DBS Asian Insights

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Evolving China Evolving Asia

BRI for SE Asia • Supply Chain • Automation

DBS

Evolving China Evolving Asia

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Introduction

Accounting for at least a third of global growth in the past decade, China is unquestionably the most important engine of economic activity in the world. Understanding China is, therefore, critical.

China's rise, driven by an average of over 8.5% real per capita income growth over the past three decades, is astonishing in scale and unprecedented in pace. No other nation has lifted its people from poverty this fast, nor has any nation become this influential in the global political-economy so swiftly.

Impressive performance notwithstanding, China is at a crossroads today. Growth has begun to slow, owing to an ageing population, hangover from over-investment, and the sheer weight of the gigantic economy. No longer nimble like a small emerging market country, China has been recalibrating to find new sources of economic dynamism. For this, China is reaching out overseas, deploying its capital to build a massive infrastructure of roads, bridges, rail lines, and ports to build or improve multiple trading routes. It is also investing heavily in research and development to become the world's leader in technological innovation. Asia's electronics supply chain, which forms the core of global electronics production, is consequently evolving, with China at its centre. Additionally, automation is becoming an integral part of China's production processes.

In this publication, three DBS Group Research analysts examine some of these interesting developments. Chris Leung takes a provocative line on China's Southeast Asia Belt and Road Initiative (BRI) tactics. He considers the political economy of the three key rail routes originating from Kunming, China and declares two of them unlikely to succeed (one through Myanmar and the other through Vietnam). Arguing that the rail artery through Laos-Thailand-Malaysia is likely to be China's flagship BRI project in Southeast Asia, Chris maps out the possible winners in this context.

Ma Tieying then looks at Asia's new wave of technological innovation, heralded by the ongoing rapid progress in artificial intelligence and the Internet of Things. As the world's largest electronics production base, China should be a major beneficiary. As it climbs up the value ladder and embraces high-end automation, China would challenge existing upstream producers like Singapore, South Korea, and Taiwan. But these economies' relatively strong

innovation capabilities should help them sustain competitiveness in the upper tiers of high value-added electronic segments. Cyber security and intellectual property-related concerns may also put a lid on China's ability to absorb the entire supply chain.

Nathan Chow follows with a piece on the automation trend. Faced with an ageing population, rising cost, and declining economic growth, China needs automation to boost productivity and maintain competitiveness. So far, the impact of automation on China's overall workforce has been modest amid low robot density. The complementary effect of automation has also outweighed the substitution effect, i.e. job creation has outstripped job losses. Occupations that require a high degree of social interaction, such as nursing and healthcare, are less prone to automation.

We hope you enjoy these insightful publications.

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BRI Tactics for Southeast Asia

Among the BRI-Southeast Asia infrastructure corridors, the central rail route through Laos, Thailand, and Malaysia has the most potential and appears to be the most feasible

The Belt and Road Initiative (BRI) integrates China's foreign policy goals with economic policy. By enhancing connectivity with Eurasia via infrastructure investment, China is undertaking an initiative unprecedented in scale. The BRI could potentially game-change the geopolitical balance in Asia, along with profound economic implications for participating countries.

The complex interplay between foreign policy objective, geographical constraint, and financing issues will inform the BRI process in the coming decades. It is important for Beijing to have a successful example to show the world and of all the land routes proposed in the BRI, we believe that Southeast Asia's will meet with initial success.

The BRI-ASEAN journey begins in the city of Kunming, capital of Yunnan province

The land route begins in Kunming, the capital of Yunnan Province, which is the closest major Chinese city to Southeast Asia.

A key plan under the BRI is to connect Kunming with Southeast Asian countries via three main railway routes:

- **Central Route** – From Kunming to Vientiane in Laos, which subsequently connects with Bangkok in Thailand. From there, it can go all the way to Kuala Lumpur in Malaysia, ultimately reaching Singapore.

- **Eastern Route** – From Kunming to Hanoi in Vietnam via the newly constructed Mengzi-Hekou railway. It will go as far as Ho Chi Minh City.

- **Western Route** – From Kunming to Yangon in Myanmar via the Dali-Ruili railway, which is still under construction.

Each of these routes hold tantalising promises of improving connectivity, and aiding the creation of rich ecosystems of producing, distributing, and consuming a wide range of goods and services. All three rail routes also connect to maritime links embedded in the BRI plan.

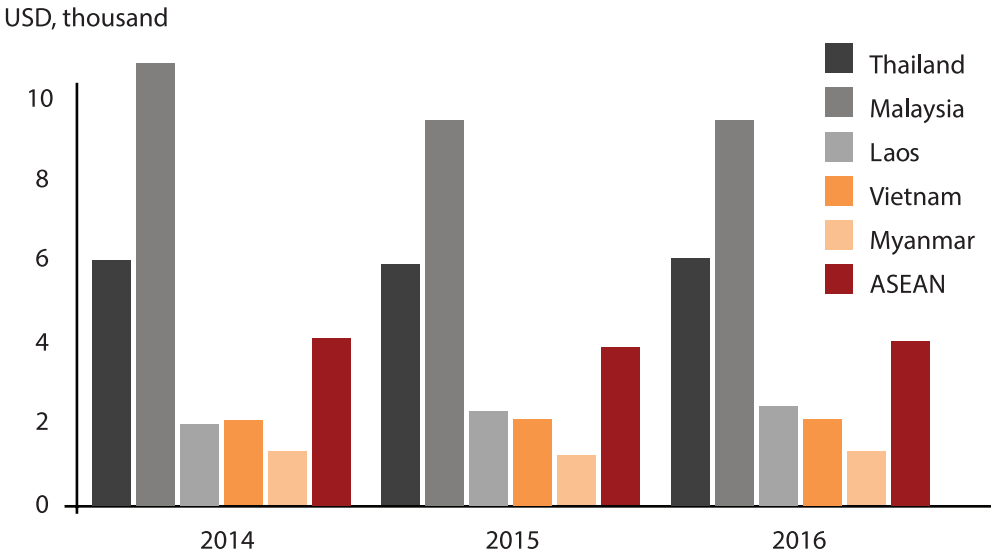
Diagram 1: Proposed BRI rail routes through Southeast Asia

Source: DBS Group Research

The BRI could potentially game-change the geopolitical balance in Asia, bringing profound economic implications to participating countries

The development or success of these initiatives, however, depends on China's diplomatic ties with the countries involved. Amongst the three routes, the most vital is the central line because it covers the highest-income countries in this region – Thailand, Malaysia, and Singapore. It also has the least political resistance, given the region's recent history and geopolitical dynamic. In the following sections, we examine, country-by-country idiosyncratic factors relevant to the BRI parameters.

Diagram 2: GDP per capita



Note: GDP per capita of Singapore, a high-income economy, is not comparable and therefore, not included in the chart
Source: Macrobond, DBS

Laos

First is Laos, which is heavily economically dependent on China. China is now Laos' biggest foreign donor, its main investor, and second-largest trade partner. In 2016, bilateral trade revenue reached USD2.3bn and Chinese investment in Laos reached USD5.4bn. The China-Laos railway, part of the BRI, is scheduled to complete in 2022 at a cost of USD5.6bn (around 50% of Laos' GDP). This railway will transform Laos from a "land-locked" country into an accessible "land-linked" country as railway tunnels will be built through its mountainous area. The Lao government has high hopes that the completion of the railway will power up economic development. In fact, the construction of the railway has already brought improvement to areas along the route, such as connecting northern Laos to the electricity grid.

Resistance to ever-rising Chinese investment in Malaysia has been strikingly low

Thailand

Thailand is in the centre of continental Southeast Asia. Over time, it will become a central trade hub as Thailand borders four countries. There is also a premeditated need for Thailand to leverage China's economic strength to safeguard an increasingly vibrant Vietnam next door. This relationship is likely to strengthen given Thailand's strategic importance to China premised on a solid diplomatic foundation established since 1975. In the words of Thai foreign minister, the relationship with China goes back more than 1,000 years, and is closer than friendship, and more like a family.

Malaysia

Malaysia is currently China's strongest BRI partner under Prime Minister Najib Razak's leadership. China has been Malaysia's largest trading partner for almost a decade, with bilateral trade volume reaching USD73bn in 2017. It is now the country's main construction contractor, its biggest source of foreign investment in manufacturing, and the third-largest source of foreign tourists. Resistance to ever-rising Chinese investment in Malaysia has been strikingly low.

Vietnam and Myanmar

The eastern route is more complicated because of Vietnam's historical territorial disputes with China as they share a border without natural geographical hindrances. As a result, the response to the BRI has been reserved hitherto.

The western route is plagued by Myanmar's ongoing ethnic conflicts and opposition to some infrastructure projects. For instance, the construction of the Myitsone dam project was halted in 2011 due to strong local opposition, well before the birth of the BRI. In 2014, the country deferred indefinitely plans to have China build a USD20bn high-speed train connection between western Rakhine State and Kunming. As a result, the construction of the Bangladesh-China-India-Myanmar (BCIM) Economic Corridor, which will end in Kolkata, India, will likely face daunting challenges. The strategic intent of this land route is to improve China's accessibility to the Indian Ocean, but we think it will be on the back-burner for a while.

Thailand Is the Key

Thailand – least politically resistant; largest trading hub

Given the political complications in the east and west, China should accelerate the development of the centre line because it has the least political resistance. Historically, all the countries along this route share friendly diplomatic relations with China. Among Laos, Thailand, Malaysia, Cambodia, and Singapore, Thailand is of most strategic importance to China because it is the largest country along this route. China must handle its relationship with Thailand in a delicate manner, given Japan's influence on the latter as it has been the biggest economic

development assistance provider to Thailand to date. In fact, China and Japan competed fiercely to sell high-speed railway to the Thai government. Following substantial concessions on interest rates made by Chinese state banks, Thailand eventually inked the deal with China. The Sino-Thai railway span Bangkok to the border town of Nong Khai, adjacent to Laos, which will then be joined with the Sino-Lao railway.

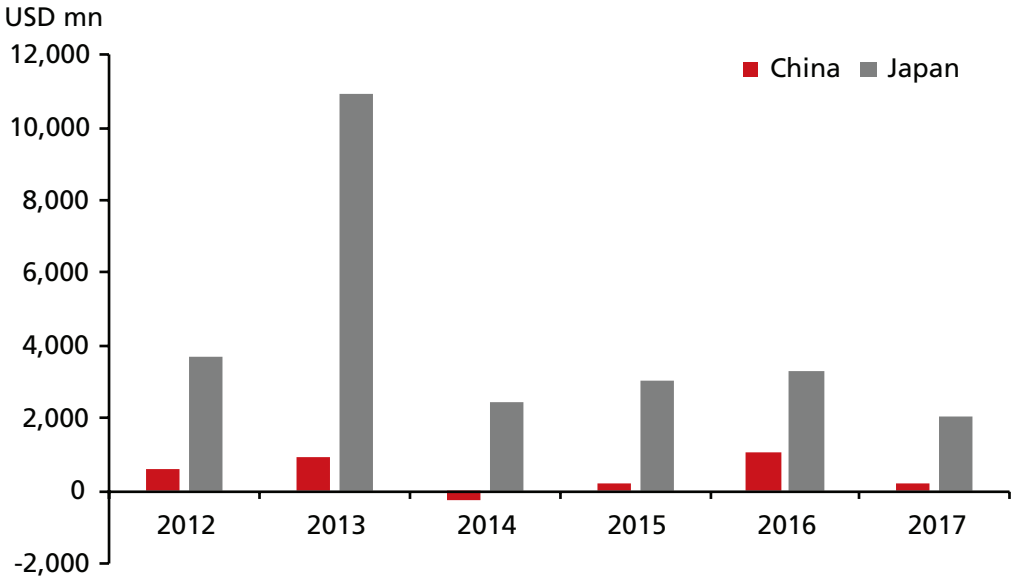
Ties between China and Thailand continued to deepen in spite of the growing trade imbalance and the strong presence of Japan. Credit goes to Beijing's diplomatic skills. Although China has been Thailand's largest trading partner since 2012, Thailand has been running an ever-rising trade deficit with China. With the exception in 2016, cumulative foreign direct investment (FDI) from China remains below the contribution from Japan, Singapore, and the US as of 2017 (see Diagrams 3 and 4). To secure Thailand as the prime partner of BRI in continental Southeast Asia, it will be wise for China to import more from them whilst increasing FDI simultaneously to protect economic ties.

