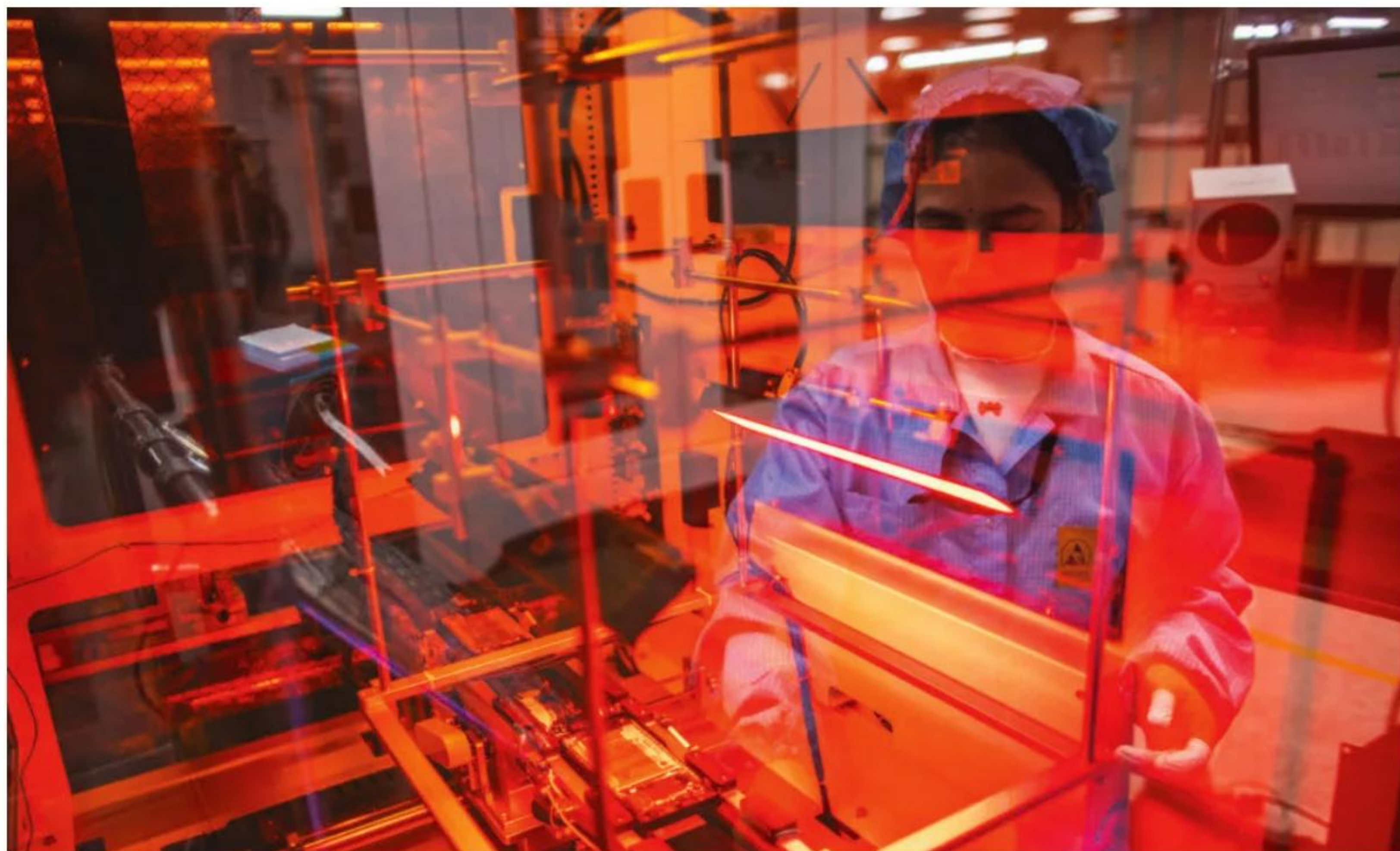


Asia



Tech in India

Innovate or die

BANGALORE

Can India seize its iPhone moment?

