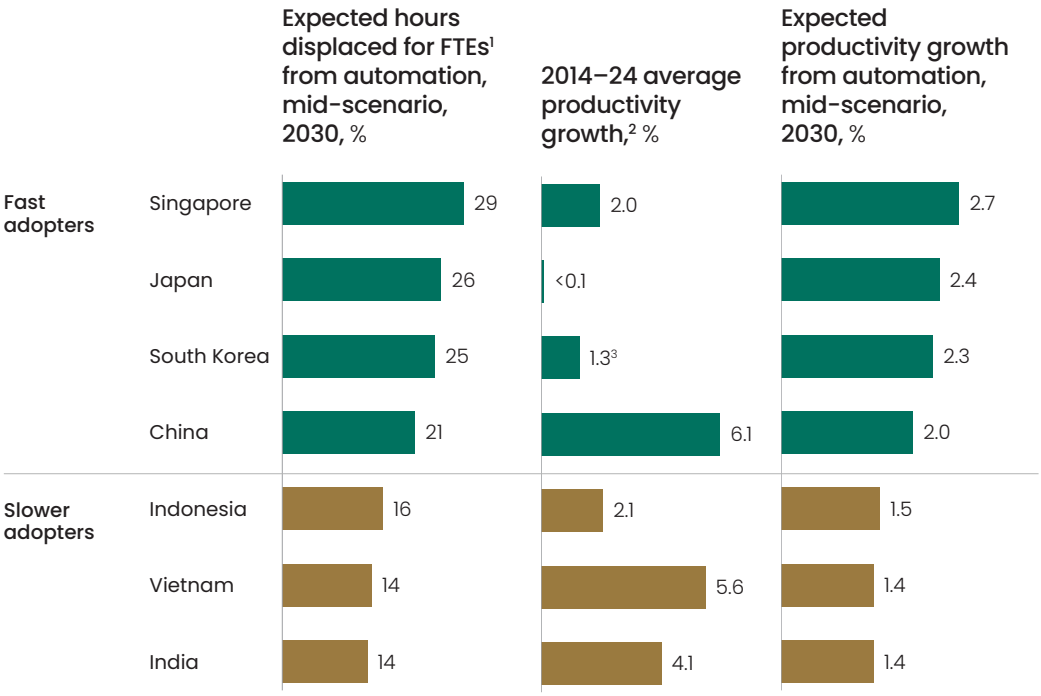
Two distinct trajectories emerge from our analysis (Exhibit 10). High-income economies with more formalized, consolidated markets; strong corporate sectors; and advanced industrial and service ecosystems are positioned to adopt automation rapidly. Conversely, lower-income economies, characterized by informality, smaller-scale enterprises, and less service-oriented structures, are likely to see a slower diffusion of technology. Together, these structural differences will determine the extent to which automation and AI translate into productivity gains and economic growth across Asia.

Similar to the methodology used in the other reports in this series, this research modeled the effect of automation on productivity growth in Asia along three scenarios for AI adoption: early, mid, and late adoption. The range of scenarios represents uncertainty regarding technology, business, and talent readiness. For simplicity, we have anchored our work here in the midpoint scenario. However, varying realities may result in different paths for different segments. For details on the modeling, see the technical appendix.

China and advanced Asia: Well positioned to lead in automation adoption and realize the strongest productivity gains. Automation could advance fastest in advanced Asia and China, where firms already operate at the technological frontier. In these economies, automation could help sustain productivity

Exhibit 10

ASIA STANDS TO BENEFIT FROM AUTOMATION, PARTICULARLY IN ADVANCED ECONOMIES.



[1]Full-time equivalent employees.
[2]Output per employee, constant 2015 $.
[3]CAGR for South Korea is 2014–23, because 2024 data was unavailable.
Source: Conference Board; World Bank; McKinsey Global Institute analysis

and competitiveness as their working-age populations shrink. Our midpoint scenario suggests that up to 30% of today's working hours could be automated. This shift is expected to support output and lift productivity by as much as 2.7% annually. This would help offset the drag on GDP caused by demographic decline, which is expected to reduce growth by 0.7 to 0.8% annually in South Korea and Japan.

While automation is likely to displace some routine roles, these economies are well positioned to manage the transition. Their strong tech investment and capabilities generate new forms of employment that absorb displaced workers and create opportunities in higher-value functions.

Reskilling will nonetheless remain critical in these countries. As technology reshapes industries, workers may need to adapt or redefine their roles to remain productive. The challenge is to ensure that workers are equipped to thrive alongside automation.

The rest of Asia: Amplifying existing labor market pressures while raising productivity. In emerging Asia, India, and the frontier Asia economies, automation presents a double-edged proposition. With abundant labor, low wages, and relatively limited industrial automation, these countries are not under immediate pressure to automate. Their informal and fragmented markets—dominated by small and medium-size firms—may also limit the potential productivity gains from technology adoption. Our modeling suggests that productivity growth in these economies could rise more gradually, ranging from about 1.1 to 2.1% in more mature markets. Yet even these gains represent a mid-scenario estimate and might vary widely depending on factors such as technological readiness, business

capability, talent availability, and access to capital. Without deliberate policy and institutional support, automation may struggle to take root if left to market forces alone, risking a loss of potential productivity benefits.

At the same time, global firms are already automating offshore IT services, business processes, and customer support functions. This could intensify labor market pressures and displace parts of the offshore workforce in these economies. The challenge is compounded by the rapid expansion of the youth population as millions of new entrants join the labor force each year. Without targeted strategies to stimulate job creation, enhance employability, and build digital skills, automation could widen the mismatch between labor supply and demand, increasing job churn and vulnerability. Yet, if these economies fail to adopt automation altogether, they may fall further behind their more advanced peers, trading short-term employment security for a longer-term loss of competitiveness.

ASIA'S TECHNOLOGICAL CAPABILITIES AND AI READINESS ARE UNEVEN

Asia's technological rise has been extraordinary but uneven. The region today accounts for more than 25%[96] of global R&D spending, almost 70%[97] of the world's patents, and approximately 60% of high-tech manufacturing output. Yet its economies occupy very different positions along the technology frontier (Exhibit 11).[98] While some economies lead in defining the next wave of innovation, others excel at adopting and scaling it. A third group is still laying the foundations for digital transformation. For this research, to capture the region's widening spectrum of technological depth, we identify economies as "shapers," "adopters," or "laggards" in the value chain (Exhibit 12). Across technologies—from semiconductors, AI, robotics, and cloud to digital infrastructure and the digital economy—a pattern is apparent: Asia leads the world in what it builds, but not yet in how widely it innovates. Much of its capability is locked within a few economies, firms, and industry clusters, leaving wide gaps in access and productivity. Bridging this divide will require a deliberate shift from adoption to innovation diffusion.

Advanced Asian nations and China: 'Shaping' frontier technologies. China, Japan, Singapore, and South Korea sit at the forefront of Asia's technological transformation. They create and export new technologies, shaping global value chains in advanced manufacturing, electronics, and artificial intelligence. Together, they account for roughly 95% of Asia's patent filings and host the region's most sophisticated industrial ecosystems, from semiconductors and robotics to AI and clean technology. Their economies combine deep manufacturing capacity, globally competitive R&D networks, and innovation systems that link research institutions, corporations, and venture investors.

Their R&D intensity averages 2.9% of GDP,[99] well above the regional median, and their industries are home to some of the world's most sophisticated production systems. Asia today produces 86% of global chip capacity,[100] and it encompasses four of the world's five most robotized manufacturing economies—China, Japan, Singapore, and South Korea.

Within this group, progress varies. China's ascent has been the most dramatic, compressing advances that took other countries several decades to achieve into less than a generation. From 2000 to 2020, China's patent filings multiplied 28-fold, overtaking both Japan and the United States and making China the world's largest source of patent applications.[101] Fueled by large-scale investment in digital infrastructure, advanced manufacturing, and AI, China has rapidly shifted from the world's factory to one of its leading innovation hubs. China released 15 foundation AI models in 2024, holds about 70% of global AI patents, and commands 15% of global in computing capacity (see Box 1, "China's AI push

96 Analysis of World Bank data.

97 *World intellectual property indicators 2024*, World Intellectual Property Organization (WIPO), 2024.

98 Comparative Industry Service Database, S&P Global, accessed November 7, 2025.

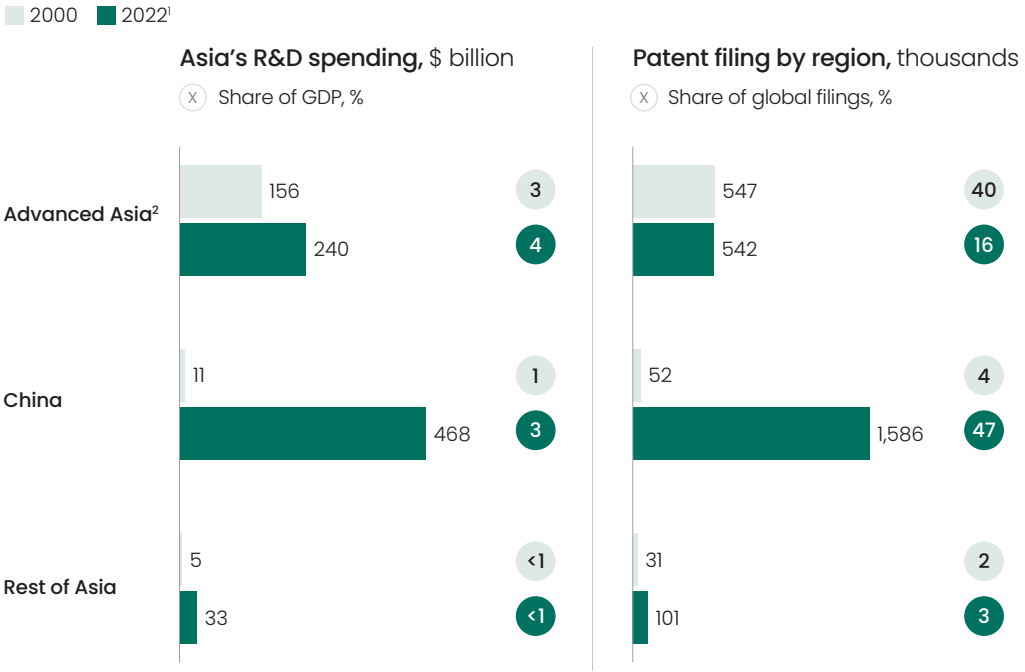
99 Analysis of World Bank data.

100 Florian Zandt, "Where can the most chips be manufactured?," Statista, December 5, 2023.

101 Analysis of World Bank data.

Exhibit 11

ASIA'S R&D SPENDING AND PATENT FILING HAVE SHOWN IMMENSE GROWTH, WITH ADVANCED ASIA AND CHINA LEADING THE WAY.