Thailand has potential to become the largest continental trade hub in Southeast Asia as it borders Laos, Cambodia, Malaysia, and Myanmar. From Beijing's perspective, the present challenge is whether they can fend off Japanese competition to secure the deal to build the 1,500km high-speed railway from Bangkok to Kuala Lumpur.

Diagram 3: Thailand's and China's trade balance

Data for all charts and tables are from CEIC and DBS Group Research (forecasts and transformations)

Diagram 4: Foreign direct investment in Thailand



Data for all charts and tables are from CEIC and DBS Group Research (forecasts and transformations)

Double Bets on Malaysia

Malaysia – a key station on the centre railway line and the new Maritime Silk Road

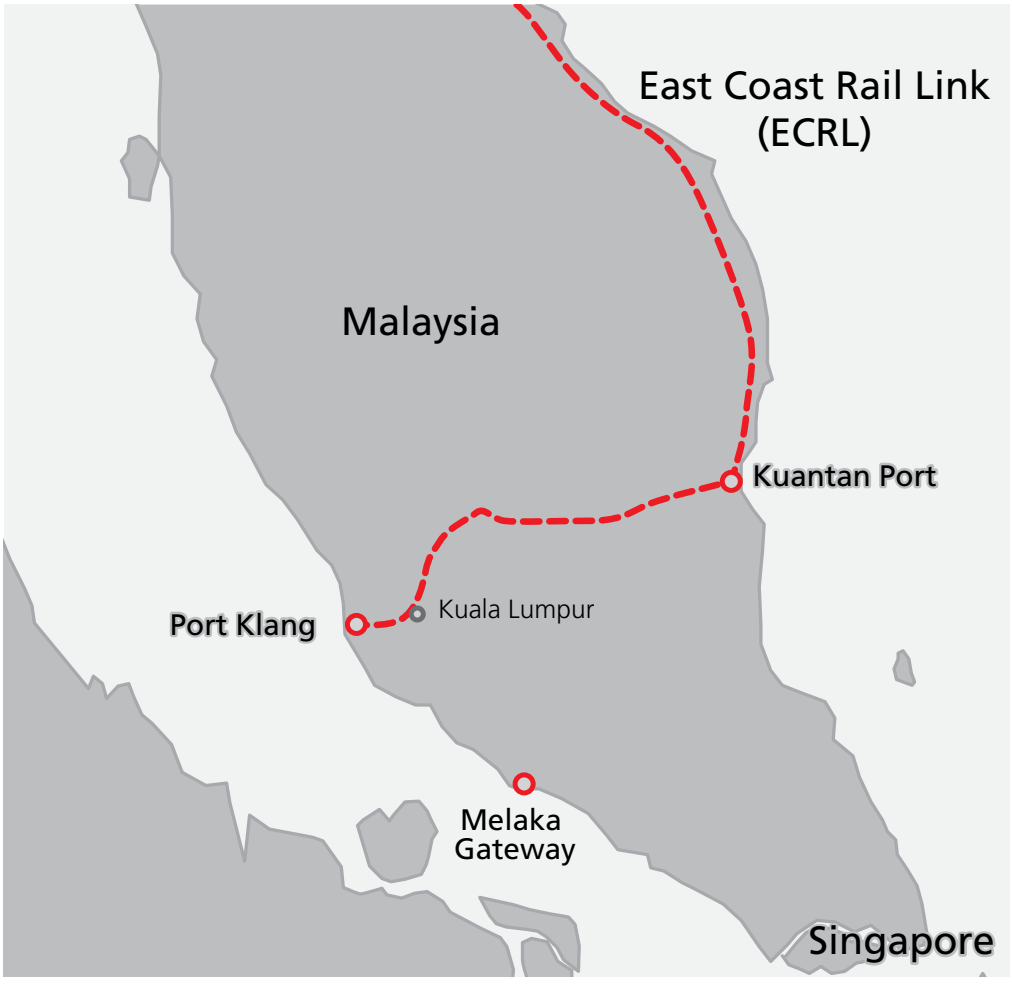
Malaysia is not only a key station on the centre railway line, it is also a key stop on the new Maritime Silk Road. To China, it is both a land and sea play. The Malaysian government cooperated with PowerChina International, Shenzhen Yantian Port Group, and Rizhao Port Group to build a deep-sea port and maritime industrial park on three reclaimed islands off the city of Melaka on the west coast. This is part of the mega Melaka Gateway Project that costs at least USD10bn. The Melaka Gateway is part of a wider port alliance between Kuala Lumpur and Beijing to increase bilateral trade and boost shipping and logistics along the Maritime Silk Road. Under this port alliance, 12 Chinese ports — Dalian, Shanghai, Ningbo, Qinzhou, Guangzhou, Fuzhou, Xiamen, Shenzhen, Hainan, Taicang, Tianjin, and Qingdao — will collaborate with nine Malaysian ports — Port Klang, Melaka, Penang, Johor, Kuantan, Bintulu, Kemaman, Sabah, and Kuching.

The objective of building deep-sea ports on both sides of the Malaysian peninsula (Kuantan in the east and Port Klang in the west), along with the East Coast Rail Link (ECRL) that runs between them, is to reduce trade dependence on the Strait of Malacca as 80% of China's oil import goes through it. Thus, China can access South China Sea, via Malaysia by rail and sea routes, if intense conflicts were to arise there. This project is estimated to cost USD13bn

as constructing a rail line across Malaysia's mountainous interior is an immense engineering challenge.

China's infrastructure investment largesse in Malaysia is a trend that will only deepen going forward. FDI from China in Malaysia has surged 47.7% YoY between January-September 2017 and the same period in 2016. Their mutual dependence in the future will be akin to the relationship between "lips and teeth", in the words of a Chinese diplomat.

Diagram 5: Linking BRI's land and maritime routes



Source: Malaysia Raillink and DBS Group Research

Malaysia is not only a key station on the centre railway line, it is also a key stop on the new Maritime Silk Road

Execution Matters

Execution – A diplomatic challenge

From Beijing's perspective, the BRI benefits all participants despite vast differences in culture and history. While it is a tremendous task, it is plausible, in our view. In fact, less developed countries are tempted to accept loans from China due to the absence of stringent institutional conditions imposed by western institutions. In return, they offer either management rights of ports/harbours to China, or in some cases, even direct equity investment in strategic assets. The deals are always mutually beneficial in the short term. However, sustaining such relationships in the longer run is a feat. Indeed, the success of the BRI depends asymmetrically on diplomacy than economics/finance.

Hiccups happened when Sri Lankan authorities sold an 85% stake in the Hambantota port project to China Merchants Port Holdings with a 99-year lease on land in lieu of debt repayment totalling USD1.1bn in 2016. This deal ignited severe protests from the public over the fear that China would end up colonising the country over time. The Sri Lankan government subsequently made a compromise with the public and agreed to decrease the Chinese equity share to 65% after a decade to placate the public.

In Pakistan, almost all projects related to the China-Pakistan Economic Corridor (CPEC) come solely from Chinese companies backed by Chinese state banks. Loans extended by the Export-Import Bank of China also require recipients to use the credit to import raw materials and labour from China. In general, the Pakistani government guarantees 17-34% return on Chinese equities in these projects. In the case of the Gwadar Port, a revenue-sharing agreement decrees that 90% of the revenue goes to China in the next 40 years. Such business terms gradually breed resentment easily, particularly when the interest of the local population is ignored. Unsurprisingly, the recent rising activism of Balochistan independent parties located in Gwadar is somewhat related to this. This situation must be resolved in a delicate manner, or growing voices of opposition will further complicate the progress of the CPEC.

It can also be argued that South Asia has been exemplifying the geographical disconnect between China and South Asia that has existed for ages. Hence, trust is difficult to build. But the real lesson to be learnt is the limited potency of the "mercantilist" approach in driving the BRI over the medium and long run.

Learning this lesson would entail China's use of a different approach in Southeast Asia. In particular, they need to:

1. pay more attention on environmental protection,

2. listen to the local population,

3. pay more compassionate/equitable monetary compensation for land taken away from locals,

4. employ more local workers and purchase more from local producers,

5. improve transparency of the project-bidding process, and

6. partner with companies from other countries to reduce the 'dominance' of China.

Last but not least, they need to offer lower interest rates for participating countries to ease their worry over mortgaging their future to China. This will take some time for China to digest because her political institution is not accustomed to such mentality in executing political imperatives. But China is learning fast, we reckon.

Southeast Asia – A Low-Hanging Fruit

Southeast Asia is a low-hanging fruit because of geographical proximity and long-standing historical ties. Most countries in the region have been maintaining a healthy diplomatic relationship with China for a few decades. From an economic standpoint, China has been the region's largest trading partner since 2009. In geopolitical terms, the connectivity with Southeast Asia allows China to reach the South China Sea by land routes if and when potential naval conflicts arise. Improving the physical connectivity on the landmass can also be viewed as a strategic hedge against the naval dominance of the US.

The consequential completion of the centre rail line originating in Kunming (some time in 2025-2030) will improve connectivity between China and Southeast Asia. The transit of goods and passengers via high-speed railway saves time for all parties, and should better facilitate mobility of capital and labour, conditional on institutional arrangement amongst the participant countries. This is conducive to economic growth over the long run. The eventual success will naturally draw others into the fold, if it is not too late by then. Thailand should be the biggest beneficiary of the high-speed railway networks, given it shares borders with four countries. Malaysia is strategically important to China as it is the only naval play in Southeast Asia where she can influence to game-change the geopolitical balance in the Strait of Malacca.

"The real lesson to be learnt is the limited potency of the "mercantilist" approach in driving the BRI over the medium and long run"

Last but not least is Kunming, which is the transportation hub of Yunnan province. It has already become China's prime gateway to Southeast Asia because all high-speed railways originate there. Yunnan's economic prosperity is directly tied to the progress of BRI in Southeast Asia. In 2017, the GDP of Yunnan advanced 9.5% YoY from 8.7% in 2016 and substantially higher than the national average of 6.9%. The driver of growth is the services sector, which represents 55% of GDP and has been expanding consistently due to improved transportation links with Southeast Asia. Tremendous business potential lies ahead.

China must deliver concrete results in Southeast Asia to highlight the brilliance of the concept worldwide. The grand plan is clear and the challenges are known. China then needs to take calculated risks and dive into the waters. But she cannot achieve such a humongous task alone. China must communicate frequently with her BRI partners to prepare for unforeseen hurdles because these setbacks will be inevitable. Diplomacy may likely matter more than finance over the medium term. The BRI is the defining feature of a new geopolitical phase that the world has already entered. Southeast Asia will be the first to reap economic benefits from this megatrend.