INDIA IS BECOMING Apple's factory floor. The world's leading gadget-maker now assembles nearly one in five of its iPhones in the country. By 2026 it hopes to make all the handsets it sells in America in Indian plants, a shift that has irritated President Donald Trump. Foxconn, its biggest supplier, recently pledged another \$1.5bn to expand local operations. It is not alone: over the past decade India's electronics industry has grown five-fold. For firms looking to reduce their dependence on China, India is increasingly attractive.

Yet Apple's pivot also shows how far India still lags behind. The phones are assembled locally, but their guts—chips, batteries and camera modules—are mostly made in China. And China is not merely a manufacturing base. Its domestic firms, such as YMTC (which makes memory chips) and Sunny Optical (which supplies advanced camera modules), have climbed rapidly up the value chain. That has made

China indispensable to Apple—not just for manufacturing, but as a place where local firms compete with global suppliers, giving Apple more choice and leverage.

This reflects a broader problem. While India is rising as a base for assembly, it remains far behind in the kind of innovation that powers advanced manufacturing. India, which is now the world's fourth-largest economy, remains a bit player in cutting-edge technologies. It spends \$71bn a year on research and development (R&D), less than a tenth of America's or China's outlay. Its R&D intensity (spending as a share of GDP) is just 0.7%, compared with 3.6% in

America and 2.4% in China (see chart 1 on next page). In an index published by the World Intellectual Property Organisation, which ranks countries relative to their size and innovation capabilities, India ranks 39th. China is 11th; America is third.

India is a bundle of contradictions. Its tech workforce is vast: the country has more open-source developers than China, second only to America. Its diaspora leads some of the world's biggest tech firms, including Google, Microsoft and IBM. Yet it is largely absent from the race to build leading artificial intelligence (AI) models (see next story). Its drugmakers supply much of the world with generic drugs but have produced few original ones. In semiconductors India is home to around a fifth of the world's chip designers, yet has few large chip firms.

Indian universities, including the elite Indian Institutes of Technology, train talent for the world, but publish little world-class research. Not one Indian university ranks among the world's top 100 for scientific research, according to the Nature Index, run by the publishers of the journal of the same name.

For a country that wants to challenge China as a high-tech manufacturing hub, these shortcomings matter. Three problems hold India back: its firms invest too little in research; universities and labs rare- ▶▶

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ly turn ideas into products; and entrepreneurs lack incentives to pursue risky, long-term innovation.