[1]2022 R&D expenditure was used when published for that year; otherwise, the most recent pre-2022 figure was used.
[2]Japan, Singapore, and South Korea.
Source: World Bank

puts it at the forefront of Asia's technological innovation").[102]

Singapore and South Korea have also sustained strong momentum. South Korea continues to lead globally in memory semiconductor fabrication (60.5% of the global memory market),[103] while Singapore has become a regional hub for AI, data infrastructure, and digital services, supported by its National AI Strategy 2.0, which commits 500 million Singapore dollars (US $385 million) over five years to AI research and development.[104]

Japan is a more complex case. It remains one of the world's most technologically capable economies, yet its digital transformation has progressed more slowly than those of its peers in advanced Asia. A combination of organizational inertia, aging management structures, and legacy IT systems has constrained adoption of new technologies.[105]

For all their technological advances, even the shapers remain dependent on imported core technologies such as advanced lithography, chip design, and enterprise software, showing that while they shape the global technology landscape, they do not yet dominate it.

102 For share of global AI patents and foundation AI models quantity, see *Artificial intelligence index report 2025*, Stanford Institute for Human-Centered AI, 2025. For GPU compute capacity, see Konstantin F. Pilz et al., "The US hosts the majority of GPU cluster performance, followed by China," Epoch AI, June 5, 2025.

103 "Semiconductor fact sheet," Invest Korea, accessed November 13, 2025.

104 *AI for the public good, for Singapore and the world*, Government Technology Agency of Singapore, December 4, 2023.

105 "Comprehensive report compiled by the legacy systems modernization committee to eliminate legacy systems," Japan Ministry of Economy, Trade and Industry, May 28, 2025; "Promotion of software modernization," Japan Information-technology Promotion Agency, updated June 3, 2025.

Box 1

CHINA'S AI PUSH PUTS IT AT THE FOREFRONT OF ASIA'S TECHNOLOGICAL INNOVATION

China has moved at high velocity since releasing the 2017 New Generation AI Development Plan,[1] which set a goal for the country to become the world's primary AI innovation center by 2030. The country combines breadth in research with applications despite some limitations in capital, computing, and compliance.

Measured by research output and intellectual property generation, China ranks first globally. In 2023 it produced about 23% of global AI publications and roughly 23% of citations, higher than any other country.[2] Its intellectual property pipeline is deep. From 2014 to 2023, China accounted for more than 38,000 gen AI inventions, about six times more than the United States.[3] Model building is advancing, with several notable Chinese AI models released in 2024 alongside rapid build-out of data centers and domestic accelerator efforts.

These gains have come despite real challenges. Private AI investment was about $9.3 billion in 2024 versus roughly $109 billion in the United States,[4] weighing on the pace of data center scaling and talent attraction. Limited access to extreme ultraviolet lithography and advanced, high-performance chips (seven nanometers or less) constrain training capacity, while ongoing brain drain and uneven enterprise adoption hinder diffusion. Despite these constraints, China has continued to narrow performance gaps through focused deployment, fast iteration, and flagship models such as DeepSeek, demonstrating the resilience and innovation potential of its AI ecosystem.

Looking ahead, continued maturation of domestic investment and capital mobilization could sustain momentum, although chip limitations and funding differentials are likely to keep frontier computing as the binding constraint.

1 Graham Webster et al., "Full translation: China's 'New Generation Artificial Intelligence Development Plan' (2017)," DigiChina, Stanford University, August 1, 2017.

2 *Artificial intelligence index report 2025*, Stanford Institute for Human-Centered AI, 2025.

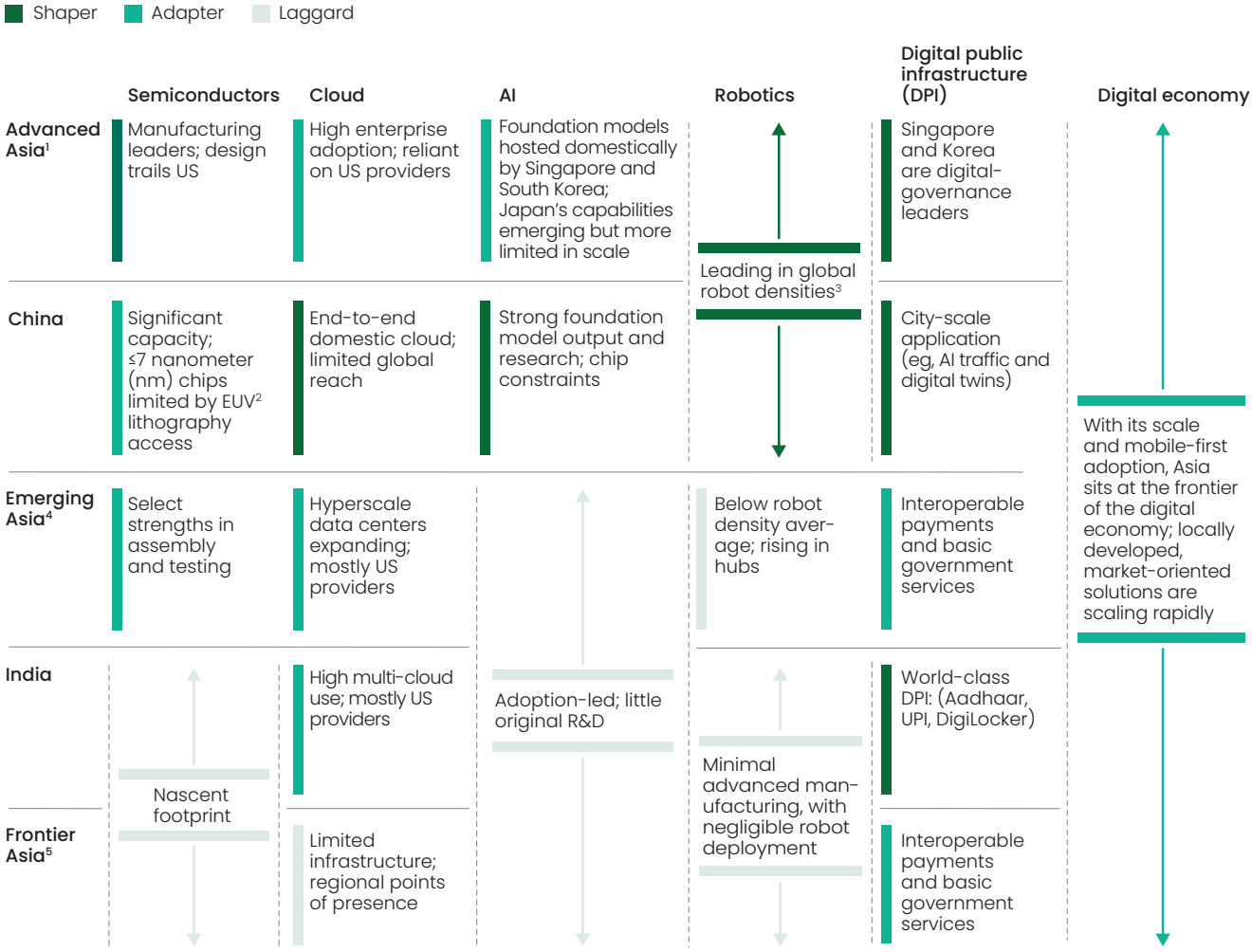
3 "China-based inventors filing most GenAI patents, WIPO data shows," WIPO, July 3, 2024.

4 "Economy," *Artificial Intelligence Index Report 2025*, Stanford Institute for Human-Centered AI, 2025.

> **"For all their technological advances, even the shapers remain dependent on imported core technologies . . . showing that while they shape the global technology landscape, they do not yet dominate it."**

Exhibit 12

ASIA'S TECHNOLOGICAL READINESS IS UNEVEN, WITH SOME REGIONS ADVANCED IN TECH AND OTHERS LAGGING.



[1]Japan, Singapore, and South Korea.
[2]Extreme ultraviolet. This technology is essential for manufacturing =7 nm chips that power AI training.
[3]Korea ranked number 1 globally, with 1,012 robots per 10,000 employees; Singapore ranked number 2, with 770; China ranked number 3, with 470; and Japan ranked number 5, with 419.
[4]Indonesia, Malaysia, Philippines, Thailand, and Vietnam.
[5]Bangladesh, Kazakhstan, Pakistan, and Uzbekistan.
Source: Cushman & Wakefield; International Federation of Robotics; Stanford's AI Index; Statista

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'Adopter' economies are rapidly scaling existing technologies. India, Indonesia, Malaysia, Thailand, and Vietnam are the region's technological accelerators. They excel at scaling and localizing existing technologies rather than inventing them, for the most part . Their strength lies less in frontier R&D than in adoption at scale. They leverage large consumer markets, competitive labor costs, and growing integration into regional and global value chains to diffuse new technologies rapidly across industries.

These countries' ability to deploy technology at scale is underpinned by significant demand and market connectivity. India's vast domestic market allows digital platforms such as the Universal Payments Interface (UPI) and the Open Network for Digital Commerce (ONDC) to reach hundreds of millions of users (see Box 2, "How open digital infrastructure transformed India's payment ecosystem and became a model for others"). Southeast Asia's economic integration helps firms in Malaysia, Thailand, and Vietnam

access supply chains that stretch across the globe, enabling fast technology transfer. Malaysia and Vietnam are deepening their semiconductor assembly, testing, and electronics clusters. For their part, Indonesia and Thailand are scaling e-commerce and hyperscale cloud ecosystems that serve consumers across borders.[106]

But these countries face infrastructure barriers that limit how deeply and quickly they can adopt these fronter technologies. Access to reliable power, broadband, and data centers remains uneven, and power outages remain pervasive: More than 13% of firms in emerging and frontier Asian economies report outages, compared with less than 5% in advanced Asia.[107] Broadband penetration averages 60% compared with 90% in advanced Asia,[108] and regional computing capacity is also thin: Except for Malaysia, countries in this group that host hyperscalers have computing capacity of more than 800,000 people per megawatt (compared with 30,000 in the United States).[109] The other countries in this segment still rely on regional network interface points of presence (PoPs). R&D spending is below 0.6% of GDP,[110] but agile private sectors and competitive workforces allow firms to scale technologies quickly once introduced. Still, most remain reliant on technology transfer from multinational firms rather than on domestic innovation.

However, some countries don't just adopt a technology; they push it to the next level. Southeast Asia's "super apps" (including Grab, GoTo, and Sea) are a prime example: They began with a single service (often ride-hailing) and then bundled in food delivery, e-wallets, microloans and insurance, and merchant mini apps. This bundling helps organizations navigate a fragmented, cross-border region with many underbanked, mobile-first users who rely on street-agent networks, cash-in/cash-out points, and QR payments rather than cards. As a result, these super apps have become globally competitive at onboarding,[111] last-mile logistics,[112] and fintech attachment.[113]

'Laggard' economies are still laying the digital foundations. The laggards are largely frontier Asian economies. Their priorities center on connectivity, inclusion, and public digital infrastructure. Broadband access, digital IDs, and interoperable payments are expanding fast, often modeled on India Stack–style frameworks.[114] Mobile-first fintech ecosystems have brought millions of people into the formal economy, showing that diffusion of simple technologies can yield transformative social impact. Bangladesh's mobile-financial-services companies have more than 200 million registered accounts, while 84% of payments in Pakistan are digital. Kaspi, an innovative bank in Kazakhstan, has a super app that connects users with more than 500,000 active merchants, a Kazakh version of Amazon.[115]

106 For Malaysia's semiconductor industry, see "Securing Malaysia's position in the global semiconductor supply chain," Malaysian Investment Development Authority, September 11, 2024. For Vietnam's, see "$1.6 billion semiconductor plant inaugurated in Bắc Ninh," *Viet Nam News*, October 11, 2023. For Indonesia and Thailand e-commerce, see "Thailand" in *e-Conomy SEA 2024*, Google, Tamasek, and Bain & Company. For cloud, see "Microsoft opens its first cloud region in Indonesia to unlock the new AI economy," Microsoft, May 27, 2025, and "AWS launches infrastructure region in Thailand," Amazon, January 8, 2025.