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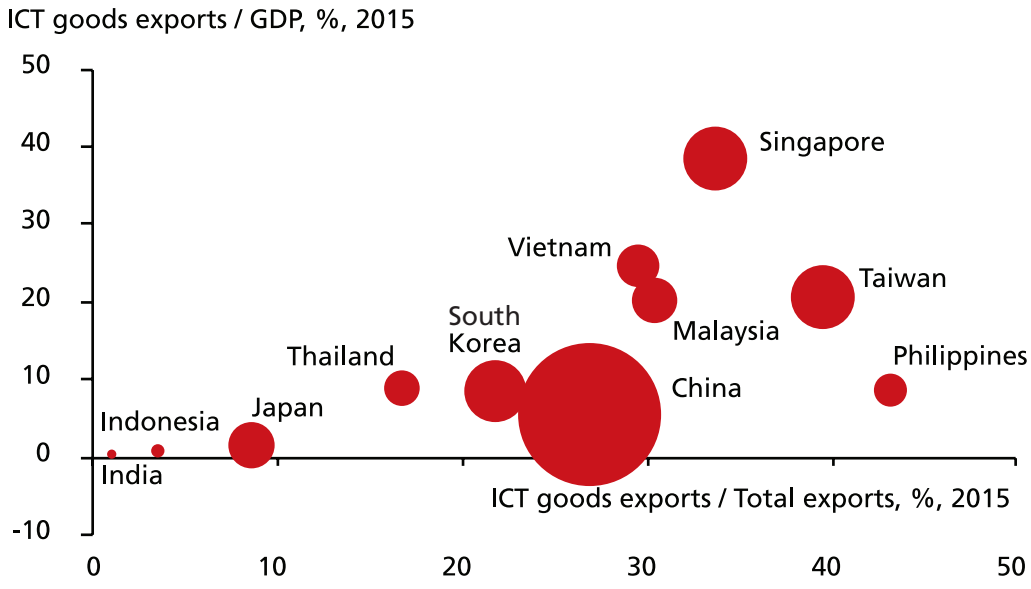
嘉诺电子

Electronics Wave; the Old and the New

Personal computers and the Internet in the 1990s; smartphones in the 2000s

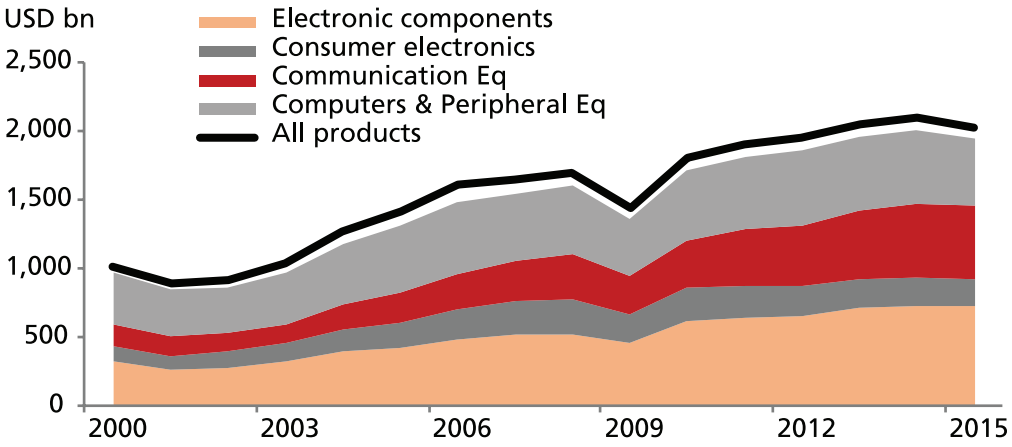
The global electronics industry experienced two waves of strong growth in the past two decades. The first was driven by the emergence of personal computers and the Internet in the 1990s, and the second by smartphones in the 2000s. Measured by trade value, global shipments of information and communication technology (ICT) goods have doubled from USD1.0tn in 2000 to USD2.0tn in 2015, registering a compound annual growth rate (CAGR) of 4.7% (Diagram 7). This was thanks to robust demand for communication equipment (e.g., smartphones, wireless networks) and electronic components (e.g., chips, semiconductors). But shipments of computers (PCs, tablets) and consumer electronics (TVs, game consoles, audios, etc.) turned flat, reflecting the saturation in these traditional product categories.

Diagram 6: Asia: The size and importance of electronics industry



Bubble size: Value of ICT goods exports, USD bn, 2015
Source: UNCTAD, CEIC, DBS

Diagram 7: Global trade in ICT goods, by product



Sources: UNCTAD, CEIC, DBS

In addition to technological changes, the strong growth in global electronics exports in the past two decades also got a boost from free trade. Tariff and non-tariff barriers have been removed on many high-tech products across a broad range of markets, thanks to the implementation of the World Trade Organization's or WTO's Information Technology Agreement, and various multilateral/bilateral free trade arrangements.

WTO Information Technology Agreement

The original Information Technology Agreement (ITA) was reached in 1996 at the first WTO Ministerial Conference held in Singapore.

The ITA covers many high technology products, including computers, telecommunication equipment, semiconductors, semiconductor manufacturing and testing equipment, software, scientific instruments, as well as most of the parts and accessories of these products.

The ITA covers 81 WTO members today, which account for 97% of world trade in information technology products.

The ITA requires each participant to eliminate and bind customs duties at zero for all products specified in the Agreement.

Source: World Trade Organization

"Tariff and non-tariff barriers have been removed on many high-tech products across a broad range of markets"

The third wave of technological innovation: AI, IoT, Big Data, the cloud, 3D printing

Looking ahead, the third wave of technological innovation looks likely to happen in the next 1-2 decades. This is heralded by the ongoing rapid progress in artificial intelligence (AI), the Internet of Things (IoT), Big Data, the cloud, 3D printing, among others. According to PwC, AI will contribute as much as USD15.7tn to the world economy by 2030. Currently, key applications of AI include voice recognition, face recognition, autonomous vehicles, robots, and drones. The areas of application will likely become more pervasive by 2030, ranging from manufacturing and transportation to home service, health care, education, and entertainment. While McKinsey projects that by 2025, IoT could generate USD4-11tn in value globally. The number of IoT-installed devices will increase to 20-30bn by 2020, up from 6-18bn currently, as per various estimates from Gartner, IDC, and IHS.

Diverse demand for electronics hardware

The third wave of technological innovation is expected to create diverse demand for electronics hardware and bring new opportunities for the global electronics industry. For instance, AI will need processors with high computing power to execute the algorithm. IoT devices will require sensors and microcontrollers to allow for data collection, and wireless networks, servers, and memory to allow for connectivity, data transmission, and storage. In addition, to enable IoT/AI, end-use devices will also need to be upgraded. This would involve a wide range of traditional and non-traditional electronic products, such as mobile phones, TVs, refrigerators, washers, speakers, wearables, etc. Consequently, the electronics content in products will rise considerably.

Admittedly, the remarkable growth in global electronics exports/imports seen in the 2000s was also helped by the free trade effect and low base. The world is now confronted with rising trade protectionism and anti-globalisation sentiment. It is uncertain whether advanced economies like the US will pursue tariff/non-tariff measures to restrict the imports of electronic products and to "protect" their domestic industries. Concerns over cyber security, amid rapid technological changes, could be used as an excuse by governments to tighten regulations on electronics imports.

Inferred from the 2000-15 trend, we reckon that global ICT goods exports could maintain a growth of about 3.6% (CAGR) in 2015-30. Upside risks could come from faster-than-expected progress in technological innovation and broader-than-expected application of new technologies. While downside risks could come from technological bottlenecks, a significant rise in trade protectionism, and over-regulation from governments.

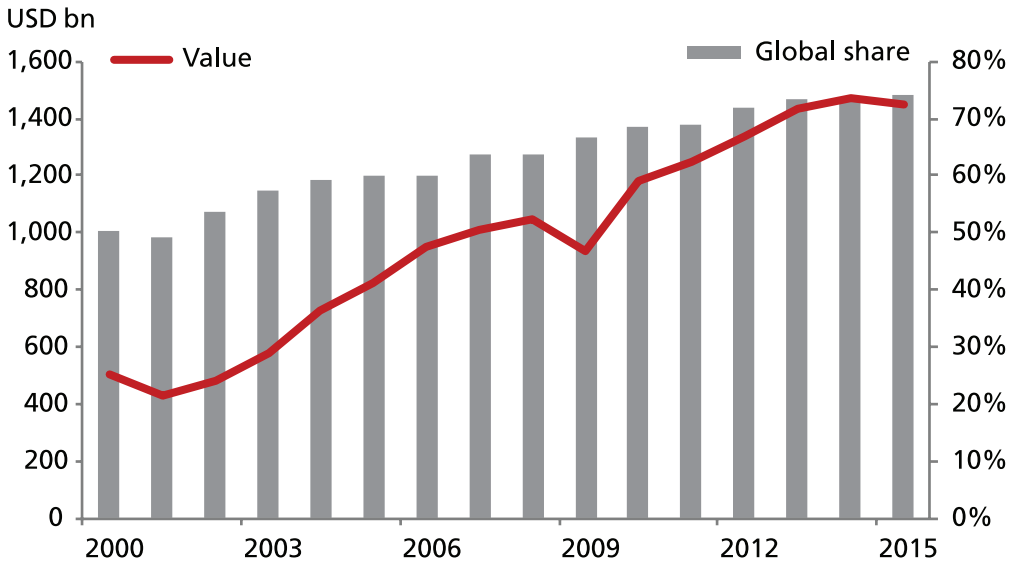
"The third wave of technological innovation is expected to create diverse demand for electronics hardware"

Asia Is Well Positioned to Benefit From the New Tech Wave

Asia has built the world's largest electronics manufacturing cluster

Asia is well positioned to benefit from the new tech wave. Over the decades, Asia has built the world's largest electronics manufacturing cluster, making a broad range of electronic parts/components and finished products. Asia accounted for as much as 74% of global ICT goods exports in 2015, a higher share than the 50% in 2000 (Diagram 8). In other words, three quarters of the world's electronic products are made in Asia today.

Diagram 8: Asia: ICT goods exports



Sources: UNCTAD, CEIC, DBS

China is the world's largest production base for mobile phones, computers, and consumer electronics

China is Asia's largest electronics production base, accounting for 31% of global ICT goods exports. The actual share would exceed 40%, if considering the indirect shipments from China to the rest of the world via Hong Kong. In terms of specific products, China is the world's largest production base for mobile phones, computers, and consumer electronics, responsible for about 40% of related exports (Diagram 9).

Advanced Asian economies like Singapore, South Korea, and Taiwan have moved the low value-added electronics production to China and other Asian markets in the past decades. Each of them accounts for only 6% in global ICT exports today. But Singapore, South Korea, and Taiwan remain the world's key producers of electronic parts and components, contributing 13%, 9%, and 12% to the world's related exports, respectively.

South Korea is currently the world's No.1 producer of memory chips and display panels. Taiwan is the largest base for wafer foundry and integrated circuit (IC) packaging & testing globally. Singapore, meanwhile, ranks as the world's biggest manufacturer of hard disk media. The city-state is also home to some of the world's leading semiconductor companies.

The ASEAN-5 countries also play an important role in the electronics supply chain, contributing a significant 9% to global ICT goods exports. Within this bloc, Thailand is the leading producer of computers (global share: 4%) and consumer electronics (3%). Vietnam has emerged as the largest production base for communication equipment (global share: 6%), thanks to heavy investment from South Korea's Samsung to build factories to assemble smartphones. Malaysia is the key supplier of electronic components in this region (global share: 5%).