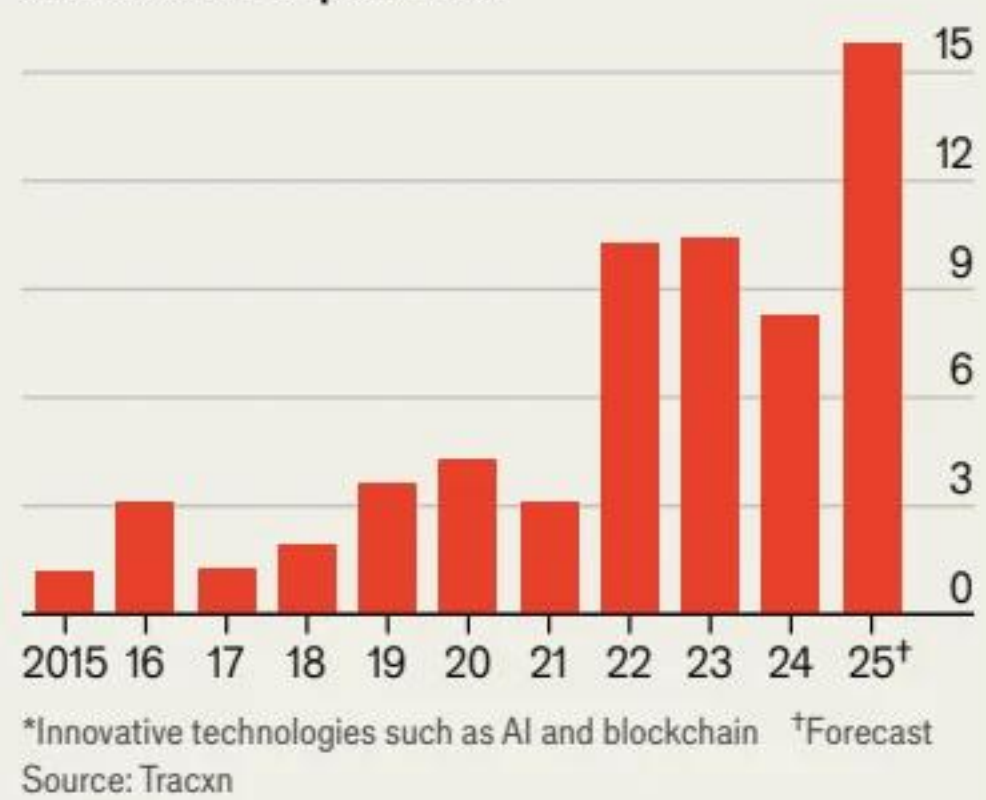
Start with industry. In particularly innovative countries, the private sector leads R&D spending, typically accounting for around two-thirds of the total. In India, it contributes just over a third. Among the world's top 2,000 corporate R&D spenders in 2023, only 15 were Indian. Together these firms invested about \$5.9bn. Google alone spent \$45bn that year. Tata Motors, a big Indian carmaker, accounts for over half of India's corporate R&D spending, but most of that comes from its British subsidiary, Jaguar Land Rover.

Why are Indian firms so stingy? Some blame smaller company sizes and thin margins in a ruthlessly price-sensitive market. But even India's most profitable outfits spend little. Naushad Forbes, an Indian businessman, notes that the five most profitable non-financial firms in India spend just 0.3% of their sales on R&D. In America the figure is 8.8%; in China, 2.1%. Even in export-facing sectors such as pharmaceuticals and software, Indian firms struggle to build serious research capacity. Infosys, a big Indian tech company, devotes only 0.6% of its \$19bn in turnover to R&D. Mr Forbes dismisses the argument that India's tech giants are mostly service firms; many Chinese ones are, too. The difference, he notes, is in mindset: many think they are spending enough, when by global standards, they are barely spending at all.

The public sector performs little better. Indian academics are prolific: by number of publications, they rank third in the world, according to Scimago, a Spanish analytics firm. But on quality they lag. Measured by the "H-index", which tracks how often work is cited, India slips to 19th place. Funding structures are partly to blame. Grants tend to go to institutions, not individual researchers. Hiring is slow and bureaucratic. The system discourages risk-taking and rarely rewards breakthrough ideas. Nor does academic work easily translate into commercial gain. A

Getting deeper

India, deep-tech investment*, % of venture-capital total



biotech entrepreneur in Bangalore notes that, unlike in America, where university partnerships often yield "marketable" products, Indian academics are content with little more than getting published.

In 2023 the government launched the Anusandhan National Research Foundation (ANRF), modelled on America's National Science Foundation. It plans to spend \$6bn over the next few years to boost research across universities and labs. Roughly 70% of the funding is meant to come from non-government sources, including private firms and philanthropies. Many remain sceptical. Susan Thomas of the XKDR Forum, a Mumbai-based think-tank, says the real issue is structural. Rather than keeping funds within state institutions, the government should outsource more research to private labs and independent centres. If the ANRF money "flows through the same old channels", she warns, "we'll get the same old results."