107 "Firms experiencing electrical outages (% of firms)," World Bank, accessed November 13, 2025.

108 Weighted average 2022 for Malaysia, Thailand, Vietnam, India, and Indonesia; weighted average 2023 for Japan, South Korea, Singapore, and China. "Individuals using the internet (% of population)," World Bank, accessed November 13, 2025.

109 "Malaysia, Thailand, Japan set pace on Asia Pacific data centre construction per capita through end of decade," Cushman & Wakefield, June 12, 2025.

110 Analysis of World Bank data.

111 Grab says it has onboarded about 600,000 micro-, small, and medium-size enterprises (MSMEs) in 2024 into its ecosystem, reflecting fast merchant activation across multiple markets; "Uplifting MSME merchant-partners," Grab, accessed November 13, 2025. GoTo also has about 14 million registered merchants; "How Tokopedia became an ecommerce titan in Indonesian market," Cube, June 13, 2024.

112 GoTo now covers 99% of Indonesian cities and reports about 60% next-day delivery, showing logistics execution at national scale; "How Tokopedia became an ecommerce titan in Indonesian market," Cube, June 13, 2024.

113 Grab weaves GrabPay through rides, food, and retail; Andrew Wang, "GrabPay: Enabling smoother, safer payments in Southeast Asia," Adyen, September 18, 2019. Shopee's checkout is integrated with ShopeePay, which is Sea's wallet under its digital financial-services arm, Monee (formerly SeaMoney); "Mobile wallets," SeaMoney, accessed November 13, 2024. GoTo embeds fintech by routing Tokopeida (GoTo's e-commerce platform) checkouts through GoPay and GoPayLater; "GoTo Financial," GoTo, accessed November 13, 2024; " GoTo's 'buy now, pay later' service is now on ShopTokopedia," GoTo, July 29, 2024.

114 India Stack is a set of open APIs and digital public infrastructure that enable digital identity, data sharing, and payments at population scale.

115 For Bangladesh, see "MFS transactions hit record Tk 1.64 trillion in December," *Financial Express*, February 16, 2025. For Pakistan, see "SBP releases Annual Payment Systems Review for FY24," Pakistan External Communications Department, October 11, 2024. For Kazakhstan, see *Kaspi.kz 3Q 2024 results*, Kaspi.kz, October 18, 2024.

Box 2

HOW OPEN DIGITAL INFRASTRUCTURE TRANSFORMED INDIA'S PAYMENT ECOSYSTEM AND BECAME A MODEL FOR OTHERS

The "shapers versus adopters" dynamic isn't a general rule: Asian countries lead in some technologies and follow in others. Emerging Asia and India have built local solutions that others now emulate. In other words, so-called adopter ecosystems do not simply imitate others; they are also able to create solutions that the rest of the world can learn from.

Over the past decade, India has carried out one of the world's most remarkable digital transformations by building a suite of open, interoperable public platforms known collectively as the Digital Public Infrastructure (DPI). At the core of this so-called Tech Stack are three layers: digital identity (Aadhaar), real-time payments (UPI), and data empowerment systems (such as DigiLocker and Account Aggregator). Together, they form the backbone of a trusted, low-cost, and inclusive digital economy that allows more than one billion people to participate seamlessly in the formal financial system.

The numbers are striking. In August 2025, India's Unified Payments Interface (UPI) processed more than 20 billion transactions worth roughly $300 billion.[1] Aadhaar, India's unique digital identity system, now covers nearly 100% of the country's adults[2] and recorded more than 2.8 billion monthly authentications,[3] enabling everything from instant bank onboarding to government benefit transfers. Meanwhile, DigiLocker—the nation's digital document wallet—has more than 500 million users,[4] and the Account Aggregator framework is rapidly transforming how individuals and businesses share financial data securely, with more than two billion financial accounts now enabled for consent-based sharing.[5]

India treated its digital-payment rails not as proprietary systems but as public goods, available through open APIs and governed by transparent standards. The National Payments Corporation of India (NPCI) and Reserve Bank of India (RBI) played catalytic roles, blending public oversight with private innovation. This approach connected about 675 banks and more than 80 apps,[6] enabling them to innovate atop common rails and creating competition in the market. The result is that anyone with a mobile phone and a bank account can send money instantly and securely across any institution, regardless of geography or device.

The societal dividends of this architecture are profound. Digital payments connect small merchants, farmers, gig workers, and women entrepreneurs. QR codes now adorn roadside tea stalls; salaries and subsidies arrive instantly in bank accounts; microloans and insurance are underwritten based on real-time transaction data. By early 2025, digital payments accounted for more than 99.8% of retail transaction volumes in India. These advances are not just about convenience; they have deepened trust, reduced leakage in welfare transfers, and formalized vast segments of the informal economy.

India's open digital-payments ecosystem is now shaping the global conversation. Several countries—including France, Singapore, Sri Lanka, and the United Arab Emirates—are adopting or interlinking with India's UPI model, recognizing the power of public digital infrastructure as a platform for inclusive growth. The Indian experience shows that when identity, payments, and data are designed as interoperable public utilities rather than private fiefdoms, digital transformation can scale both equitably and sustainably.

1 "Product statistics," National Payments Corporation of India, accessed November 13, 2025.

2 Aman Sharma, "99.9% adults in India have Aadhaar number and 'use it at least once a month', says UIDAI," Firstpost, July 23, 2022.

3 "Over 284 crore Aadhaar authentications in January 2025; 32% jump y-o-y sign of growth of digital economy with Aadhar playing an integral role in daily life," India Ministry of Electronics and IT, February 8, 2025.

4 As of July 2025; "Ten years of digital progress: Building an inclusive and future-ready India," India Press Information Bureau, July 1, 2025.

5 "Celebrating four years of launch of the Account Aggregator Ecosystem - India's Digital Public Infrastructure (DPI)," Ministry Industry of Finance, September 2, 2025.

6 "India's UPI revolution: Over 18 billion transactions every month, a global leader in fast payments," India Press Information Bureau, July 20, 2025.

The constraint is less about invention and more about last-mile connectivity, including issues of trust, and policy execution at scale. This is especially the case for countries such as Bangladesh and Pakistan, where internet penetration is less than 45%[116] and where firms experience frequent power outages.[117]

BUSINESS AND TALENT READINESS: COUNTRIES FACE CHALLENGES IN PROVIDING YOUTH WITH THE SKILLS THAT EMPLOYERS NEED

The ability to harness technology depends as much on people and institutions as on the technology itself. Across Asia, readiness among businesses and workers is as varied as technological depth. Advanced Asian economies possess capital, infrastructure, and digital ecosystems, but their firms often move cautiously, constrained by legacy systems and risk-averse cultures. In contrast, emerging Asian economies are eager adopters yet face capacity constraints. Across both groups, a shortage of tech-skilled workers remains a shared constraint.

To understand business and talent readiness for technology adoption in Asia, we launched two complementary surveys across Asia: the youth survey previously mentioned and a second survey involving about 1,700 business executives in nine countries . These surveys, similar to those conducted for other reports in this series, inform

116 Individuals using the internet (% of population), World Bank.

117 For Bangladesh, see *Bangladesh: April 2025 country private sector diagnostic*, World Bank Group, April 2025; for Pakistan, see *Gallup Pakistan analysis of World Bank Enterprise Survey*, Gallup Pakistan, July 2023.

and corroborate the other research findings. The questions covered issues including tech adoption, labor and skill shortages, youth upskilling, career expectations, and tech readiness.[118]

Business readiness marked by security concerns, an SME adoption gap in advanced Asia, and structural and financial barriers in emerging and frontier Asia

Across Asia, risk and security concerns stand out as the leading barrier to technology adoption. In our executive survey, 49% of respondents cited these concerns, a significantly higher percentage than in other regions—22 percentage points above the United States and 19 points above Europe. This gap likely reflects the region's growing exposure to cyberthreats: Asia–Pacific experienced 34% of global attacks in 2024 (up from 23% in 2023), ten percentage points more than North America. The rise in such attacks stems from the region's critical role in global supply chains and its status as a technology and manufacturing hub. With manufacturing the most-targeted sector globally, cyberattacks continue to exploit outdated legacy systems, which are common in this sector.[119]

In advanced Asia, larger firms are generally well capitalized and operate within mature technology ecosystems. However, our survey highlights a gap between large companies and small and medium-size enterprises (SMEs) with fewer than 500 employees: Only 48% of SMEs use AI, compared with 79% of large firms (Exhibit 13). The pattern is similar in cloud adoption (21% versus 46%). While SME adoption is expected to remain modest, the challenge is more persistent in these markets because the gap between SMEs and large firms is wider than in other regions. In Europe, the gap between large firms and SMEs is 12 percentage points in AI and 19 in cloud, whereas in the United States, it is ten points in AI and two in cloud.

Japan stands out as a relatively reluctant player. Survey results indicate that many businesses remain cautious about disruptive technologies, preferring incremental improvement over transformation. Reflecting this mindset, only 64% of surveyed business executives in Japan said they expect to use AI within five years, the lowest in the region. This hesitancy, which may be rooted in risk aversion,[120] aging management structures, and ingrained work practices, limits the diffusion of new technologies despite high on-paper readiness. For example, legacy IT systems still account for 90% of total enterprise IT spending in about 40% of businesses, and the average CEO age is 60.[121]

Emerging and frontier Asian economies have a large appetite for digital transformation but are constrained by financial and infrastructure challenges. In India, Indonesia, and Vietnam, more than 86% of executives responding to the survey expect their companies to use AI tools within five years. However, firms in these economies typically face structural and financial barriers to execution. Most businesses in the segment are SMEs, accounting for 81% of total employment, compared with 53% in advanced Asian economies.[122] Limited access to finance, smaller operational scale, and a shortage of digital management talent are seen as constraining their ability to adopt technology at depth.[123] As a result, digitalization remains concentrated among large corporations and foreign-invested firms, while most SMEs trail behind.

Talent readiness: Tech skill shortages and talent retention challenges

Talent readiness is a significant constraint across Asia. Advanced technologies have rewritten the skills playbook for nearly every industry, making digital capabilities essential well beyond IT. In today's digital age, literacy means not only

118 For details of the surveys, see the technical appendix. Survey findings may be constrained by cultural biases, age distributions, language differences, and survey timing, which could potentially reduce comparability.

119 *IBM X-Force 2025 Threat Intelligence Index*, IBM, 2024.

120 Chiharu Nakayama, "Reconciling tradition and innovation: Japan's path to global AI leadership," World Economic Forum, December 17, 2024.