Diagram 9: Asia's ICT exports, by product, by market

USD bn (% global share red)

		2000	2010	2015
All products	China	44	460	608
		4	27	31
	South Korea	59	100	114
		6	6	6
	Taiwan	63	95	110
		6	5	6
	Singapore	76	121	116
		8	7	6
	ASEAN-5	-	132	173
			8	9
Computers & peripheral equipment	China	18	197	184
		5	39	39
	South Korea	20	14	11
		5	3	2
	Taiwan	29	11	9
		8	2	2
	Singapore	31	22	16
		8	4	3
	ASEAN-5	-	51	45
			10	9

The ASEAN-5 countries also play an important role in the electronics supply chain, contributing a significant 9% to global ICT goods exports

Communication equipment	China	6	107	214
		4	32	41
	South Korea	7	26	30
		4	8	6
	Taiwan	3	10	7
		2	3	1
	Singapore	3	7	11
		2	2	2
	ASEAN-5	-	7	39
			2	7
Consumer electronics	China	11	65	74
		11	28	37
	South Korea	6	4	5
		5	2	2
	Taiwan	2	3	3
		2	1	1
	Singapore	4	4	2
		3	2	1
	ASEAN-5	-	19	16
			8	8
Electronic components	China	7	74	120
		2	13	18
	South Korea	25	46	62
		8	8	9
	Taiwan	26	66	83
		8	12	12
	Singapore	35	87	85
		11	15	13
	ASEAN-5	-	51	70
			9	10

Notes: ASEAN-5 refers to Malaysia, Thailand, Indonesia, the Philippines, and Vietnam
Sources: UNCTAD, CEIC, DBS

Asia has built an intertwined and sophisticated electronics supply chain

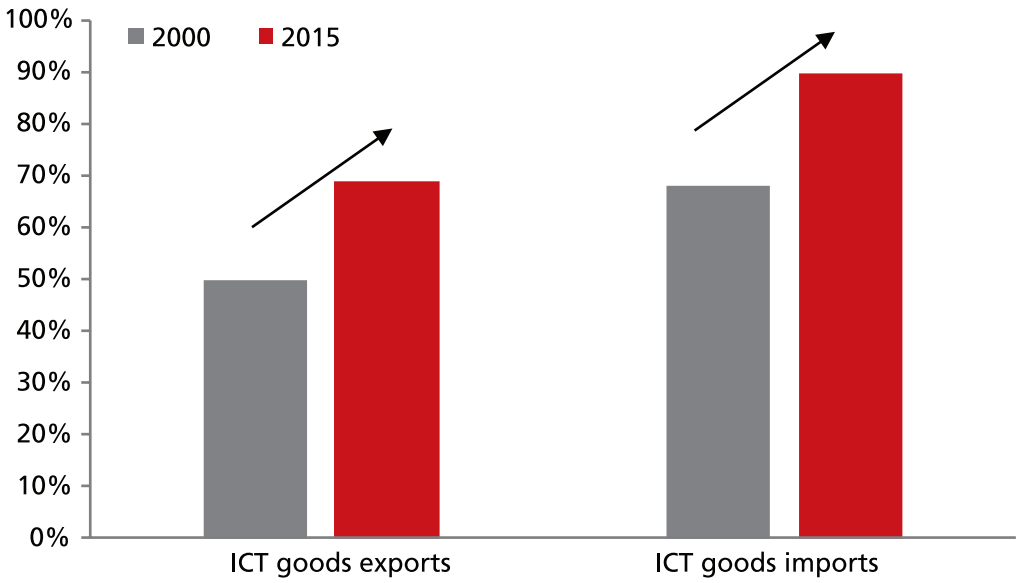
Asia has built an increasingly intertwined and sophisticated electronics supply chain over the decades. There is now a well-defined division among the major production bases in the region, including the fabrication of various electronic parts and components, and the assembly, testing, and exports of finished products. The production process of Apple's iPhone is a good

example. While the iPhone is designed in the US, its production is largely conducted in Asia. The core processors could be made in Taiwan by TSMC, the displays made in South Korea by LG, and the cameras sourced from Sony in Japan. The phone is subsequently assembled in China by Foxconn and exported around the world.

Asia's electronics trade is largely comprised of intra-regional trade nowadays

The establishment of Asia's interdependent electronics supply chain is manifested by the rapid expansion of intra-regional trade. A large portion of Asian electronics exports/imports are being shipped within Asia. Based on the 2015 statistics, 68% of Asia's ICT exports were shipped to countries within the region, a higher share than the 50% in 2000. Then again, as much as 90% of Asia's ICT imports were sourced from countries within the region, also a higher share than the 69% in 2000 (Diagram 10). The proportion of intra-regional trade is highest in the electronic components segment, at 89% currently (for both exports and imports).

Diagram 10: Share of intra-Asia trade in ICT goods trade



Sources: UNCTAD, CEIC, DBS

China's Rise and Rise as an Electronics Powerhouse

China has developed its own technological power and moved up the value chain

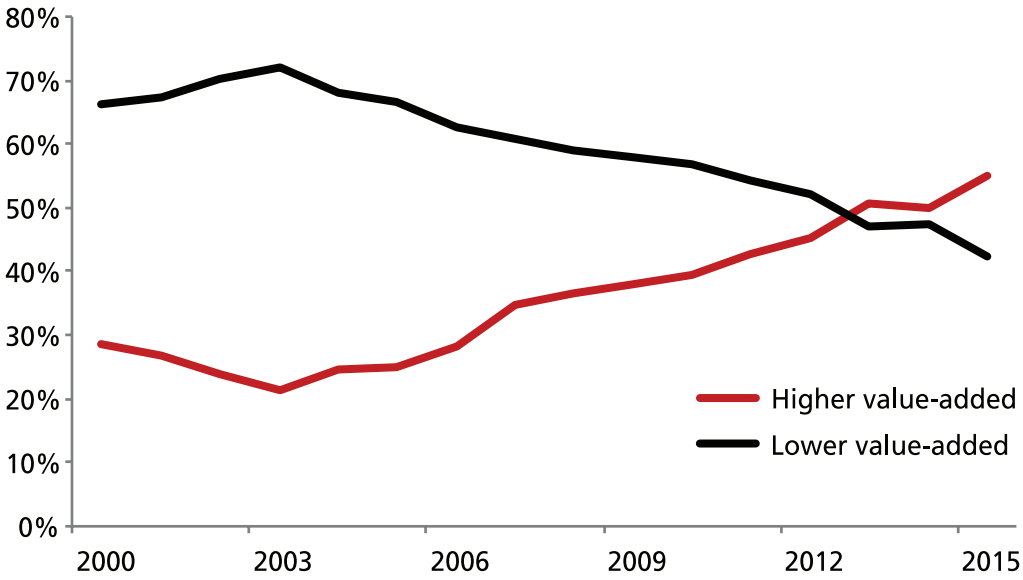
China is likely to benefit considerably from the new tech wave. Through successfully attracting foreign direct investment in the past decades, China has turned itself into the

"Asia has built an increasingly intertwined and sophisticated electronics supply chain over the decades"

world's and the region's largest electronics manufacturing powerhouse. As mentioned, China is currently the world's biggest manufacturing base of various electronic products – computers, communication equipment, and consumer electronics, responsible for about 40% of related exports.

More importantly, China has demonstrated its ability to develop its own technological power and move up the value chain. In China's total ICT goods exports, the share of higher value-added products (communication equipment and electronic components) has risen to 55% in 2015, up sharply from the 28% in 2000. Conversely, the share of lower value-added products (computers and consumer electronics) has fallen to 42% from 66% (Diagram 11).

Diagram 11: China: Composition of ICT goods exports



Sources: UNCTAD, CEIC, DBS

Today, it is not only foreign electronics firms that engage in manufacturing works in China; a number of Chinese firms have also emerged as electronics giants. In the smartphone segment, for instance, China is now home to many successful self-branded companies, including Huawei, Oppo, and Xiaomi. Their combined shares in the global market have well exceeded that of Apple's and Samsung's (Diagram 12).

"China has demonstrated its ability to develop its own technological power and move up the value chain"

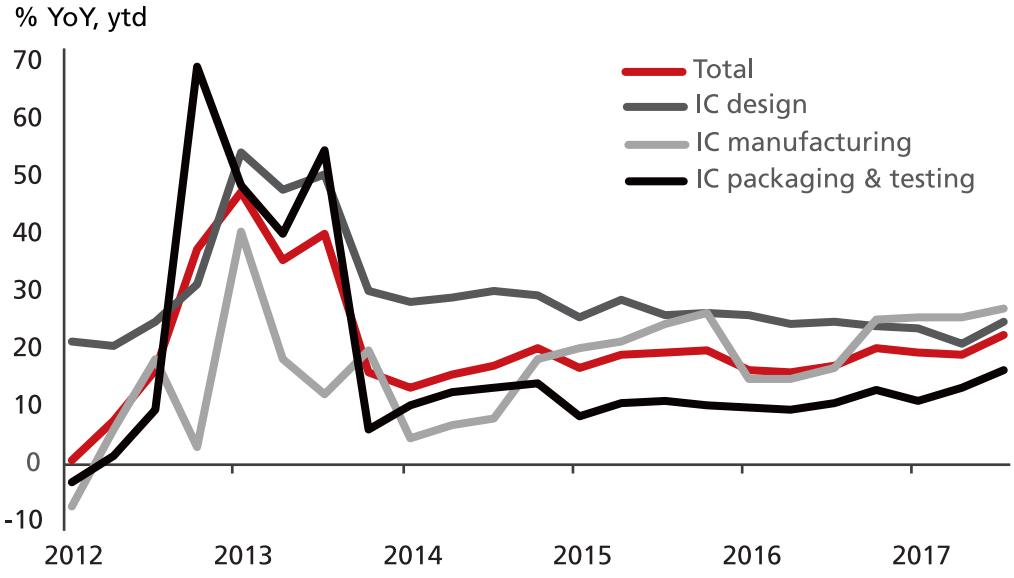
Diagram 12: Worldwide market share of smartphone companies (%)

	4Q16	2Q17	4Q17
Apple	18.2	11.8	19.7
Samsung	18.0	22.9	18.9
Huawei	10.6	11.1	10.7
Xiaomi	3.3	6.2	7.2
Oppo	7.3	8.0	6.9

Sources: IDC, DBS

China still relies on the foreign supply of some core technologies today. The country remains a net importer of various types of electronic parts and components, such as chips, semiconductors, and precision equipment. Having said that, China has also made significant advances in certain fields in recent years through technological investment and mergers & acquisitions. The country's IC sales began to surge in 2012, registering an average growth of about 20% YoY in the last five years (Diagram 13). Growth in IC design was especially strong, at nearly 30% YoY.

Diagram 13: China's IC sales



Sources: CEIC, DBS

China's HiSilicon and Unigroup are now among the world's top 10 fabless companies, though still ranking behind many US counterparts (Diagram 14). Three Chinese names – Jiangsu Changjiang, Tianshui Huatian, and Nantong Fujitsu – have also joined the global top 10 list of IC packaging and testing companies (an area dominated by Taiwan).