India's startup sector, often held up as a bright spot, does little to close the gap. In April Piyush Goyal, the commerce minister, caused a stir when he asked founders whether they wanted to "make ice cream or build [semiconductor] chips", a jab at the sector's fixation on quick-delivery apps. He contrasted this with Chinese startups pouring money into electric vehicles and batteries. The criticism is not unfounded. Between 2017 and April this year, Indian "deep-tech" startups—those working in fields such as AI, computer vision and robotics—raised just \$8bn, according to Tracxn, a research firm. That accounts for barely 5% of total startup funding in India in that period (see chart 2). Chinese deep-tech firms raised \$6.4bn in 2024 alone.

Entrepreneurs point to misaligned incentives. India's patchy infrastructure presents firms with many challenges in consumer tech, such as quick delivery or digital payments, that are relatively easy to address and offer speedy returns. More complex pursuits, with longer payback periods, get far less attention. Access to long-term capital is also limited. Ganapathy

Subramaniam at Yali Capital, a deep-tech fund, says that India has a lot of "micro funds" that can make small investments, but if a company needs \$25m to \$100m to scale, that is lacking.

That may help explain why, despite being the second-most popular destination for American firms to set up R&D hubs (after Britain), India sees little domestic spillover into deep innovation.

One small step

India's space programme is an exception. It offers a rare example of successful public-private collaboration. In 2020 the government opened the space sector to private firms. Before that, companies could act as suppliers only to the Indian Space Research Organisation. A new agency, IN-SPACE, was created to grant private firms access to state-developed technology and infrastructure. So far, it has approved over 50 firms aiming to launch satellites and offer space-based services. Mr Forbes acknowledges the success of IN-SPACE but sees it as a special case—powered by a capable public agency and with a clear mandate. If India wants to be more than the world's next assembly line, it needs to bring the same clarity of purpose that launched satellites into orbit to the far messier business of making innovation take off on Earth. ■

AI in India

Indic intelligence

BANGALORE

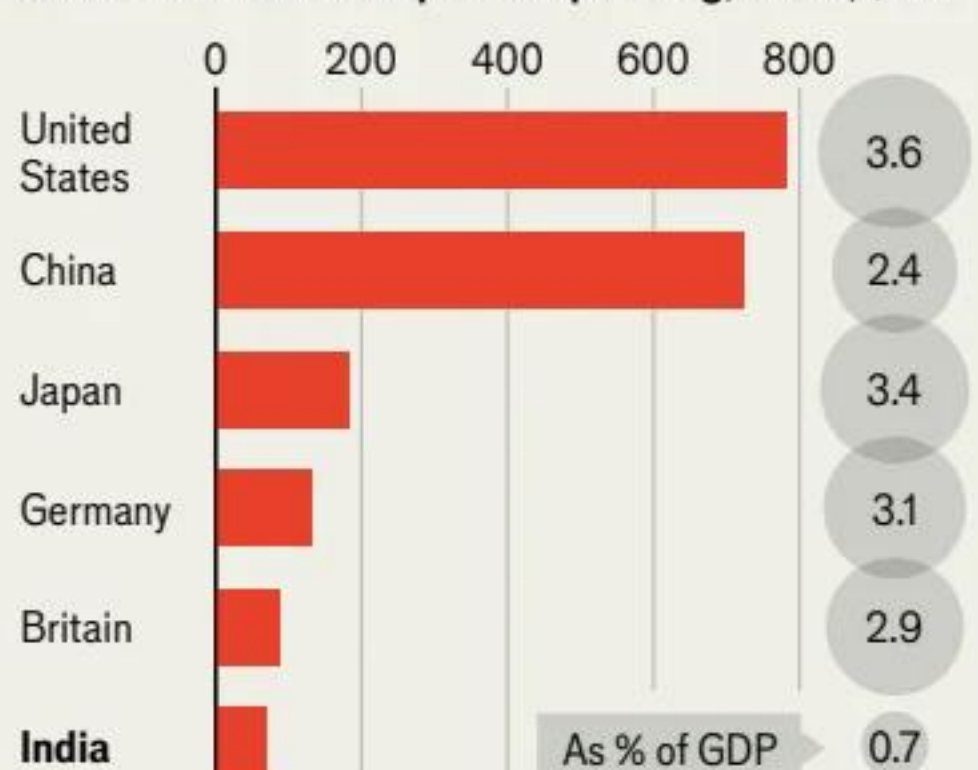
The country has a lot of work to do to lead in AI