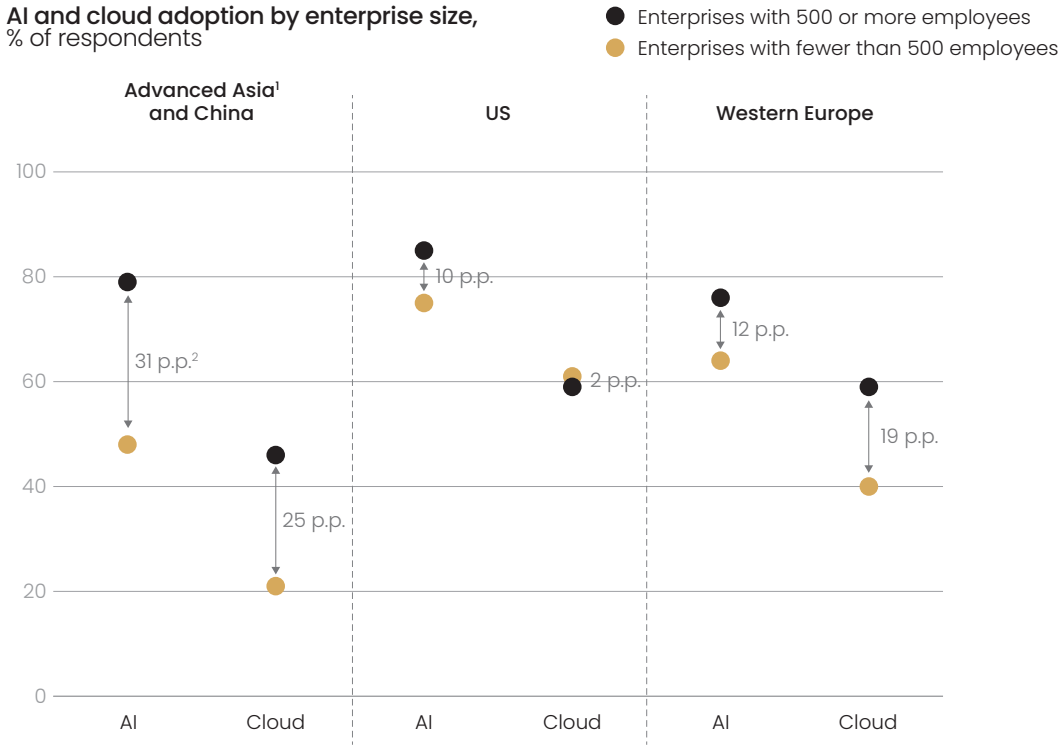
121 For legacy system, see "What is the 2025 cliff? Why Japanese business owners can't ignore the 2025 cliff anymore," VTI, December 11, 2024. For average age of CEOs, see "Nationwide 'CEO age' analysis survey (2024)" [全国「社長年齢」分析調査(2024年)], Teikoku Databank, March 26, 2025.

122 The ILO defines SMEs as enterprises with fewer than 50 employees. The most recent data for available countries were used for Indonesia, Japan, South Korean, Thailand, and Vietnam.

123 *SME digitalisation to manage shocks and transitions*, OECD, September 16, 2024.

Exhibit 13

SMALL AND MEDIUM-SIZE ENTERPRISES IN ADVANCED ASIA AND CHINA LAG IN KEY TECH ADOPTION COMPARED WITH OTHER REGIONS.



[1]Japan, Singapore, and South Korea.
[2]Percentage points.
Source: Future of Work Survey – Asia 2025

reading and writing but also using technology in daily life. The bar for proficiency now rises far above basic digital skills: Advanced tech skills are increasingly required across non-tech roles. At the same time, these higher requirements collide with the outflow of top tech talent to global hubs, making it harder to staff critical roles and scale digital programs. To be ready for the future of work, Asia needs to close digital-literacy gaps and upskill youth to meet today's job requirements. It also needs to invest in retaining talent.

Tech skills gaps are particularly evident from our surveys. When asked whether their workforces had the right tech skills to meet the business strategy, only 29% of business leaders reported that more than 80% of their workforce has the tech skills required to meet business goals. Respondents identified the most acute shortages in occupations requiring technology development and data science and analytics (Exhibit 14). The mismatch begins at the entry point: 64% of executives said hiring is difficult, while only 42% view graduates as job-ready, a gap directly linked to curriculums that underemphasize tech skills (Exhibit 15). Asian youth concur: In our survey, 69% of youth respondents said their education does not sufficiently emphasize tech (Exhibit 16).

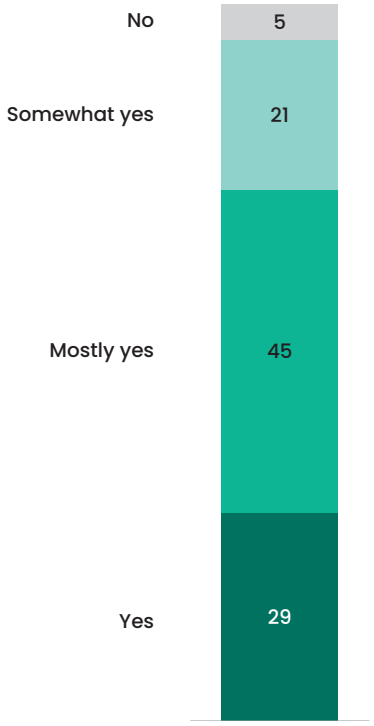
Across advanced Asia, a paradox becomes evident: While respondents said these countries have the most digitally skilled employees in Asia (Exhibit 17), businesses in the region face more difficulties in hiring and have a lower perception of youth job readiness. This could reflect a tighter labor market, higher expectations, and more complex digital demands rather than lower capability.

China stands out for tech skills readiness. Its advances in AI and cloud, which it achieved with limited reliance on imported talent, point to strong domestic capability. Among Asian countries surveyed, Chinese business leaders expressed the least concern about lack of emphasis on digital skills in academic curriculums. While the country has some educational mismatches,

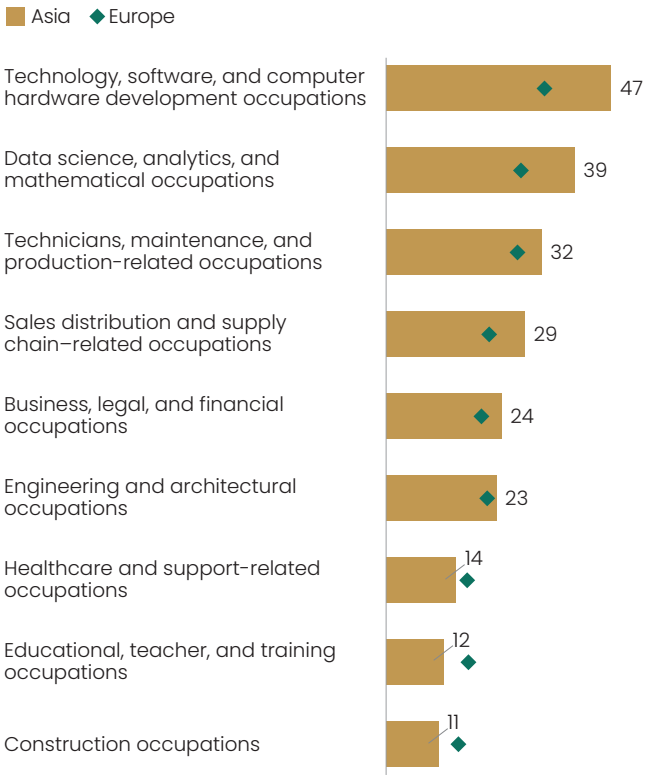
Exhibit 14

ONE-QUARTER OF ASIAN BUSINESSES' WORKFORCES DO NOT HAVE THE REQUIRED TECH SKILL.

Does your workforce have the right tech skills to meet your business strategy?,
% of respondents, n = 1,688



Where do you currently have shortages?,
% of respondents, n = 1,688



Source: Future of Work Survey – Asia 2025

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unemployment pressures appear to be less pronounced than in other countries.

Education may be the key here. The scale of China's tech-education transformation is unprecedented, driven by sustained education reforms and robust industry–academia collaboration. Structural reforms in higher education include the creation of dedicated AI schools, expansion of graduate enrollment in strategic disciplines, and integration of STEM into vocational education. These have produced skilled talent at scale. More than 40% of students graduating from Chinese universities now hold STEM degrees , significantly higher than Japan (about 20%) and South Korea (about 30%).[124]

Furthermore, industry and academia in China are integrated at an institutional depth unmatched by regional competitors. The government's ten-year Plan for Educating and Training Outstanding Engineers, launched in 2010, exemplifies this: More than 10,000 companies contracted to participate, including more than 5,000 large enterprises and more than 4,000 high-tech firms, collectively investing $360 million.[125] This led to the creation of more than 600 national-level education centers for engineering

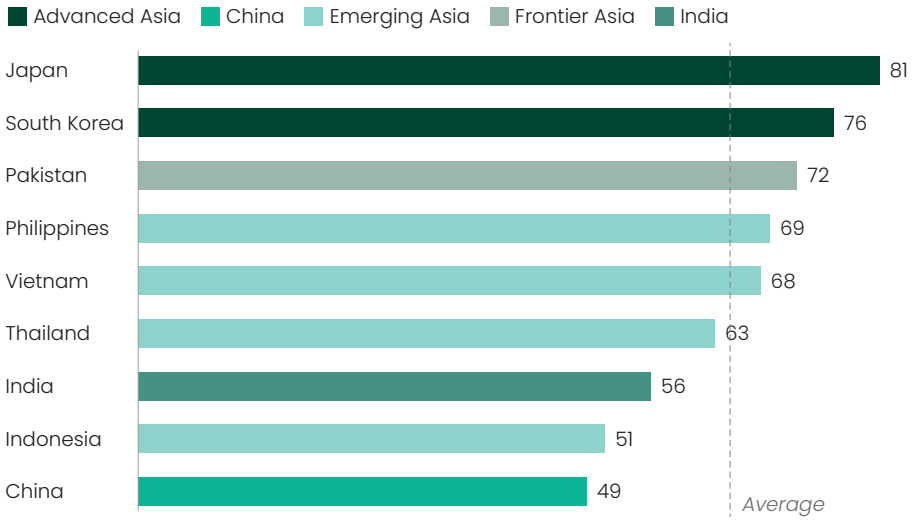
124 For China, see Brendan Oliss, Cole McFaul, and Jaret C. Riddick, "The global distribution of STEM graduates: Which countries lead the way?," Center for Security and Emerging Technology, November 27, 2023. For Japan, see "Japan: Overview of the education system (EAG 2025)," OECD, accessed November 13, 2025. For South Korea, see "Korea: Overview of the education system (EAG 2025)," OECD, accessed November 13, 2025.

125 Hang Zhang and Ming Li, "Experiences, issues and reflections of school-enterprise joint training in Chinese mainland under the vision of PETOE strategy: An empirical study based on small-n cases," American Society for Engineering Education, June 2020.

Exhibit 15

EXECUTIVES IN ADVANCED ASIA REPORT THE MOST HIRING DIFFICULTIES.