Diagram 14: The world's top 10 fabless companies

2017 Rank	Company	Headquarters
1	Qualcomm	US
2	Broadcom	Singapore
3	Nvidia	US
4	MediaTek	Taiwan
5	Apple	US
6	AMD	US
7	HiSilicon	China
8	Xilinx	US
9	Marvell	US
10	Unigroup	China

Sources: IC Insights, DBS

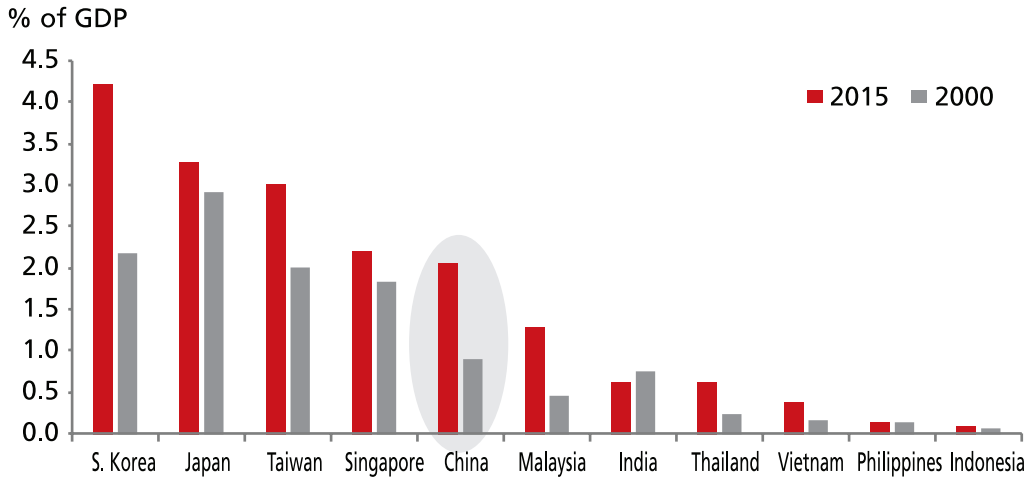
Both public and private sectors make consistent efforts to invest in technology development

There are good reasons to expect China to continue to climb up the value ladder and embrace the new tech wave in the next decade, as both public and private sectors make consistent efforts to invest in technology development. The Chinese government is actively pushing for industrial upgrade and transformation under the "Made in China 2025" programme. The aim is to strengthen China's capabilities in high-tech industries, ranging from ICs and robots to aviation, marine engineering, new-energy vehicles, among others. The government has allocated more public funds to support technological R&D and is also encouraging large state-owned enterprises to participate in the programme.

In the private sector, there is also impetus for Chinese companies to engage in more R&D and design to increase the value-added elements of their products and/or to employ automated production technology to shift the entire value curve upwards. In the context of an ageing population, a rapid rise in labour costs, and a relatively strong renminbi, technological innovation would be increasingly regarded as the way forward for Chinese manufacturers to boost productivity, sustain profitability, and maintain competitiveness.

China's R&D expenditures have risen significantly in the past decades, from an equivalent of 0.9% of GDP in 2000 to 2.1% in 2015. The pace of increase is the second-fastest in Asia, just after South Korea (Diagram 15). Under the 13th Five-Year Plan, the Chinese government aims to lift the R&D expenditure-to-GDP ratio further to 2.5% by 2020. Public and private R&D spending is expected to total RMB11.2tn in 2015-20, nearly double that during the 12th Five-Year Plan.

Diagram 15: R&D expenditure in Asia



Sources: The World Bank, DBS

China has a unique advantage in its market scale

In addition, China has a unique advantage in its market scale. China's huge consumer market and rising consumer power provide a favourable environment for the marketisation of new business models and the application of new technologies. Presently, the country has as many as 700mn internet users, the world's largest e-commerce market, and the world's highest mobile payment penetration rate. This could generate a large volume of data, paving the way for the development of machine learning/AI. The application of AI will then boost demand for high-end electronic components and drive the development of China's semiconductor sector. In short, China's domestic demand in the new tech areas could serve as an intrinsic catalyst for its electronics supply chain to continue to evolve.

The Competitive Edge of Singapore, South Korea, and Taiwan

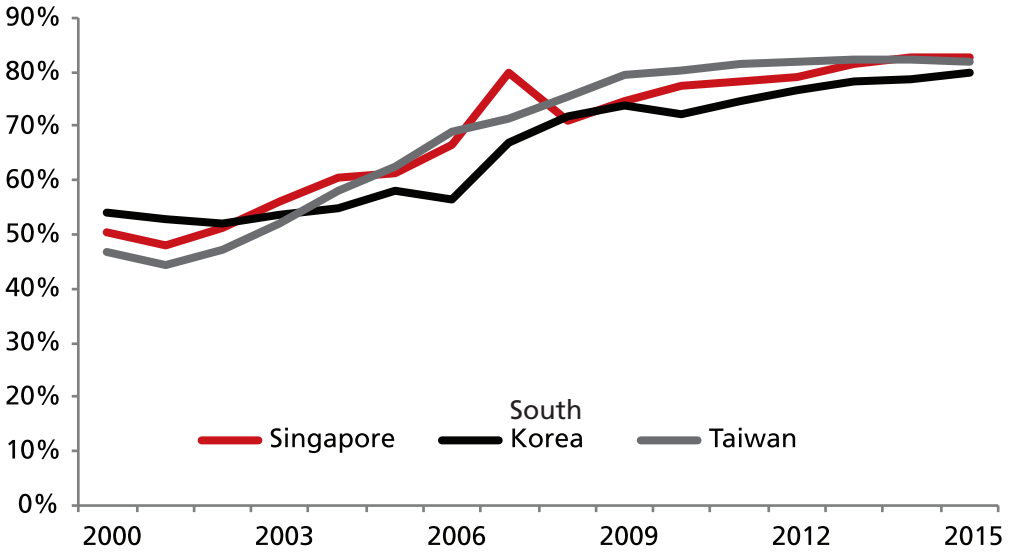
As China moves up the electronics value chain, it will likely erode the market shares of existing upstream producers in Asia's advanced economies, namely Singapore, South Korea, and

"The Chinese government is actively pushing for industrial upgrade and transformation under the "Made in China 2025" programme"

Taiwan. But this doesn't mean China will readily absorb the upstream production capacity. The relatively strong innovation capabilities of these economies could help them to sustain competitiveness in the upper tiers of high value-added electronic segments. Meanwhile, given their existing position in the high value-added segments, these three economies should be among the first to benefit from the new tech wave which is expected to boost demand for high-end electronic components. Cyber security and intellectual property-related concerns may also put a lid on China's ability to absorb the entire supply chain.

Singapore, South Korea, and Taiwan have successfully moved up the value chain, upgrading their manufacturing capabilities and transforming their electronics sectors. By moving the production of low value-added electronic products to China, Vietnam, and other Asian countries, they are able to focus on high value-added works today. Electronic components and communication equipment account for as much as 80% of their total ICT goods exports (Diagram 16).

Diagram 16: Singapore, South Korea, and Taiwan: Share of higher value-added products in ICT goods exports



Sources: UNCTAD, CEIC, DBS

Singapore, South Korea, and Taiwan have strong R&D capacity, highly-educated human resources, and robust institutional/legal frameworks

Compared to China, these advanced Asian economies have relatively strong R&D capacity, highly-educated human resources, and robust institutional/legal frameworks. Singapore has strong human resources, thanks to the heavy investment in higher education and the government's open immigration policy to import skilled labour. Given its easy business

Cyber-security and intellectual property-related concerns may also put a lid on China's ability to absorb the entire supply chain

environment, comprehensive free trade networks, and superior geographic location, Singapore could also continue attracting foreign electronics companies to set up headquarters to control their regional operations and supply chains.

South Korea is the leading country in Asia for R&D expenditures, at 4% of GDP. Its chaebol-dominated electronics sector has the willingness and capabilities to take risks, expand R&D budgets, and enter new emerging areas.

Taiwan's advantage is its well-established semiconductor supply chains. Thanks to the vertical division between upstream and downstream (IC design, fabrication, packaging and testing), Taiwanese semiconductor companies could provide diversified and customised products for global customers in an efficient way.

Opportunities for Southeast/South Asia

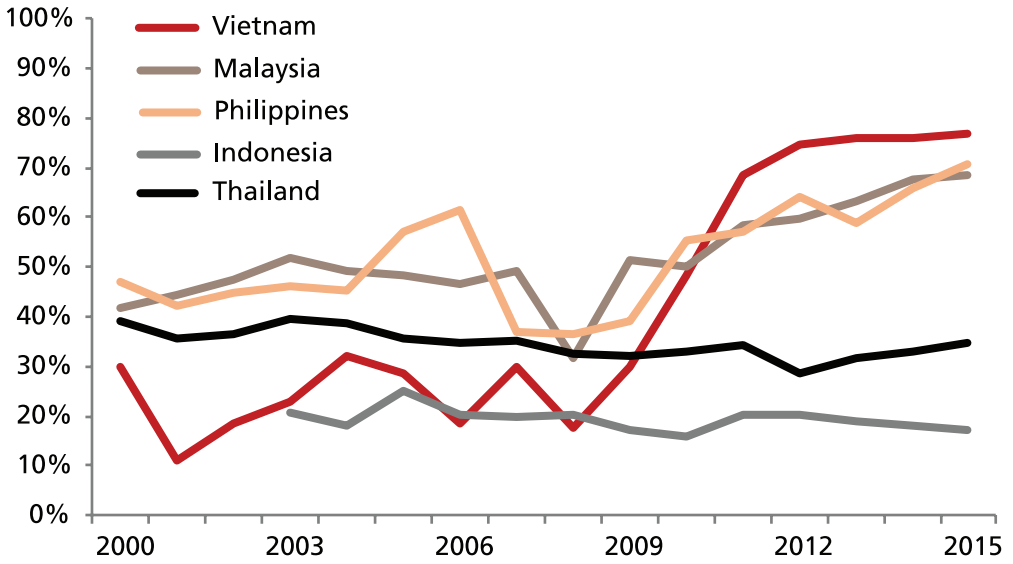
It will take time for the prices of robots/ smart machines to fall to the level of wages in lower-income Asian economies

As China moves further up the electronics value chain, it would also create opportunities for lower-income countries in Southeast/South Asia. Given the rapid rise in wage pressures, Chinese electronics firms and foreign electronics firms based in China will likely consider relocating low-end manufacturing and assembly works to lower-cost Asian countries. It is true that the ongoing technological changes will increase the proportion of automated operations, reduce reliance on labour, and eventually, downplay the importance of labour costs in business investment decisions. But it will still take quite some time for the prices of robots and other smart machines in China to fall to the level of wages in lower-income Asian economies.

Some Southeast Asian countries have made advances in the electronics value chain, while the others remain laggards. Malaysia, the Philippines, and Vietnam have seen a notable rise in the share of high value-added products in total ICT exports in the past decade. But Indonesia and Thailand didn't see much changes (Diagram 17). We believe there is room for Indonesia and Thailand to undertake more electronics manufacturing/assembly works and to upgrade their industrial structure.

"As China moves further up the electronics value chain, it would also create opportunities for lower-income countries in Southeast/South Asia"

Diagram 17: ASEAN: Share of higher value-added products in ICT goods exports



Sources: UNCTAD, CEIC, DBS

India is not yet embedded in the global electronics supply chain – its share in global ICT goods exports is almost negligible. Given its cheap wages, abundant labour supply, and large consumer market, there is potential for India to receive the lower-end manufacturing/ assembly works transferred from China and to play a bigger role in the global electronics supply chain.