INDIA IS HOOKED on artificial intelligence. The country is the fastest-growing market for ChatGPT. By some estimates it accounts for the largest share of users, or about 14% of the total. Soon, the popular bot may have local competition. On May 23rd Sarvam AI, a Bangalore-based startup, unveiled an "Indic" large language model (LLM) capable of conversing in Indian languages. Early this month, Bharat Gen, a publicly funded model, made its debut. Both aim to help users engage with AI in the languages they speak, from Hindi to Malayalam.

The Indian government's ambitions stretch further. Narendra Modi, the prime minister, wants the country to lead in AI and insists that any global progress in the field is incomplete without India. In February Ashwini Vaishnaw, the minister in charge of technology, pledged that India would release an indigenous foundational model within ten months and develop do-

Laggardly

Research and development spending, 2023, \$bn



► mestic AI chips in three to five years.

So far progress is modest. Sarvam's system is built atop technology from Mistral, a French firm. Bharat Gen is based on other open-source variants. No Indian model features among the top 200 LLMs ranked by LMArena, a benchmarking website. According to the AI Index compiled by researchers at Stanford University, in 2024 India attracted just \$1.2bn in private AI investment, placing it 12th globally, behind Austria and Sweden. In America the figure was \$109bn and China \$9bn.

India's digital infrastructure also lags woefully: its datacentres account for just 3% of global capacity. While America and China build foundational platforms from scratch, India remains an adapter, repurposing foreign models for domestic needs. Whether this will be a transitional phase or a lasting weakness is an open question.

Policymakers are now playing catch-up. Last year the government announced a \$1.2bn programme to support local AI efforts. Some of the funds have gone towards buying more than 34,000 chips, which are being made available to researchers and startups. (Meta, an American social-media giant, owns ten times as many.) Sarvam will have access to 4,000 chips for six months. Abhishek Singh, who leads the IndiaAI Mission, the agency overseeing the project, says the goal is to kick-start a domestic ecosystem. The agency has made AI processors available at roughly a third of the cost globally. Four companies, including Sarvam, have also been selected to develop a fully homegrown AI model.

Booting up

Not everyone is convinced. Anirudh Suri of India Internet Fund, a venture-capital firm, argues that policymakers are too fixated on chips and code. Rather than trying to pick winners, he says, they should focus on building the infrastructure that allows AI development to thrive.

One missing piece is data. India has one of the world's largest bases of smartphone users, internet subscribers and digital transactions. Its collection of public-facing digital platforms, such as a national biometric ID system and real-time payments, generates troves of data. But much of it remains siloed and inaccessible to researchers and developers. Although the IndiaAI Mission has begun releasing datasets, progress has been sluggish. Without open, high-quality data, developers in India will struggle to break new ground.

Talent is another problem. The country trains large numbers of coders, but few specialists in cutting-edge AI research. Of those, many head abroad, mostly to America. A study in 2022 by MacroPolo, an American think-tank, found that only one-fifth of India's top AI researchers remain in the country. Harshit Jain, an AI researcher

of Indian origin at Stanford University, says the appeal of working abroad lies in easier access to resources and the chance to collaborate with the world's best minds. Had he stayed in India, he says, "the fear of missing out" would have loomed large.

Those who remain often work at the Indian outposts of American tech giants such as Google and Microsoft, which operate some of the best-funded AI labs in the country. Yet their presence has not catalysed a thriving local ecosystem. One reason, suggests Kailash Nadh, chief technology officer at Zerodha, a fintech firm, is that India lacks a culture of patient, long-term research. "There is a lack of cohesion between industry and academia," he says. As a result, original research remains sporadic and siloed.