Do you face difficulty in hiring?, % of respondents, n = 1,688

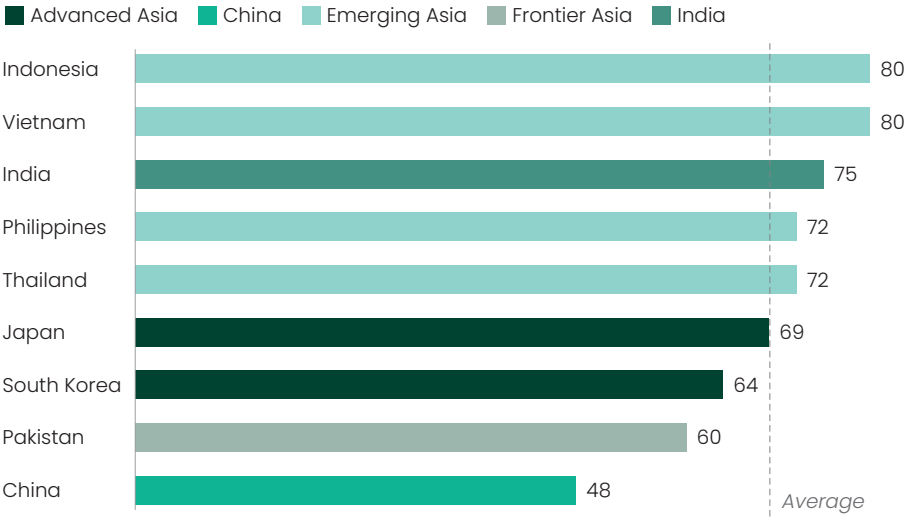


Source: Future of Work Survey – Asia 2025

Exhibit 16

YOUTH ACROSS ASIA REPORT THAT TECH SKILLS ARE UNDEREMPHASIZED IN ACADEMIC CURRICULA, THOUGH LESS SO IN CHINA.

Do you think that tech skills are/were underemphasized in academic curricula?,
% of respondents, n = 928

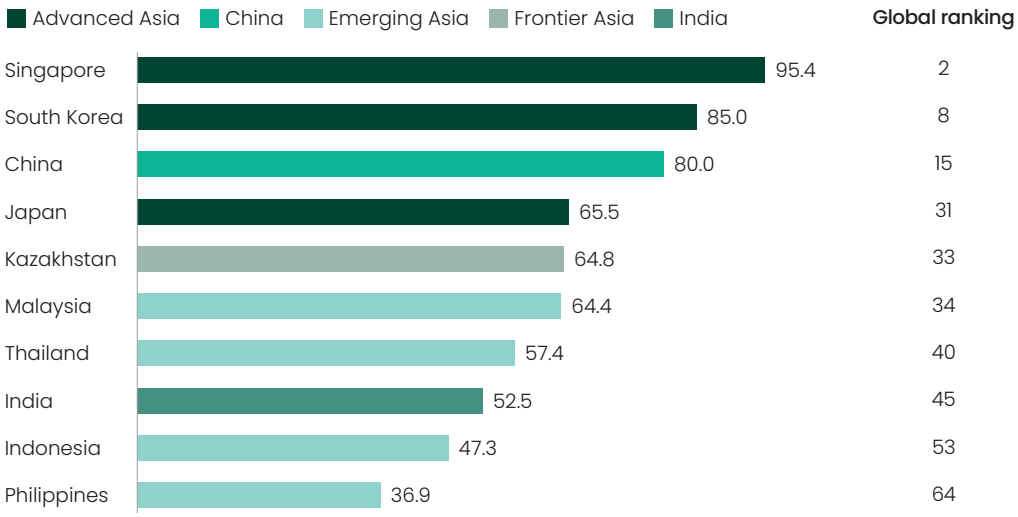


Source: Future of Work Survey – Asia 2025

Exhibit 17

SINGAPORE, SOUTH KOREA, AND CHINA LEAD IN DIGITAL TALENT, WHILE THE REST OF ASIA HAS ROOM TO IMPROVE.

IMD's Digital Competitiveness Ranking, knowledge criteria,[1] 2024



[1]Measures the know-how necessary to discover, understand, and build new technologies. Includes talent, training and education, and scientific concentration.
Source: Future of Work Survey – Asia 2025

practice, in which students complete mandatory one-year enterprise training. The impact is evident in our survey results: Chinese youth are the most likely in the region to report closing skills gaps through internships or part-time work (Exhibit 18).

By contrast, Japan appears to lag behind some peers in core tech skills. Historically, its technological strength stemmed less from education quality and more from an intensive on-the-job training model, in which firms hired new graduates as generalists and developed them into specialists once they started working. That system produced company-specific expertise and sustained innovation. But rapid digital transformation now demands ready-made capabilities that on-the-job training alone cannot supply; accordingly, firms are starting to question the rigidity of this program. Furthermore, the system is based on hiring from select universities rather than focusing on skills. As Japan's population declines, sought-after talent is becoming scarcer; the new-job-to-applicant ratio for IT engineers is now 3.4.[126]

For their part, many emerging and frontier economies continue to struggle in digital education. For example, Asia accounts for 30 universities in the global top 100 for computer science and information systems[127]—but only three of those universities are in emerging and frontier economies (two in India and one in Malaysia). While there are many engineering schools in these countries, some are of insufficient quality. As a result, these countries face a thinner pipeline of top talent with advanced skills in cutting-edge technology. This limits innovations in advanced software engineering, data science, and AI; reduces university–industry spillovers and start-up formation; and ultimately slows productivity growth and R&D intensity. These limitations are particularly evident in India, which produces many mid-level ICT engineers but far fewer

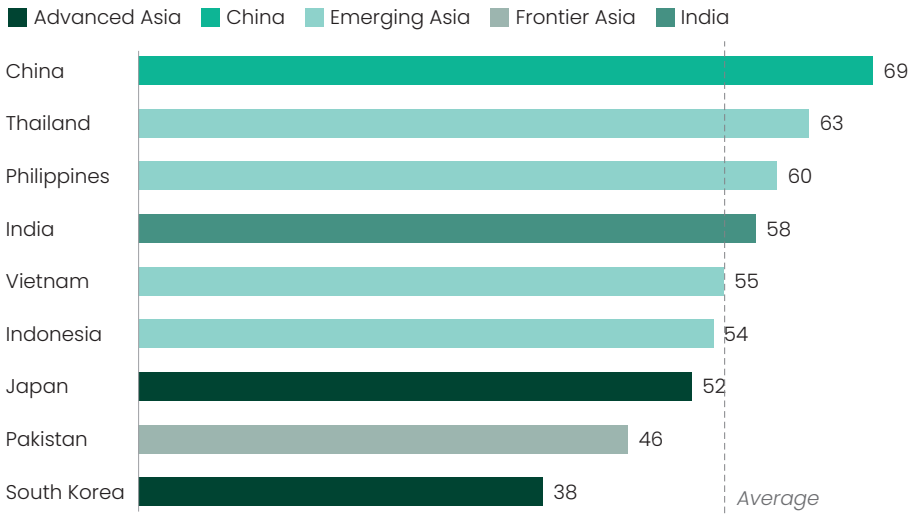
126 "What is the effective job vacancy rate for IT engineers? Latest trends and recruitment tips for November 2025" [ITエンジニアの有効求人倍率は？2025年11月の最新動向と採用のコツを解説], Type, updated November 5, 2025; "General employment placement status (September 2025)" [般職業紹介状況(令和7年9月分)について], Japan Ministry of Health, Labour and Welfare, October 2025.

127 "QS world university rankings by subject 2025: Computer science and information systems," QS Top Universities, March 12, 2025.

Exhibit 18

CHINESE YOUTH ARE MORE LIKELY TO ADDRESS SKILL GAPS USING INTERNSHIPS OR PART-TIME JOBS.

Do you address skill gaps through internships or part-time jobs?,
% of respondents, n = 928



Source: Future of Work Survey – Asia 2025

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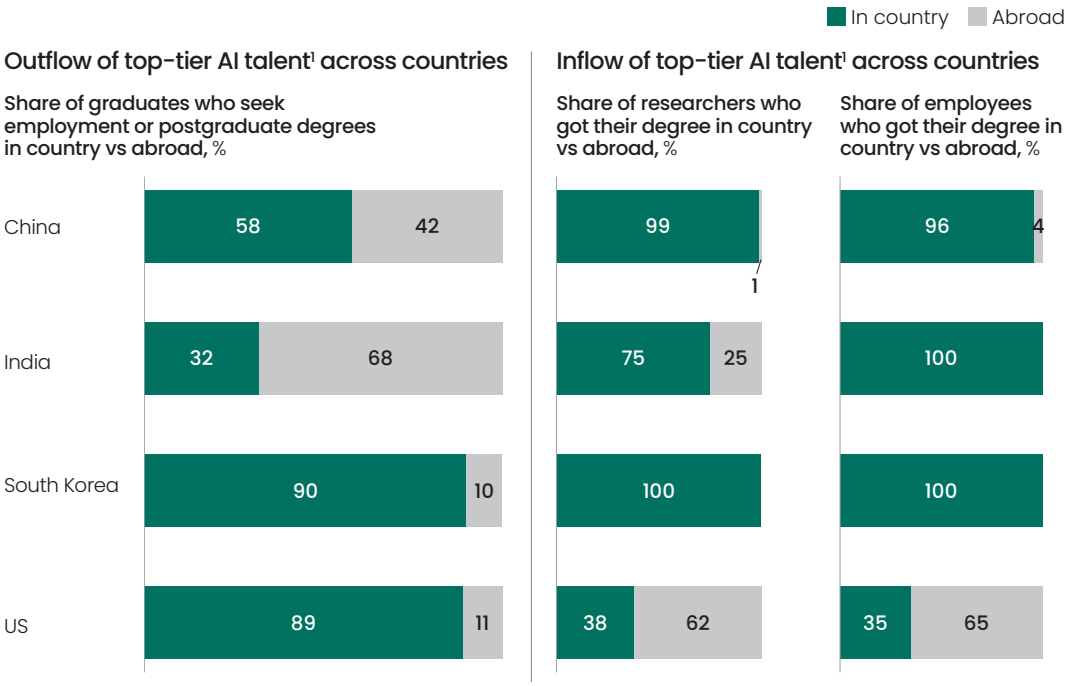
Exhibit 19

RETAINING AND ATTRACTING TOP AI TALENT IS CHALLENGING FOR ASIAN ECONOMIES.



[1]The analysis was done in 2022, based on data set that includes only the authors of papers accepted at NeurIPS (the Neural Information Processing Systems Foundation).
Source: MacroPolo's Global AI Talent Tracker 2.0

advanced AI engineers, relative to its population, than China.

Brain drain is also a constraint across Asia. For example, China, India, and South Korea are experiencing substantial outflows of top AI talent (Exhibit 19).[128] According to the Paulson Institute, only about 58% of top AI workers[129] who completed undergraduate degrees in China work or pursue a postgraduate degree in China. In India, the figure is even lower, at about 32%. Meanwhile, about 10% of top AI talent from South Korea is employed abroad. In some countries in the region, specific patterns are emerging for tech talent. For example, Malaysia is ceding skilled professionals to nearby Singapore. These outflows are driven largely by wage and funding differentials. Access to frontier computing also plays a role, along with attractive immigration pathways in established hubs such as the European Union, Singapore, and the United States. Looking ahead, flows could be tempered by tighter visa laws, national onshoring incentives, and the rising attractiveness of domestic ecosystems that would reduce the need to relocate.

For all the gaps noted above, Asia's youth remain a powerful source of potential. About 72% of survey respondents expressed interest in AI-related work, far higher than our previous surveys found in Europe or the United States . This enthusiasm suggests that, with the right access to training and opportunities, young people could rapidly build the capabilities needed to close the region's tech skills gap.