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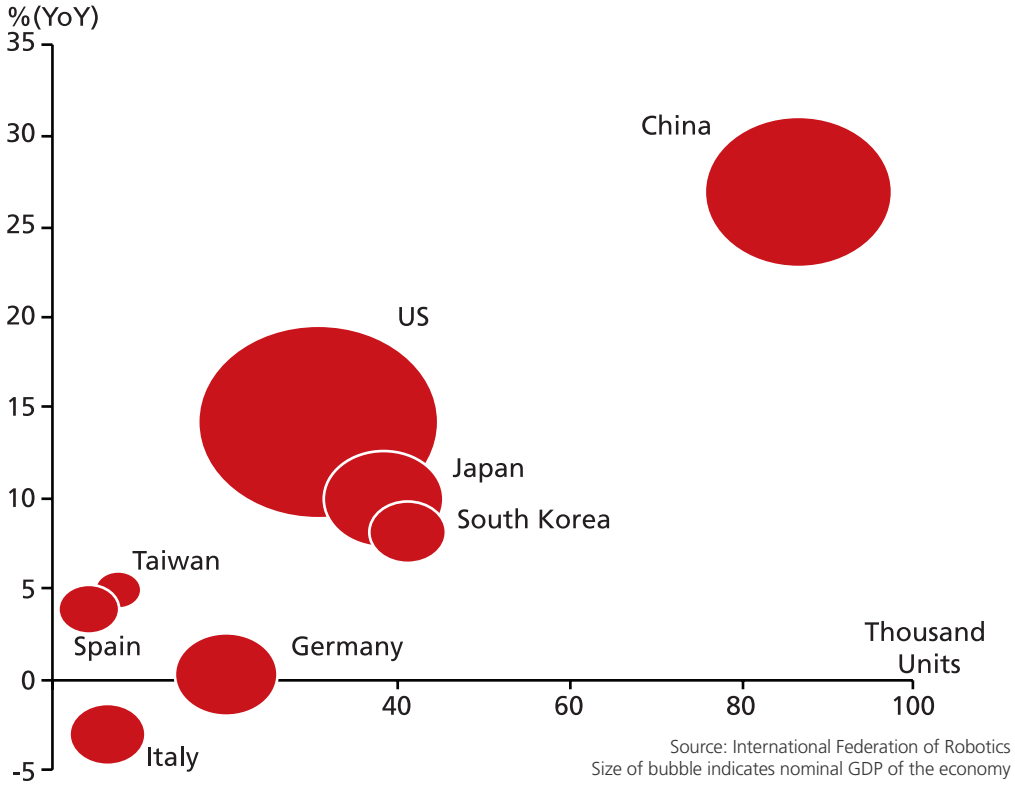
Automation Drive Is Essential and Welcome

Dwindling Productivity Growth

China's economy has witnessed impressive growth since the country opened its doors in the late 1970s. GDP surged from less than USD0.2bn in 1978 to USD13tn in 2017, lifting more than 600mn people out of poverty. This achievement has been built on two powerful pillars: tens of millions of workers migrating from the countryside to power the mainland's industrial economy and the government's massive investments in factories, infrastructure, and machinery.

Diagram 18: Robot shipments in 2016

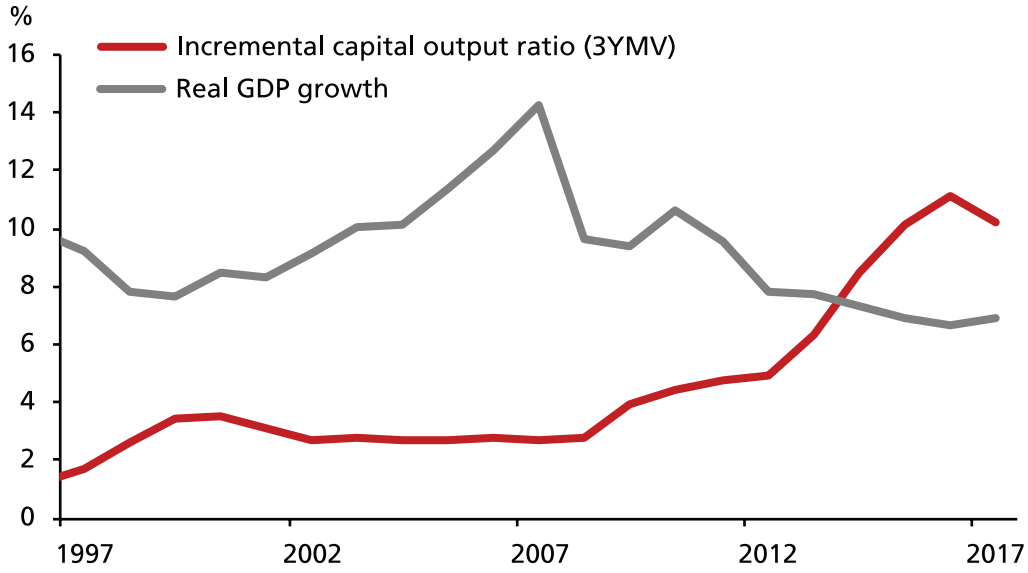


Source: International Federation of Robotics
Size of bubble indicates nominal GDP of the economy

The growth in the number of migrant workers seeking city jobs has slowed since 2005

However, the growth in the number of migrant workers seeking city jobs has slowed since 2005. Also, the massive expansion of capital investment hitherto has resulted in a decline in capital efficiency, evident in the surge in incremental capital output ratio (Diagram 19). Productivity has fallen as a result. After achieving an annual average of 8.8% during 2001-10, productivity growth declined to 5.2% in 2011-17.

Diagram 19: Incremental capital output ratio and GDP growth



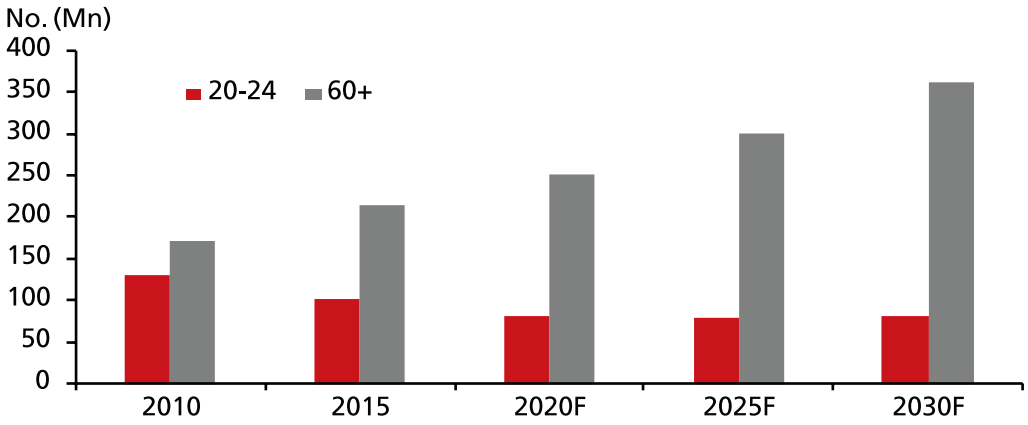
Sources: Data for all charts and tables are from CEIC, Bloomberg and DBS Group Research (forecasts and transformations)

Productivity growth is faltering due to an ageing population and SOE domination

An ageing population and domination by state enterprises are a recipe for weak productivity growth. The projected division between China's young and aged populations by 2030 is stark. According to the United Nations' forecast, the number of Chinese aged 20-24 will decrease 40% to just 81mn (6% of the predicted population) and the number aged over 60 is projected to rise to 362mn (25% of the projected population) (Diagram 20). The speed of this demographic shift will become more apparent, given the falling fertility rate, which dropped below the "replacement level" in the 1990s and currently stands at 1.60.

The relaxation of the one-child policy in 2013 is unlikely to have a notable demographic impact, particularly in urban areas where couples are now reluctant to have two children due to high living costs. An ageing population pushes up healthcare costs and pension expenditure, which in turn will translate into a larger fiscal burden.

Diagram 20: China's population by age group



Source: United Nations

The ROE at SOEs has always lagged that of private firms

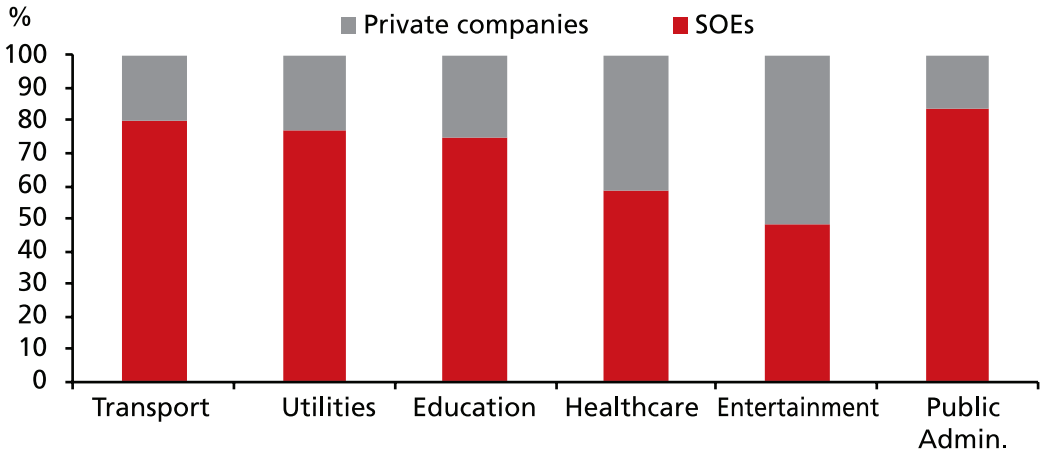
The next challenge is the drop in private investment. In 2017, investments by state-owned firms were up 10.1% YoY, compared with a 6% expansion for private firms. A larger share for the state sector of the economy will be a drag on efficiency. Underlying causes are manifold including misallocation of capital. There has been a fresh push over the past few years on state-sector reform, from introducing mixed ownership to corporatisation. Yet, little progress has been made in closing the profitability gap between SOEs and their private counterparts. Since 2008, private enterprises have delivered a ROA of around 10%-14%; for SOEs, it has run between 3%-6% (Diagram 21). Despite poor returns, SOEs have dominated investment (Diagram 22).

Diagram 21: Return on assets

Data for all charts and tables are from CEIC, Bloomberg and DBS Group Research (forecasts and transformations)

Yet, little progress has been made in closing the profitability gap between SOEs and their private counterparts

Diagram 22: Fixed asset investment in tertiary sector



Data for all charts and tables are from CEIC, Bloomberg and DBS Group Research (forecasts and transformations)

Automation is the key to reviving productivity

Against this backdrop, automation is key to reviving productivity. Academic literature has long recognised the importance of technology on growth and productivity, and China has been following these trends accordingly. Robots were first mentioned in the Government Work Report of 2014, in the context of China's aim to achieve "major breakthroughs in super computing, intelligent robots, super hybrid rice, and other key technologies". President Xi Jinping called in a speech to the Chinese Academy of Sciences in 2014 for a "robot revolution", in a nod to automation's vital role in raising productivity.

Thanks to the government's efforts and incentives over the past few years, China is forging ahead with great force in the field of robotics, known as "the jewel in the crown of manufacturing". And this great force comes from the 13th Five-Year Plan (2016-2020), the Made in China 2025 programme, the Robotics Industry Development Plan, and the Three-Year Guidance for Internet Plus Artificial Intelligence Plan (2016-2018).

Current State of the Chinese Robot Industry

Shipments of robots to China increased 27% in 2016

China installed 87,000 industrial robots in 2016, up 27% YoY and a record for any country (Diagram 18). The main drivers were the electrical and electronics industry, with sales jumping 75% to almost 30,000 units. Major manufacturers of electronic devices (e.g. semiconductor and chips) have invested heavily in automation.

Meanwhile, the automotive industry has remained a powerful driver of industrial-robot sales. Between 2011-16, a total of 108,000 units were installed, representing an average increase of 18% per year. Sales to China made up 25% of the global supply of industrial robots in the

automotive industry in 2016. Large battery-production facilities are being installed to meet the increasing demand for electric and hybrid cars. China is currently the world's largest car market and production site for automobiles. Some international robot suppliers have already set up production plants in China and more will likely follow suit in the coming years. This implies ample growth potential of the use of robots in the car-making industry. In fact, the impact of automation on growth appears to be promising. In 2016, motor vehicle production grew 15%, compared to the industry average of 6.2%.