Electric sheep

India's AI push has also leaned heavily on the domestic market. Policymakers often speak of making AI "work for India". That seems sensible. Many of the country's challenges—from health care to education—could benefit from AI. But a narrow domestic focus may also limit ambition. To truly seize the moment, argues Mr Suri, India needs a "big bet" mindset. AI, he argues, is more than just a tool; it is also a powerful engine for economic growth.

India has heard this story before. Previous waves of digital change, from the internet to the smartphone, were dominated by American tech firms. India is one of the largest users of products from Google, Microsoft and Meta. These shifts did give rise to some local champions, mostly in e-commerce and fintech. But few of these companies have expanded abroad. For a country that has ambitions of moving up the innovation ladder, the opportunity offered by AI is too big to be missed. ■



Taiwan

Horns of a dilemma

SINGAPORE

If China invaded Taiwan, who would enter the war?

“THE ELEPHANT in the room”, acknowledged Emmanuel Macron, France's president, speaking to an audience of defence bigwigs at the Shangri-La Dialogue in Singapore on May 30th, “is the day China decides a big [military] operation.” Would France intervene on day one of such a war, he mused? “I would be very cautious today.”

Mr Macron's ambivalence is widely shared. If China were to invade Taiwan, no one is certain how different countries would line up. A new paper by the Centre for a New American Security (CNAS), a think-tank in Washington, examines that question. If America stayed out of the war, it suggests, everyone else would, too. Speaking in Singapore, Pete Hegseth, America's defence secretary, sought to dispel that thought. “Any attempt by Communist China to conquer Taiwan by force would result in devastating consequences,” he said. “Our goal is to prevent war, to make the costs too high.”

In practice, many Asian allies fear that America is getting wobblier on the issue (see The Telegram). Last year Donald Trump said that he would “have to negotiate things” before coming to the island's aid; some in the Pentagon see the Taiwanese as perhaps even a lost cause.

If America does step in, the two allies most severely affected would be Japan and the Philippines. Neither country would be enthusiastic about direct involvement, though. Japan's participation would be unlikely to go much further than submarine patrols or missile strikes, argues CNAS. The Philippines, which has 175,000 citizens in Taiwan, would be more cautious still. But if China's armed forces were bogged down, it could be tempted to grab territory in the South China Sea, where it has multiple disputes with China, suggest the authors. All this would depend on whether China had first attacked American bases in those two countries to pre-empt American involvement or whether it held back, hoping to secure American neutrality.

A second group of countries—South Korea, Australia and India—would be more insulated. But America would put pressure on each one to help. South Korea's immediate concern would be deterring North Korea from exploiting any diversion of American forces. The country might offer “rear-area support”, such as logistical assistance, reckons CNAS. ►►

▶ Australia has become an increasingly important base for American forces, too. It has not formally pledged to join a war over Taiwan, even in private. But Australian officials acknowledge that their relationship with America, including the AUKUS nuclear submarine pact, could be in jeopardy if they stayed out. India would almost certainly focus on defending its land border with China, but America could probably count on co-operation on intelligence and anti-submarine warfare.

Then there is South-East Asia. Around 900,000 passport-holders from the region live and work in Taiwan, notes CNAS, accounting for 90% of foreign citizens there. Many countries would probably attempt to remain neutral, not least because China is by far the most important trading partner for most of the region. But America would probably push for access to Thai and Singaporean air and naval bases.

What about Europe? France and Italy have recently sent aircraft-carriers to the

region; Britain has one en route. In private, European policymakers are increasingly concerned about a Chinese invasion of Taiwan. A handful could offer cyber and space capabilities. More consequential would be a decision by the EU to impose sanctions on China. In particular, writes Agathe Demarais of the European Council on Foreign Relations, another think-tank, a ban on Chinese imports to Europe “could be game-changing”. For now that is an exceedingly tall order. ■