128 "The global AI talent tracker 2.0," Macro Polo, accessed November 13, 2025.

129 "The global AI talent tracker 2.0," Macro Polo, accessed November 13, 2025.

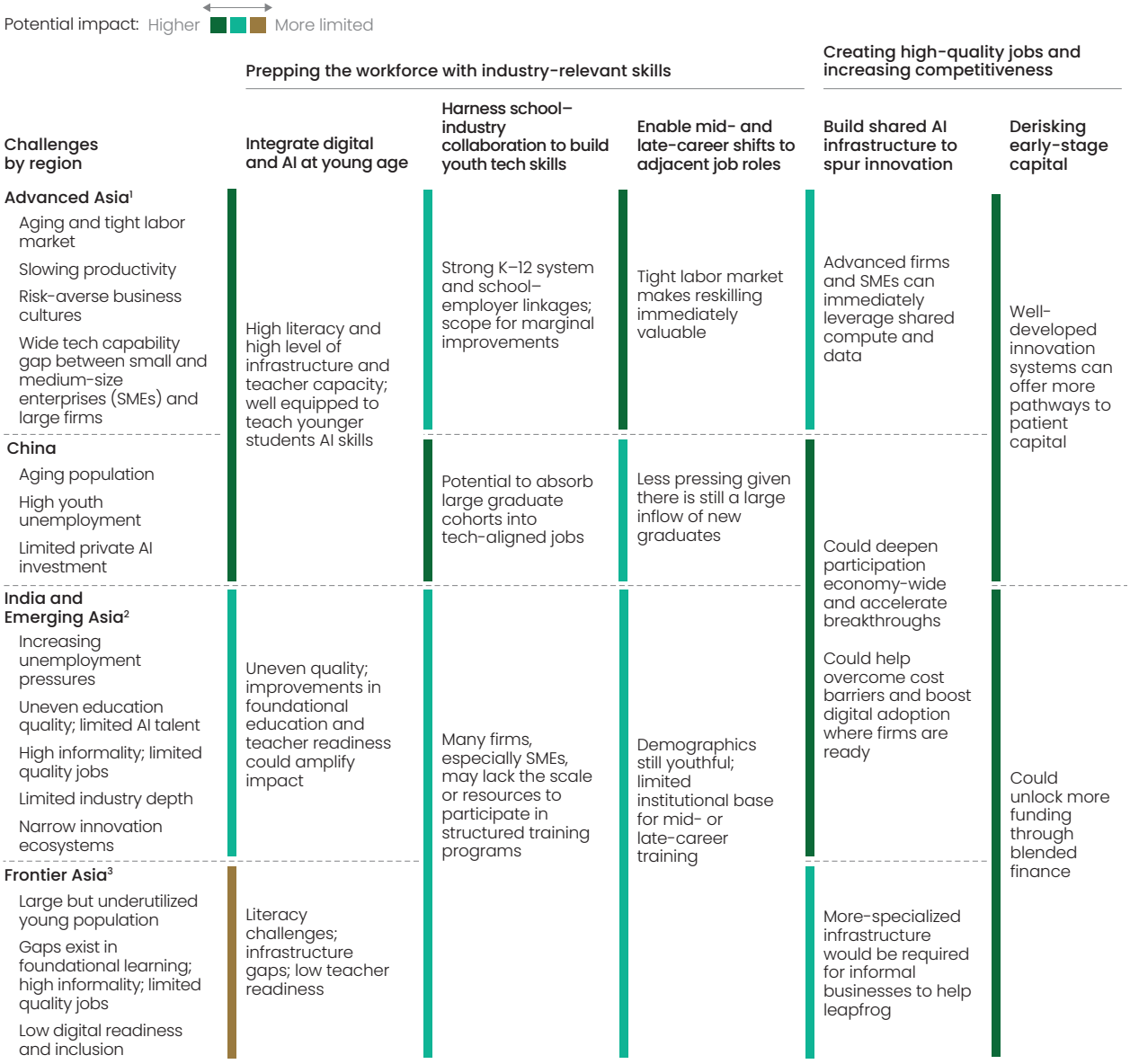
3 ALIGNING SKILLS AND JOBS FOR ASIA'S NEXT PHASE OF GROWTH

ASIA'S NEXT PHASE will not be based on a single path forward, but common priorities are emerging across the region. Countries will need to equip workers with future-ready skills by integrating digital and AI literacy early in education, harnessing school–industry collaborations to build tech skills, and enabling mid- and late-career shifts to "adjacent" jobs. At the same time, creating better jobs will depend on enabling widespread technology adoption and competitiveness. This could be achieved through shared AI infrastructure that democratizes access to innovation and through financing mechanisms that derisk investment in emerging tech sectors (Exhibit 20).

Such solutions are by no means exhaustive nor comprehensive, but they address the current tech landscape's challenges with human capital and business and labor competitiveness highlighted in the previous chapters. Such solutions can take the form of systematic policy-driven initiatives, or they can be orchestrated on a smaller yet still powerful scale.

Exhibit 20

ASIA'S SEGMENTS REQUIRE DIFFERENT INTERVENTIONS TO KEEP WORKERS FUTURE-READY AND ENHANCE JOB QUALITY.



[1]Japan, Singapore, and South Korea.
[2]Indonesia, Malaysia, Philippines, Thailand, and Vietnam.
[3]Bangladesh, Kazakhstan, Pakistan, and Uzbekistan.

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BOTH YOUTH AND MID-CAREER WORKERS NEED FUTURE-READY SKILLS

To keep their workforces competitive, countries need to tailor their approaches to their stage of development. In parts of Asia where literacy and numeracy gaps persist, closing these foundational learning gaps remains the first priority. Where basic education systems are stronger, schools can begin integrating digital and AI literacy early, to build lifelong learning capacity. Equipping youth with industry-relevant skills and ensuring continuous reskilling for mid- and late-career workers are equally critical today to keep workers of all ages adaptable and productive amid rapid technological change.

Including digital and AI literacy for youth as part of foundational learning

As technology and AI increasingly shape the world of work, digital literacy and AI literacy are becoming foundational future skills. Introducing these subjects early in students' education not only builds their comfort with technology but also strengthens critical thinking, problem-solving, and analytical abilities.[130] At younger ages, children are especially receptive to developing computational thinking, which enhances logical reasoning, cognitive flexibility, and lifelong adaptability. Such interventions can have the biggest impact in places where foundational education is already strong and systems are ready to integrate higher-order digital competencies at scale. Reflecting this, Japan and South Korea have mandated digital and computational learning in primary curriculums, while China recently introduced AI education across all school levels, including primary. In Vietnam, where learning outcomes have been exceptional relative to the country's income level, computer science has been a compulsory subject starting in third grade since 2022.[131]

In contrast, in many lower-income economies across Asia, the immediate priority lies in strengthening primary learning, where outcomes remain weak, and literacy and numeracy, where gaps persist. Robust education systems, with adequate teacher capacity, infrastructure, and institutional readiness, need to be built in order to close foundational learning gaps. Laying the groundwork would then allow for integration of digital and AI education in a meaningful way, once systems capacity and student readiness allow.

Harnessing university–industry collaboration to build youth tech skills and strengthen employability

As technology rapidly transforms industries, closer collaboration between schools and industry has become important to ensure young people gain practical, market-relevant experience. With tech firms increasingly shaping the pace and direction of skill demand, such partnerships help align education with real-world needs.[132] Students gain early exposure to emerging job skills needs, while businesses benefit from a tech-ready talent pipeline. Such collaborations are likely to have the most impact in economies with mature industrial ecosystems and strong technological capabilities, where firms possess both the expertise and the capacity to transfer knowledge to schools and students, creating a continuous feedback loop between education and industry demand.

Several countries have already institutionalized this model, most notably China, where integration between higher education institutions and the private sector has become a central part of its workforce strategy (see Box 3, "In China, collaboration between universities and industry aligns

130 Diane Vassallo, "Fostering computational thinking in early learners: An iterative approach in a Maltese primary school," *Discover Education*, May 2025, Volume 4, Number 126.

131 "In 2024, students from which grade will begin studying computer science in Vietnam? What are the general objectives of the General Education Program in Computer Science?," LawNet, February 26, 2024.

132 Embedding industry projects into university curriculums increased placement rates from 20% in the third year to 65% by the fifth year as more cohorts gained real-world experience and direct exposure to employers; Navneet Kaur Popli and Rudra Partap Singh, "Enhancing academic outcomes through industry collaboration: Our experience with integrating real-world projects into engineering courses," *Discover Education*, November 2024, Volume 3, Number 217.

higher education with businesses' needs"). Companies co-design curriculums, train teachers, and establish on-site practice bases, while government credits and tax incentives help scale partnerships. China's success with university–industry talent pipelines could be attributed to policy-backed integration, large-scale vendor academies inside universities (for example, Alibaba Cloud Academy), and a dense tech R&D network funded by domestic champions and many R&D centers of multinational corporations.

Box 3

IN CHINA, COLLABORATION BETWEEN UNIVERSITIES AND INDUSTRY ALIGNS HIGHER EDUCATION WITH BUSINESSES' NEEDS

China's university–industry collaboration has evolved over four decades from a research-oriented system to a talent-oriented one. During the 1980s and 1990s, the government encouraged universities to engage in applied research and form partnerships with industry, leading to the establishment of university-run enterprises and technology transfer offices. By the early 2000s, the creation of university-linked science parks and incubators further institutionalized this agenda.[1]

As China's economy entered a new phase of industrial upgrading, a different challenge emerged: Graduates struggled to find suitable employment while firms faced shortages of technically skilled workers. To address this, the Ministry of Education launched a new wave of teaching-focused university–industry collaboration in 2014,[2] calling on enterprises to co-develop teaching content, provide training infrastructure, and help modernize curriculums in partnership with universities.

Building on early pilots, the State Council elevated the initiative to a national strategy in 2017, transforming fragmented efforts into a systemwide agenda.[3] To operationalize the model at scale, the ministry launched a digital project platform that allowed enterprises to post collaboration proposals, while universities could apply for projects aligned with their areas of expertise.

Over time, the model has engaged thousands of enterprises and institutions in co-developing talent pipelines tailored to emerging industrial priorities. While the government continues to act as the primary orchestrator, firms and industry associations now play a growing role in setting agendas, reflecting a gradual shift toward shared governance.

Today, China experiences widespread adoption of internships that help close skill gaps[4] and produces a substantial share of the world's top AI talent.[5]

Countries such as Japan and the United States also emphasize university–industry collaboration, but their models typically focus on universities driving innovation into industry. China's approach, in contrast, reverses this direction, positioning industry as the driver of higher education reform.

The approach still has a few limitations, including uneven depth of collaboration across regions, limited enterprise engagement beyond formal partnerships, and gaps in teacher readiness and training-base quality. These limitations are being gradually addressed,

1 Tengteng Zhuang, Misao Oh, and Keiko Kimura, "Modernizing higher education with industrial forces in Asia: A comparative study of discourse of university-industry collaboration in China, Japan and Singapore," *Asia Pacific Education Review*, January 2025, Volume 26.

2 "The tenth anniversary! The Ministry of Education's Industry-University Collaborative Education Project continues to exert its influence" [第十年！教育部产学合作协同育人项目持续发力], ScienceNet.com, November 28, 2023.