While automation brings substantial improvements in prosperity, the transition also creates challenges. International experience suggests that technological advancement has in some countries led to subdued growth in wages and loss of jobs. For example, digitisation has been affecting the occupational and skill mix of the US workforce since the 1980s. Employment in middle-skill jobs has declined, given the many routine production and assembly tasks being automated.

No doubt such concerns have been amplified by recent headlines about robot adoption by some well-known companies. Foxconn, supplier to Apple and Samsung, has replaced 60,000 factory workers with robots. China's home-appliance maker Midea's USD4bn acquisition of German robot giant Kuka also highlights the scale of ambition in automation by the world's factory. Aside from manufacturers, e-commerce giants are also following suit. Alibaba has been putting robots to work - picking up and moving around stacks of goods in its logistics warehouses. Together, fears are rising that robots might take on many of the jobs that once pulled hundreds of millions out of poverty in China.

Automation Will Not Happen Overnight

Overall robot density is still low

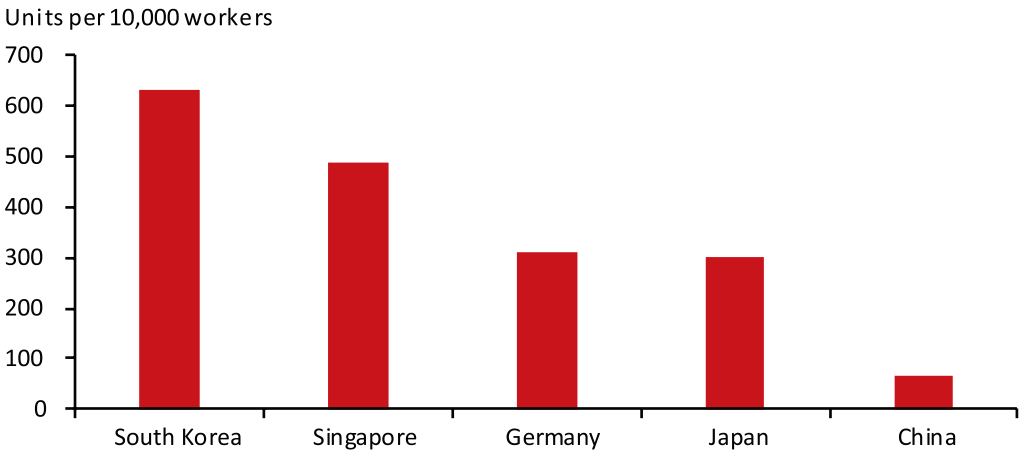
However, such worries ignore the country's relatively low robot density. In 2016, China had only 68 robots to every 10,000 persons employed in the manufacturing industry, versus the global average of 74. The most automated countries are South Korea (631 units), Singapore (488 units), Germany (309 units), and Japan (303 units) (Diagram 23). Even assuming that robot installation would register a 20% annual growth in the next few years, China's robot density will just be around 166 (per 10,000 workers) by 2020. This reinforces the fact that the growth in robot installation so far has not depressed wages in the country. From 2010 to 2016, the wages of manufacturing workers surged more than 90%.

Besides, technical feasibility is not the only condition for automation; cost and elasticity are also pivotal factors. Empirical analysis has shown that technological progress lowers the price of investment goods and thus induces firms to substitute capital for labour[1]. But this is by

1 World Economic Outlook, IMF, Apr 2017

and large an advanced-economy phenomenon. In China, information and communications technology capital as well as machinery and equipment (the group of capital goods that leads the decline in the relative price of investment) account for a mere 6% in its investment goods basket. That stands in stark contrast to the situation in developed economies. For instance, a similar basket of capital goods accounts for 62% in the US and 56% in South Korea. As such, the impact of technology on labour will be less pronounced in China, reflecting a milder decline in the relative price of investment goods.

Diagram 23: Robot density of selected countries in 2016



Source: International Federation of Robotics

Augmentation Rather Than Substitution

Automation enables lower-skilled workers to work on higher value-added jobs

Wider adoption of technology enables those with lower skills to work on higher value-added jobs. Such a complementary effect mitigates or even outweighs the potential displacement of labour. A great example would be the manufacturing sector. Although it was one of the most heavily-automated sectors in recent years, a net balance of 6.32mn manufacturing jobs was created between 2012-16 (Diagram 24). That is equivalent to a cumulative growth of 15%, matching the total labour growth during the period.

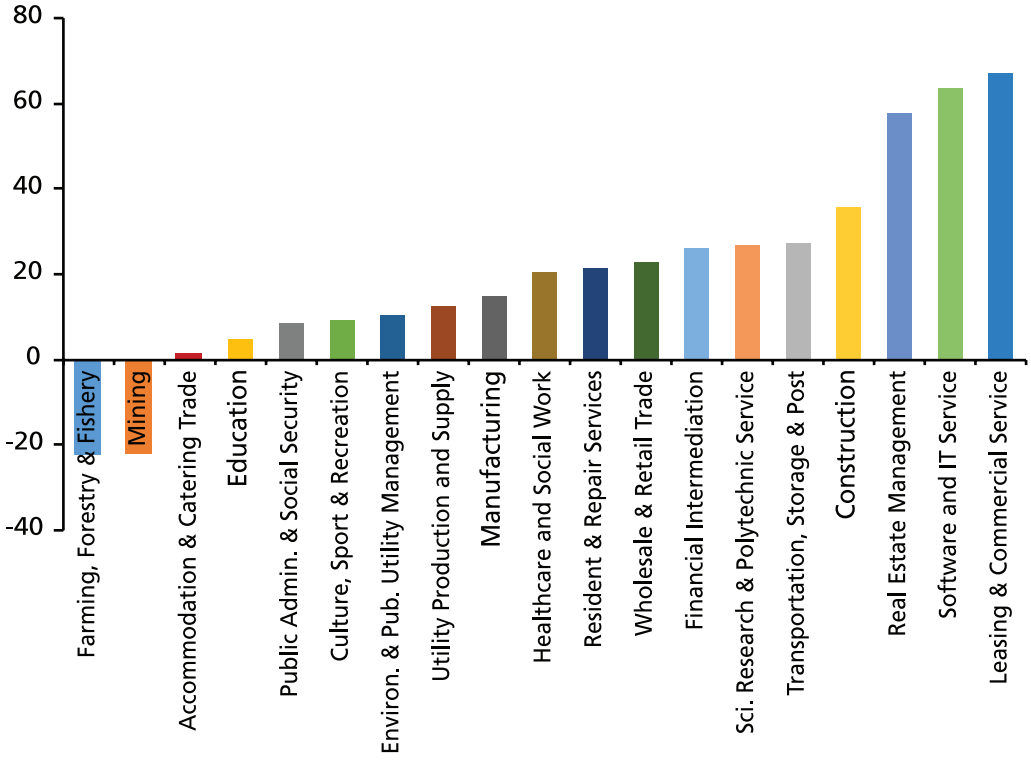
A benign interpretation is that the adoption of robotics engineering replaced repetitive tasks previously done by workers. But through training, these workers have been able to focus on higher value-added elements in the manufacturing process such as R&D, as well as process and quality control.

Fears are rising that robots might take on many of the jobs that once pulled hundreds of millions out of poverty in China

Another example would be the wholesale and retail trade sector, which saw 23% cumulative labour growth during the period. While machines have been able to take over virtually all roles performed by sales staff and cashiers (i.e. self-scanning and self-checkout systems), many companies have opted for a mix of automated and human-operated sales and payment systems. This reflects not only the customers' preference but also the social-interaction factor, which can be important for a human salesperson.

The same is true for financial intermediaries. Nowadays, more and more banking functions can be automated. Payments are increasingly made not in branches but online. Automated advisers enable portfolio allocations to be made at a lower cost. Rule-based algorithms can also be created and used to select as well as assess insurance risks. However, human advice is still preferred when transactions become more complex or involve larger sums (e.g. buying property, withdrawing pension, and private banking). Highly trained and skilled financial professionals can offer tailored recommendations to their clients. That explains why the sector still registered cumulative labour growth of 26% during 2012-16.

Diagram 24: Cumulative labour growth (2012-16: %)



Data for all charts and tables are from CEIC, Bloomberg and DBS Group Research (forecasts and transformations)

Through training, these workers have been able to focus on higher value-added processes

Unsurprisingly, mining and agriculture & forestry were the only two sectors that recorded net job losses during the period. Automation is not a new phenomenon within these industries. For many years, cultivation robots, weeding robots, and harvesting robots have been deployed in greenhouses and farms. The drone is the latest in a slew of hi-tech products adopted by Chinese farmers to enhance efficiency. The number of drones deployed for crop-dusting has skyrocketed from only 500 in 2014 to about 8,000 in 2016. Noteworthy, although mining and agriculture lost 20% of jobs, this was relatively insignificant in terms of total employment (4%).

Impact of automation on workforce varies by sector

At the other end of the spectrum are jobs in information transmission, software and IT services, leasing & commercial services, and real estate management. The number of jobs in these industries, which require both technical and management expertise, has risen 50-60% during the period.

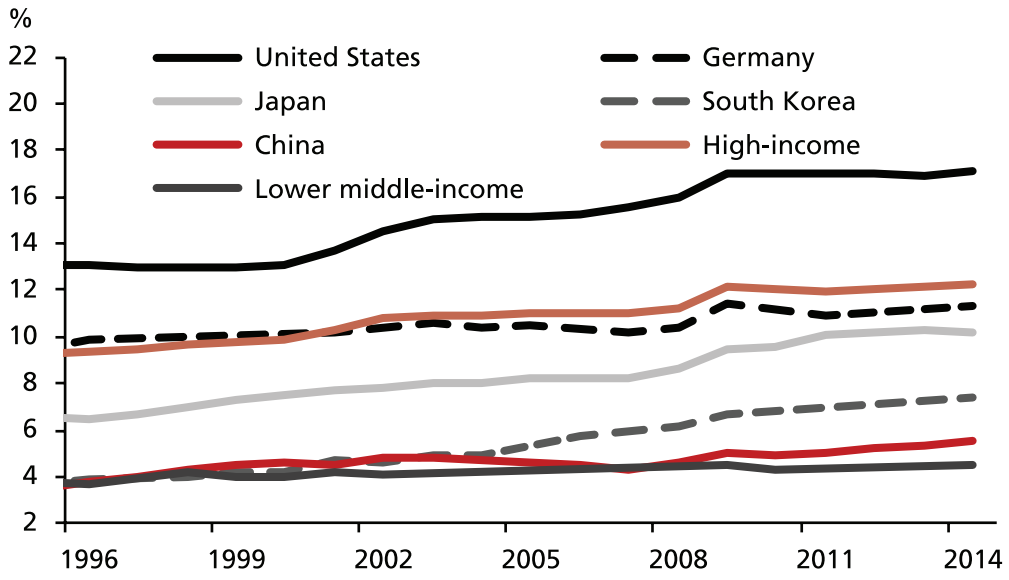
In sum, automation has had a modest impact on China's overall workforce, although this varies by sector. Generally, the higher the level of skills/education required by the job, the more sheltered it is from automation. Occupations most susceptible to automation include those that involve physical labour in predictable environments, repetitive tasks, and unskilled manual labour. This will likely be the case over the next 10 years.