3 Huang Shimou, "Research on the dynamic mechanism of industry-education integration in vocational colleges based on school-enterprise destiny community," *Journal of Information Systems Engineering and Management, 2025*, Volume 20, Number 24.

4 FII Future of Work Survey 2025.

5 China accounts for a substantial and growing share of top-tier AI researchers globally, rising from 29% in 2019 to 47% in 2022. See "The global AI talent tracker 2.0," Macro Polo, accessed November 13, 2025.

Indonesia has also taken a systematic approach. Led by the Ministry of Education, Culture, Research, and Technology, the Certified Internship and Independent Study Program (MSIB)[133] connects universities with employers via a centralized platform. Partner companies design real-world projects or skills-based courses, provide mentors, and host students for a full academic term. Participants earn academic credits, while firms receive visibility and financial support, including student stipends and mentor subsidies. The platform—which has over 500,000 active users and more than 250,000 applicants registering each semester—offers both internship and independent-study pathways focused on industry-relevant skills. The clear value proposition and incentives for both students and firms help sustain this partnership.

In other settings, collaboration can begin on a smaller scale and evolve over time. The coordinating role can extend beyond government to industry associations or nonprofits that connect universities with firms, set standards, and sustain partnerships. For example, India's IT industry body, NASSCOM, works with the Ministry of Education and state governments to embed industry-ready curriculums in engineering colleges. Where domestic industrial ecosystems are less mature, cross-border partnerships help bridge gaps. Kazakhstan, for instance, integrates global industry certificates into university programs via Coursera, reaching more than 111,000 learners.[134]Similarly, Amazon Web Services (AWS) has multiple partnerships with universities across Asia, including in India, Pakistan, and Vietnam, to deliver cloud-focused curriculums and skills training.

Enabling mid- and late-career workers to shift to adjacent job roles

While youth training remains vital, reskilling mid- and late-career professionals is equally critical, especially in economies facing aging populations and tight labor markets. Automation is reshaping work, but many experienced employees possess deep institutional knowledge and technical expertise that remain highly valuable. Organizations and governments are increasingly recognizing the value in helping employees shift into adjacent, higher-value roles that build on their existing experience while layering in new digital and AI-related skills. Such interventions are likely to have the greatest impact in advanced and upper-middle-income economies where workforce aging is pronounced, firms are technologically mature, and structured corporate training systems already exist to support large-scale reskilling.

Companies are already demonstrating what this can look like. Malaysia's Petroliam Nasional Berhad (PETRONAS),[135] for instance, established a digital academy to accelerate workforce transformation and embed data and digital capabilities across the organization. With multiyear funding and joint ownership between corporate and business units, the academy used an AI-driven platform to map skill gaps and create role-aligned learning pathways. Training combined instructor-led sessions with self-paced modules, co-developed with partners such as AWS Skills Guild. By 2022, close to 30,000 employees had been upskilled through this approach. Its success reflects several factors, including treating digital upskilling as a sustained, enterprise-wide priority; ensuring business co-ownership and dedicated budgets; leveraging data-driven platforms for job-relevant learning; and fostering deep collaboration with training partners.

At the broader ecosystem level, Singapore's Career Conversion Programmes illustrate how employer-led reskilling can work nationally. The program enables mid-career workers aged 40 and above to transition into growth roles through subsidized training jointly designed and led by employers (see Box 4, "Singapore's successful programs to retrain mid-career as well as younger workers"). In 2017 DBS became the first bank in Singapore to run this program for its own employees, committing to retrain about 1,500 staff in legacy roles to enable them to take on tech and data roles.[136]

133 "Certified Internship and Independent Study Programs (MSIB)," Indonesia Ministry of Education, Culture, Research, and Technology, accessed November 13, 2025.

134 "Kazakhstan modernizes education and transforms economies with Coursera," Coursera, accessed November 13, 2025.

135 Datuk Bacho Pilong, "Project delivery and technology," Petroliam Nasional Berhad (PETRONAS), 2022.

136 "DBS to proactively re-skill 1,500 employees to equip them with new skills and competencies to be future-ready," DBS, October 30, 2017.

At the firm level, embedding reskilling into corporate strategy requires employer buy-in; companies need to believe that the reskilling outlays are an investment rather than a cost, and that a failure to act now would only cost them later. Fiscal incentives to encourage firm participation, such as wage co-funding or tax credits, can help offset up-front costs and build confidence and employer support until productivity gains are visible. Furthermore, firms that lack in-house training capacity can outsource training or share resources to fill the gap. In Malaysia, eligible employers contribute a small payroll levy (around 1% of monthly payroll) to the HRD Corp fund and can claim grants to finance staff training via registered providers, making workforce upskilling more accessible even for smaller firms.[137]

As more pilots demonstrate success, these models can be scaled through shared national platforms and tools such as "skills passports," which document workers' evolving competencies and help match them to new, higher-value roles. Singapore's Careers & Skills Passport, a digital wallet within MySkillsFuture, does this by consolidating individuals' qualifications, training records, and employment histories to support lifelong employability.

137 "Malaysia," *Global review of training funds*, UNESCO, 2022.

Box 4

SINGAPORE'S SUCCESSFUL PROGRAMS TO RETRAIN MID-CAREER AS WELL AS YOUNG WORKERS

Mid-career workers aged 40 to 59 constitute about half of Singapore's resident workforce,[1] making their continued employability essential to sustaining productivity and growth. To support this group, Singapore has developed a comprehensive system to help workers reskill and transition into growth sectors through Career Conversion Programmes (CCPs), launched in 2016 and managed by Workforce Singapore (WSG). This program is part of SkillsFuture, a broader initiative that seeks to foster a culture of lifelong learning and continuous mastery of skills.[2]

Under the program, companies can send any current employee for reskilling to take on new or redesigned job roles. Each sector maintains a catalog of adjacent job roles developed jointly by WSG and sector agencies.[3] Employers can refer to this guide to redesign roles, identify emerging skills, and build three- to six-month training pathways that combine classroom learning, online modules, and on-the-job practice. WSG reviews these plans to ensure that they are tied to real, in-demand jobs and that workers are redeployed upon completion.

To lower costs for employers and encourage participation, the government subsidizes training fees (up to 90% for workers aged 40 and above) and provides wage support covering 70 to 90% of salaries during training. Over five years, CCPs have supported more than 37,000 workers and 7,000 employers.[4]

Along with these efforts to retrain mid-career workers, SkillsFuture has several other instruments that deliver skills to workers through close collaboration among government agencies, education institutions, and industry partners. One program provides all Singaporeans aged 25 and above with learning credits to offset training costs, encouraging personal ownership of lifelong learning while stimulating demand for industry-relevant courses. For those entering or changing industries, another set of programs integrates classroom learning with structured on-the-job training. Participants participate in facilitated learning, workplace projects, and mentorship, allowing them to deepen the skills and knowledge gained in school while supporting a smoother transition into employment. Companies and education providers co-design and co-deliver curriculums that connect theory and practice, while firms provide structured workplace guidance and progression pathways for participants.

These models show how strong public financing, institutional coordination, and a cultural emphasis on lifelong learning can help mid-career workers remain economically active. But replicating these models elsewhere may be challenging, because few countries can sustain the high levels of wage co-funding or fee subsidies that Singapore does. Moreover, without a social compact that values senior employability, investments in retraining may not translate into demand from employers.

1 "Growth opportunities and skills-based pathways for mid-career workers," *Skills demand for the future economy*, SkillsFuture Singapore, 2022.

2 SkillsFuture Singapore website.

3 "Jobs transformation maps," Workforce Singapore, accessed November 13, 2025.

4 "Career conversion programmes (CCPs) frequently asked questions (FAQs)," Workforce Singapore, updated March 2025.

SHARED DIGITAL INFRASTRUCTURE AND PATIENT CAPITAL FOSTER INNOVATION AND HELP CREATE MORE PRODUCTIVE JOBS

A constantly reskilled and adaptive workforce is essential—but on its own, it is not enough. Fully translating new skills into higher productivity and incomes requires a supportive ecosystem that boosts innovation and creates more productive jobs. Shared AI infrastructure can broaden access to innovation and "democratize" it, enabling start-ups and smaller firms to develop and scale solutions that drive new industries. At the same time, mobilizing patient, risk-tolerant capital is essential to fund these innovations. Mechanisms such as blended finance, first-loss guarantees, and co-investment funds can crowd in private investors, helping early-stage firms overcome financing constraints.

Building shared digital infrastructure to spur innovation

Shared digital infrastructure can be a powerful equalizer, lowering barriers to innovation, reducing duplication of effort, and allowing start-ups, researchers, and smaller enterprises to access capabilities that would otherwise be out of reach. By pooling resources such as compute power, data, and open APIs, countries can accelerate experimentation and ensure that innovation is not limited to large, well-funded firms. Such infrastructure tends to have the greatest impact in economies with emerging AI ecosystems and a critical mass of innovative firms that can use these shared capabilities to develop and scale new solutions.

India's experience with Unified Payments Interface (UPI), described in Box 2 in the previous chapter, shows how an open, shared platform can unleash innovation and inclusion across the financial sector. UPI set up common payment rails that thousands of fintechs and small merchants built on, driving scale within a few years. A mix of regulatory flexibility, visible early use cases, and low adoption costs for merchants contributed to its success.

Building on that logic of shared foundational infrastructure, the IndiaAI Mission (2024)[138] uses a similar model to support AI initiatives. With investments of about 104 billion Indian rupees ($1.2 billion) over five years, financed through a public–private partnership model, the mission aims to create shared AI infrastructure that smaller firms, start-ups, and researchers can use without prohibitive cost. This includes features such as pooled computing power, public data sets, and locally trained AI models.

Comparable initiatives are emerging elsewhere. The Japanese government's R&D agency AIST operates the AI Bridging Cloud Infrastructure (ABCI)[139] as a national compute platform for academia and industry, coupled with practical onboarding and hands-on training to encourage use. In Singapore, the AI Trailblazers program[140] provides up to 100 organizations with temporary, no-cost access to Google Cloud's GPUs, pretrained models, and developer tools, allowing firms to prototype gen AI applications in a controlled environment.

138 "Cabinet approves ambitious IndiaAI Mission to strengthen the AI innovation ecosystem," Press Information Bureau, Government of India, March 7, 2024.

139 "Creation of an AI research infrastructure for industry, academia and government; Start of 'ABCI' supercomputer operation," National Institute of Advanced Industrial Science and Technology, accessed November 13, 2025.

140 "MCI, DISG, SNDGO, and Google Cloud launch AI Trailblazers Initiative to accelerate the development of impactful generative AI solutions in Singapore," Singapore Economic Development Board, July 24, 2023.

> **"Countries will need to equip workers with future-ready skills by integrating digital and AI literacy early in education . . ."**

Mobilizing patient capital through risk sharing

Even when promising ideas exist, translating innovation from concept to commercial scale often requires significant up-front capital at precisely the stage when returns are uncertain and private investors are most risk averse. Asian financial markets tend not to have the abundance of risk capital and tolerance to higher failure rates that are common in the United States. In such contexts, targeted derisking instruments can help close the financing gap by absorbing part of the early-stage risk, crowding in private investment, and directing funds toward strategic sectors that have long-term economic value but delayed payoffs. Such mechanisms tend to be most effective in emerging and middle-income economies where public institutions can anchor funding and there is a growing pipeline of investable opportunities but insufficient venture financing or risk appetite to support them at scale.

Saudi Arabia's Jada Fund of Funds,[141] launched in 2018, anchors the domestic venture capital and private equity ecosystem with 4 billion Saudi riyals (about $1 billion) in capital. Rather than investing directly in start-ups, it backs professional fund managers focused on Saudi SMEs, balancing commercial returns with development goals. To date, Jada has committed more than 3.3 billion Saudi riyals across 39 funds, supporting more than 500 SMEs and creating more than 12,000 jobs.

Indonesia's Merah Putih Fund (MPF)[142] stands out for its state-linked consortium model, pooling capital from the venture arms of state-owned enterprises (SOEs). The fund targets "soonicorns," start-ups nearing large-scale growth, and couples financing with market access through SOE client networks and data ecosystems, reducing both market and financial risk. The MPF achieved a $300 million first close, meaning it secured its initial round of committed capital from anchor investors before starting to deploy funds—a milestone demonstrating investor confidence and the model's ability to mobilize capital at scale.

Asia's productivity and growth story over the past three decades has been remarkable, but the region cannot rest on its laurels. A decisive new phase has arrived. The region needs to accelerate its transformation as it addresses the forces reshaping global production, work, and innovation. The prize for getting it right will be Asia's continued competitiveness and the creation of many more high-quality jobs. By spreading awareness and giving people the right tools and skills to embrace and propel technological change, Asia can strengthen its capacity to innovate, harness its talent, and secure its place in the rapidly evolving global economy.

141 Jada website.

142 Merah Putih Fund website.

TECHNICAL APPENDIX

THIS APPENDIX PROVIDES an overview of the methodologies used in the report. It comprises the following sections:

1. Scope and country coverage
2. Clustering methodology
3. Automation model methodology
4. Primary research and survey design

SCOPE AND COUNTRY COVERAGE

This report examines 32 countries across East, Southeast, South, and Central Asia:

- Afghanistan
- Bangladesh
- Brunei
- Bhutan
- Cambodia
- China
- Hong Kong SAR
- India
- Indonesia
- Japan
- Kazakhstan
- Laos
- Kyrgyz Republic
- Macau SAR
- Malaysia
- Maldives
- Mongolia
- Myanmar
- Nepal
- North Korea
- Pakistan
- Philippines
- Singapore
- South Korea
- Sri Lanka
- Taiwan, China
- Tajikistan
- Thailand
- Timor-Leste
- Turkmenistan
- Uzbekistan
- Vietnam

References to "Asia" denote weighted averages calculated across 32 countries using available data for each indicator. Wherever a smaller subset is used due to data gaps, this is noted in the footnotes of the main body of text. These Asia-level figures therefore reflect the continent as a whole, excluding Western Asia.

SEGMENT METHODOLOGY

For segmented and deep-dive analysis, the report focuses on 14 countries (Japan, Singapore, South Korea, China, Indonesia, Malaysia, the Philippines, Thailand, Vietnam, India, Bangladesh, Kazakhstan, Pakistan and Uzbekistan). This subset was selected based on data availability, as well as its representativeness of Asia's population, economic scale, and structural diversity. These 14 economies represent 94% of the total Asian population (for all 32 countries) while remaining 18 countries account for long tail of smaller population. Similarly, these 14 economies account for 98% of Asia's GDP (constant 2015 $); GDP excludes North Korea and Taiwan due to reporting challenges or inconsistencies.

To compare the unique and shared features of the 14 Asian countries in the context of the labor market, the research assessed three dimensions—human capital capability, labor and business competitiveness, and demographics shift. These factors were selected based on their availability and comprehensiveness to ensure a clear understanding of each country's labor market landscape.

Based on this exercise, and supported by insights from comparable studies, five distinct segments of Asian countries emerged:

- **Advanced Asia:** Japan, Singapore, South Korea
- **China**
- **Emerging Asia:** Indonesia, Malaysia, the Philippines, Thailand, Vietnam
- **India**
- **Frontier Asia:** Bangladesh, Kazakhstan, Pakistan, Uzbekistan

AUTOMATION MODEL METHODOLOGY

The model for expected rate of automation adoption includes the following data and assumptions:

Base data. The analysis is based on employment data, measured by the number of employees by sector (ISIC Rev. 4) and one-digit ISCO-08 occupations for the year 2022, as well as wage data, measured by average yearly wages, by one-digit ISCO-08 occupations for the same year.[1] This data was sourced from the International Labour Organization. We then scale up these employment distributions for the year 2024, using Oxford Economics total employment numbers. We collected the productivity data, measured by real gross value-added per labor by sector (ISIC Rev. 4), from the IHS Markit database.

Archetyping approach. The countries were benchmarked based on the similarity of sectoral productivity across all countries in the sample. For Asian countries, the model compares productivity in each sector against a cohort of more than 20 countries for which granular occupational and wage data is available. For example, if the productivity of Brazil's transportation and storage sector is most similar to that of Indonesia, then the granular occupational employment and wage distribution for Indonesia's transportation and storage sector should follow that of Brazil. While ideally the estimation should be done based on actual granular occupational distribution specific to the country, an archetyping approach was chosen because of data unavailability.

Automation potential and adoption scenarios. To analyze the impact of automation on work activities, the model breaks down some 850 occupations into about 2,100 constituent activities using data from O*NET OnLine. Each activity was further mapped to a set of 18 capabilities required to perform that activity. For all 18 capabilities, the research assessed the current availability of technology and scenarios for future availability across required proficiency levels. This helps assess the automation potential for an activity today and in the future. This potential at an activity level is further aggregated by time spent on those activities in an occupation to calculate occupation-level automation potential. These occupational estimates are then aggregated at the sector and country levels by a weighted average of employment in respective occupations to estimate overall impact.

Scenarios for automation adoption. Several factors can hinder or support the timing and pace of adoption. Solutions requiring different technologies have varying levels of ease of integration. It takes time to integrate capabilities into current technical platforms and combine them into an organic entity. Further, these solutions need to be economically feasible relative to labor cost, or wages, so that organizations can implement them at scale. Barriers also exist on the organizational side. Human talent and organizational structures might act as bottlenecks to implementation, and policies and regulations can also affect the pace of technology innovation and adoption. Finally, consumers might have varying levels of acceptance for automated solutions, which could affect the pace of adoption. To incorporate all these factors, the research used the mathematics of the Bass diffusion model, a well-known and widely used function in forecasting, especially for new-product sales forecasting and technology forecasting. F(t) is the installed base fraction (that is, adoption of a given technology or product), and f(t) is the corresponding rate of change.

$$\frac{f(t)}{1 - F(t)} = p + qF(t)$$

Two scenarios were then simulated for historical technology adoption curves. The fitted values of parameters p and q are consistent with historical adoption curves for multiple technologies. It takes about ten years to reach 50% adoption in the earliest scenario and approximately 40 years in the latest scenario. The range of scenarios represents uncertainty regarding the availability of technical capabilities, based on interviews with experts and survey responses. The early scenario makes more-aggressive assumptions for all key model parameters (technical potential, integration timeline, economic feasibility, and regulatory and public adoption). The midpoint adoption scenario is the average between the early and late scenarios.

Impact of automation on productivity. In the model, GDP per full-time-equivalent worker (FTE) was used as the measure of productivity. To measure automation's effect on productivity, the number of FTEs affected by automation was calculated by multiplying the number of FTEs in 2022 by the

1 ISIC Rev. 4 refers to the International Standard Industrial Classification of All Economic Activities, Revision 4, a global classification system for economic sectors/industries published by the United Nations. ISCO-08 refers to the International Standard Classification of Occupations, 2008, published by the International Labour Organization (ILO), a global framework for classifying jobs and occupations based on tasks and skill levels.

estimated automation adoption rate in 2030. To maintain consistency with other data sources, several additional assumptions were made. Only job activities that were currently available and well defined as of the date of this report were considered. Also, to be conservative, automation was assumed to have a labor substitution effect but no other performance gains. Finally, a scenario was created in which FTEs displaced by automation rejoin the workforce at 2022 productivity levels. Under the assumptions outlined above, the additional GDP impact of FTEs rejoining the labor force after the defined automation adoption scenario was calculated as follows: Additional GDP from displaced FTEs rejoining the economy equals FTE impact of automation adoption times productivity of 2022. The additional GDP was then added to 2022 GDP to derive the productivity impact and its growth from 2022 to 2030.

PRIMARY RESEARCH AND SURVEY DESIGN

To inform this report's findings and ground its recommendations in lived experience, two dedicated surveys were conducted across Asia: one targeting business leaders and another focused on youth. These complementary research efforts provide insights from both the demand and supply sides of the labor market—capturing employer perspectives on technology adoption, macroeconomic trends, youth skills readiness, and reskilling efforts, as well as young people's views on digital transformation, employment opportunities, job preparedness, and the education and training systems meant to support them.

Business Executive Survey. The Future of Work Business Executive Survey gathered responses from 1,688 business leaders across nine Asian countries. The respondents were distributed as follows:

- Thailand (212)
- India (207)
- Indonesia (205)
- Vietnam (204)
- China (204)
- The Philippines (203)
- Japan (202)
- South Korea (201)
- Pakistan (50)[2]

Respondents represented a wide range of industries, including manufacturing (20%); professional, scientific, and technology services (17%); retail and wholesale (12%); finance (11%); construction and real estate services (8%); telecommunications, media, and entertainment (7%); healthcare (4%); education (4%); energy (4%); oil and gas (3%); transportation and logistics (3%); accommodation and food services (2%); and agriculture (1%).

The surveyed companies varied in size: 21% employed fewer than 100 workers, 22% employed between 100 and 999 workers, 33% employed between 1000 and 5,000, and 25% were large enterprises with more than 5,000 employees.

The survey was directed toward senior leaders: 30% of participants were CEOs, 21% were other C-level executives, 44% were senior managers, and 5% were board-level executives. The survey consisted of approximately 29 questions, covering topics such as talent shortages, hiring challenges, technology adoption, workforce upskilling, and alignment between education systems and employer needs. The insights formed a core empirical input for understanding regional workforce constraints and opportunities.

Youth Survey. The Future of Work Youth Survey captured the voices of 928 young people aged 18 to 26 from nine countries, offering a rich view of how Asia's next generation of workers perceive their preparedness for employment in an increasingly technology-driven economy.

- India (106)
- Thailand (105)
- The Philippines (104)
- Indonesia (104)
- China (104)
- Pakistan (102)
- Vietnam (102)
- Japan (101)
- South Korea (100)

The survey captured a balanced gender split (49% male, 51% female) and included respondents currently studying full-time (28%), studying while working part-time (18%), employed full-time after graduation (34%), unemployed but seeking work (13%), and not currently seeking work (6%).

Comprising about 33 questions, the survey focused on perceived job preparedness, digital and vocational training access, interest in emerging technologies, and barriers to employment.

Together, the executive and youth surveys provide a 360-degree perspective on the future of work across Asia—grounded in the views of those shaping and entering the workforce today.

2 Limited to 50 responses due to limited feasibility and quality control challenges.

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