Nevertheless, this correlation should not be interpreted as causal. Whilst training is crucial, it is not the sole consideration in future-proofing employment. Jobs that require a high degree of social interaction, such as nursing and healthcare, are also less vulnerable to automation. Indeed, this industry foresees particularly strong employment growth as the Chinese population continues to age.

A recent study shows that spending on hospital care for an 85-year-old is five times that for those who are 19-44 years old[2]. A positive correlation can also be found between GDP per capita and expenditures in healthcare. In 2014, the ratio of healthcare expenditure to GDP in China was 6%, significantly lower than the US's 17% and Germany's 11% (Diagram 25). Demand for healthcare services is expected to grow rapidly as China is set to join the rarefied ranks of high-income economies.

2 US Center for Medicare and Medicaid Services

Diagram 25: Health expenditure (% of GDP)



Data for all charts and tables are from CEIC, Bloomberg and DBS Group Research (forecasts and transformations)

Wage Polarisation Can Be Avoided

Urbanisation creates large-scale employment in middle-wage jobs

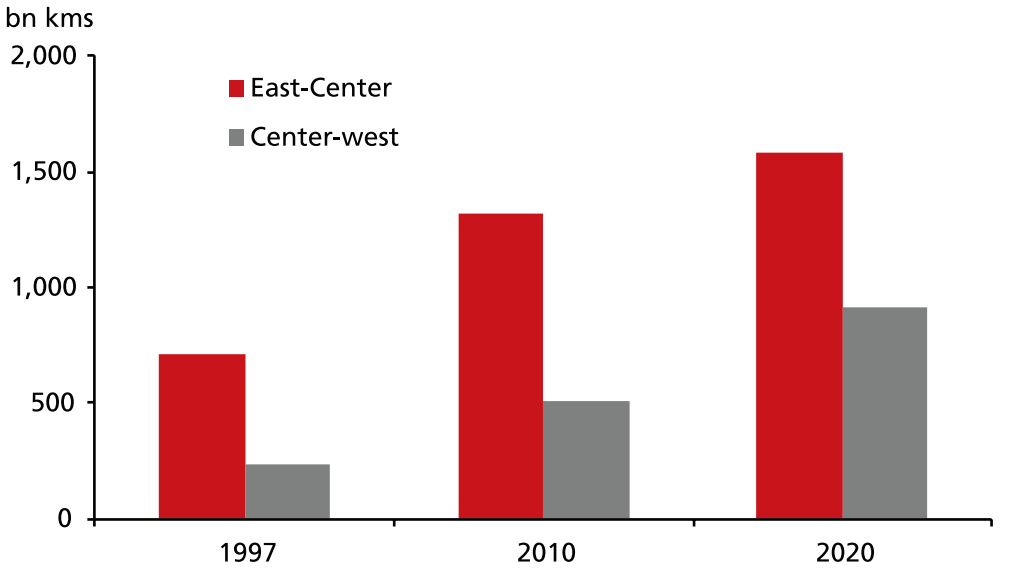
Aside from the new economy and service industry, another potential source of labour demand will be the construction sector. Notwithstanding the fact that China has already made significant investments in infrastructure over the past decade, there is room to step up construction spending. Home to a growing network of high-speed railways and expressways, the nation still lags in areas such as clean energy and sanitation. China's electricity consumption per capita is about 46% of Organisation for Economic Co-operation and Development (OECD) average. Its water-storage capacity is just a third of the US' on a per-capita basis.

Infrastructure investment has also been unbalanced geographically. Take interregional transport infrastructure as an example. The density of transport infrastructure is much higher in the eastern region, which is endowed with less than 10% of the total land area and 34% of the population. In contrast, the western region occupies 59% of land area and has 27% of the population (Diagram 26)[3]. The east–west gap in transport infrastructure will narrow significantly by 2020, according to the government's plan.

Quality is another concern. The World Economic Forum's Global Competitiveness Report (2017-2018) shows that China ranked 47 in terms of infrastructure quality (Switzerland tops the

3 Infrastructure and Urbanization in the People's Republic of China, ADBI, Jan 2017

Diagram 26: Inter-regional transportation capacity



Sources: Ministry of Railways, National Statistical Bureau

rankings, followed by Singapore and Hong Kong SAR). Low construction standards recently led to calls for improvement in infrastructure quality with world-scale capacity. A good example is the Hongqiao Hub in Shanghai, an integrated system with high-speed rail service, an airport terminal, and metro connection in one location that also includes a district energy system.

Meanwhile, urbanisation is taking place at an unprecedented scale in China. By the end of 2017, 58.5% of its population lived in urban areas, a dramatic increase from 26% in 1990. If the current trend holds, the urban population will hit the 1bn-mark by 2030, giving China the potential to create large-scale employment for middle-wage jobs such as architects, engineers, carpenters as well as construction workers and machinery operators. In this regard, China will find herself in an advantageous position versus advanced economies, many of which witnessed a decline in middle-income occupations in the face of automation. This exacerbated wage polarisation and complicated policy responses.

Policy Implications - Increasing Skill Development and Job Mobility Is Key

Labour transition is essential

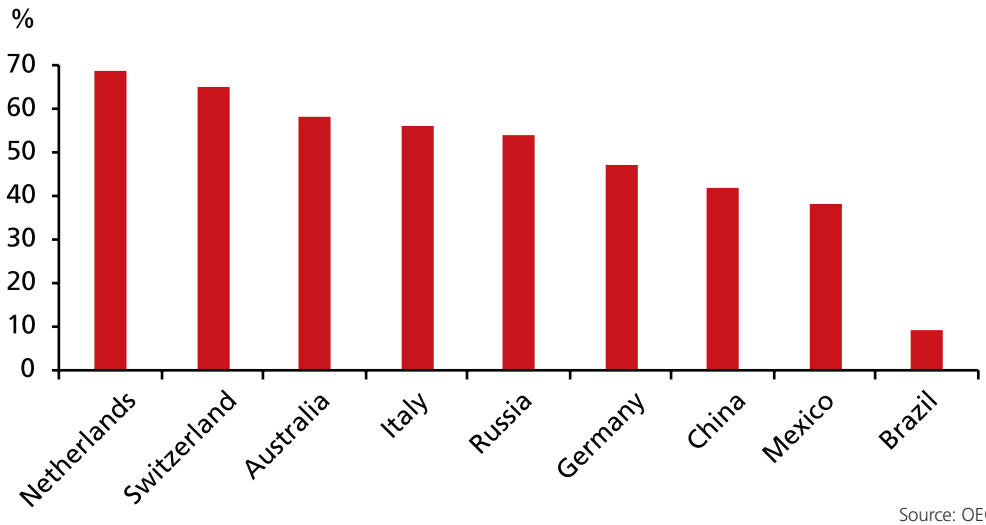
Automation is a deep and unstoppable force. Its impact on the workforce will be increasingly visible in the longer term. Many occupations will face structural change or displacement. Hence, facilitating labour transition is essential. Failure to do so could lead to rising unemployment rates,

slower wage growth, and even social unrest. Effective policy framework must be put in place to smooth the transition.

Workers most affected by automation are currently the least equipped in terms of education and skills.

Thus, increasing opportunities for reskilling through vocational training is important. China's vocational programmes have been badly neglected when compared with the country's rapidly multiplying universities. This owes much to the long-held perception that vocational training is tantamount to dirty hands, a poor working environment, and meagre wages. There are also issues of quality and relevance, as evidenced by limited training equipment and outdated curricula. As a result, participation and graduation rates are low compared to developed countries (Diagram 27).

Diagram 27: Vocational programme enrolment as a share of upper secondary enrolment



Source: OECD

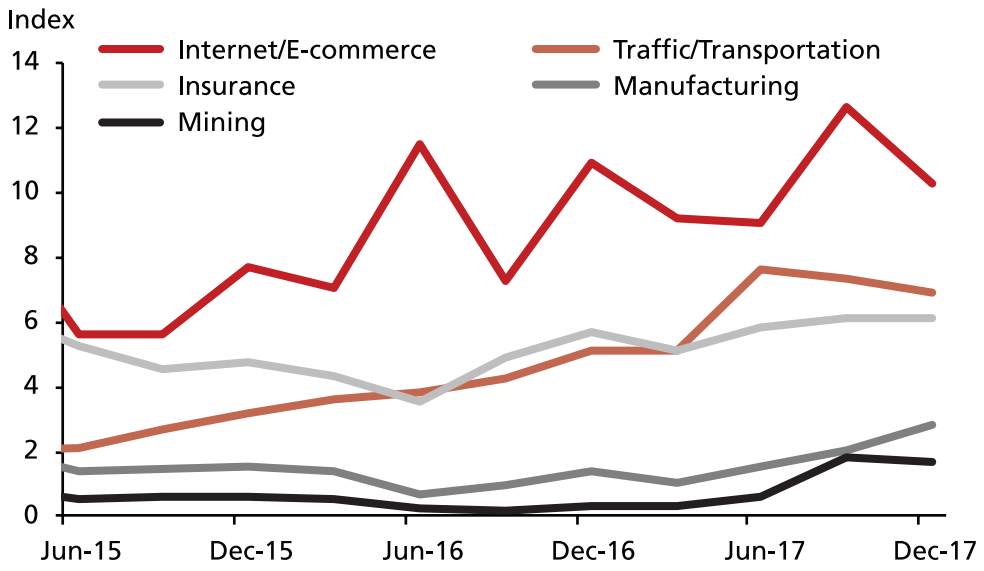
Improving labour mobility is important

In view of this, an updated curriculum is essential to equip students with the skills necessary for a dynamic, technology-, and increasingly, service-oriented labour market. It is vital for teachers to participate in competency-based training, and the school-industry collaboration to be enhanced such as partnering with enterprises to provide on-the-job training and technical development. The government could encourage and incentivise enterprises, for example, through investment and/or subsidies.

"Failure to do so could lead to rising unemployment rates, slower wage growth, and even social unrest"

Improving labour mobility is equally important. Currently, there is a significant disjoint in the workforce – companies struggle to find the employee they need, and people cannot find the opportunities for which they are best qualified. According to Zhaopin's China Employment Indexes, there are 10.2 job vacancies for every job seeker in e-commerce, compared to 1.7 in the mining industry (Diagram 28). One of the reasons behind the mismatch is that job opportunities abound the most in areas with insufficient skilled labour.

Diagram 28: Zhaopin CIER China Employment Index



Data for all charts and tables are from CEIC, Bloomberg and DBS Group Research (forecasts and transformations)

At present, the hukou system in China designates a resident's status based on his or her registered birthplace. Migrant workers from the countryside are not entitled to public services in the cities. The central government has committed to a goal of giving urban residency to 100mn migrant workers by 2020. But in practice, migrant workers' chances of acquiring an urban hukou differ considerably across the country. New hukou rules in big cities such as Beijing, Shanghai, and Guangzhou remain tough for migrant workers.

Applications are graded according to a point system based on an applicant's education level, tax payments, and work experience. Finances is another concern. Migrants who give up their land rights in hometowns as part of their application for an urban hukou are often not compensated properly. Other deterrents include a lack of affordable housing and difficulty finding stable jobs

in the cities. Speeding up the revamp of the hukou system and related reforms could remedy the situation.

A range of other measures including financial aid and psychological counselling can also smooth the transition of workers between jobs. The goal is to avoid long-term negative consequences and provide adequate support for workers caught in the cross-currents of automation. Last but not least, policy intervention is warranted to ensure automation broadens prosperity to prevent a repeat of what happened in developed countries, where income disparity led to a backlash against automation. Reconfiguring tax systems and addressing wealth distribution have the potential to generate a higher degree of equity. Together, the dividends of technological change will be fairly shared; enabling automation to work for the common good.

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