

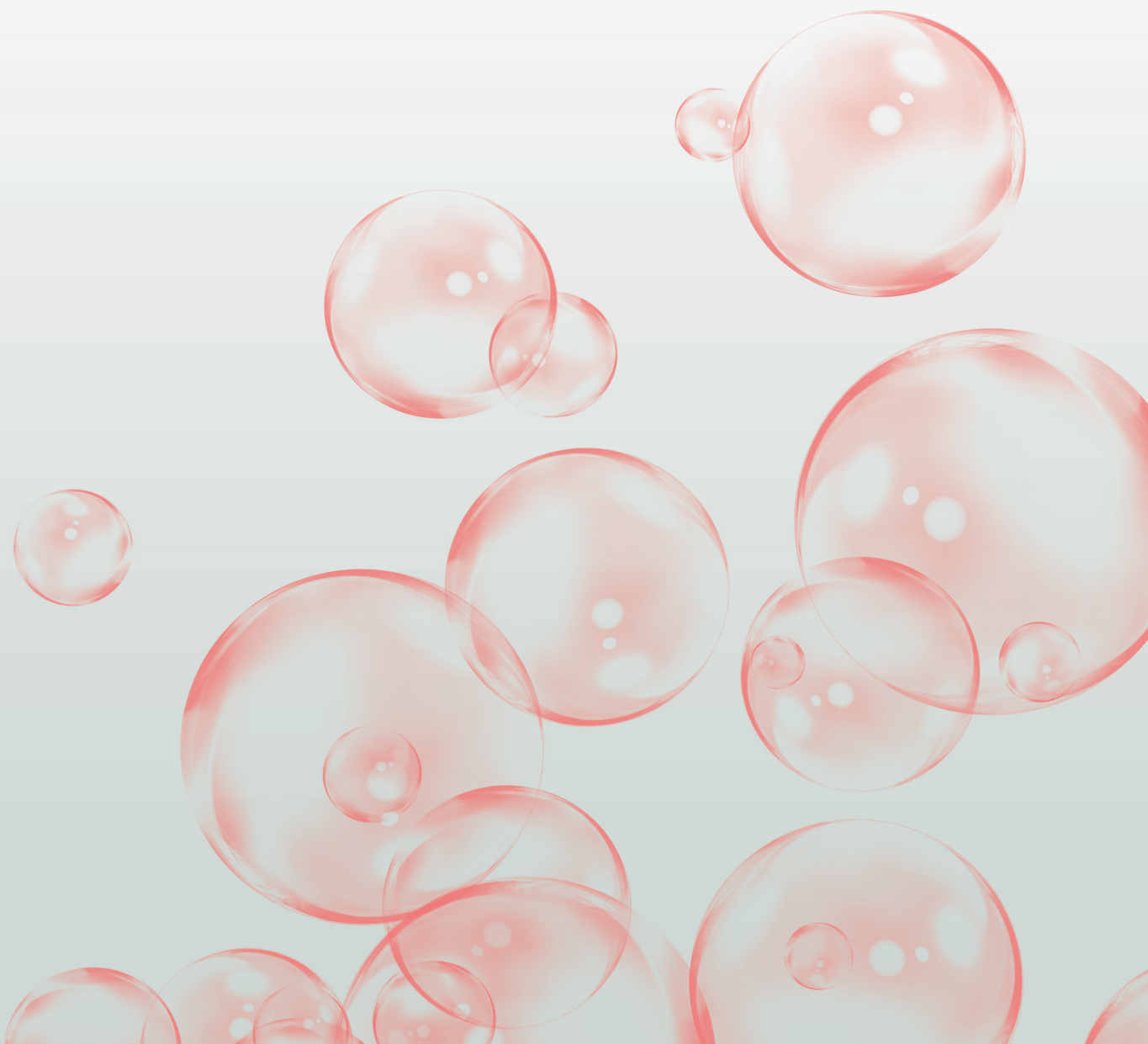
Digital Divide in China:

Annual Competitiveness Analysis on Greater China Economies

Zhang Xuyao

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Digital Divide in China: Annual Competitiveness Analysis on Greater China Economies

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About ACI

The Asia Competitiveness Institute (ACI) was established in August 2006 as a research centre at the Lee Kuan Yew School of Public Policy (LKYSPP), National University of Singapore (NUS). It aims to build intellectual leadership and network for understanding and developing competitiveness and sustainable growth in Asia. ACI seeks to contribute to the enhancement of inclusive growth, living standards, and institutional governance through competitiveness research on sub-national economies in Asia. It identifies mitigating issues and challenges for potential public policy interventions through close collaboration with regional governments, business corporations, policy think tanks, and academics. ACI's three key research pillars include (i) sub-national economies level competitiveness analysis, (ii) emerging sustainable development landscape in 16 Asia economies, and (iii) Asia's long-term growth strategies and public policy analysis.

ACI's value propositions may be encapsulated in its acronym:

Analytical inputs to initiate policies for policy-makers and business leaders in Asia

Capacity building to enable others through improvement in productivity and efficiency

Intellectual leadership to create pragmatic models of competitiveness and inclusive growth

Vision and Mission

- ACI's over-arching vision is to build up its research credibility with policy impact, contributing as a professional, world-class think-tank.
- ACI's mission is to establish our niche as a leading policy think-tank by identifying development trends, opportunities, and challenges among Asian economies and business corporations.
- ACI endeavours to articulate sound recommendations, promote discussion, and shape research agenda in the arena of public policy amongst Asian governments.
- ACI undertakes evidence-based analysis of public policy issues and decisions, in order to provide assessment of their effectiveness as well as economic and societal impact.

Preface

This book is the tenth edition of the Greater China competitiveness research series produced by the Asia Competitiveness Institute (ACI) at the Lee Kuan Yew School of Public Policy (LKYSPP), National University of Singapore (NUS). As one of ACI's flagship projects, the study adopts a comprehensive framework to measure competitiveness and conducts an assessment at the sub-national level to account for considerable provincial disparities within Greater China.

The year 2022 was challenging for China's economic development. The annual GDP growth reached 3%, missing the target of 5.5%. The "internal circulation" (内循环) was disrupted by outbreaks of the Omicron subvariant in several provinces. As a result, the unemployment rate rose from 5.1% in Q1 to 5.8% in Q2, and landed at 5.5% at the end of the year. In addition, consumer confidence was hit hard and the consumption expenditure per capita dropped 0.2%.

On the other hand, despite border controls, the "external circulation" (外循环) showed a strong and stable performance. China's foreign trade value exceeded RMB 40 trillion. In particular, as the Regional Comprehensive Economic Partnership (RCEP) agreement came into effect on 1st Jan 2022, China's trade with the member states achieved a growth of 7.5%, amounting to RMB 12.95 trillion.

The acceleration of digital development also fostered China's economic growth. In 2021, the value of the digital economy reached RMB 45.5 trillion, accounting for 39.8% of the GDP. China also achieved significant development in digital infrastructure. By June 2022, it had constructed 1.85 million 5G cell towers. The number of 5G phone subscribers also reached 455 million. However, digital development at sub-national levels is still diverse. The policy chapter of this book will look into the details of the digital divide in China.

Understanding competitiveness and digital competitiveness is crucial for identifying economies' potential, especially the recovery path in the digital era. I am confident that this publication will deepen our understanding of China's sub-national economies and provide insightful information for policymakers.

Professor Paul Cheung
Director, Asia Competitiveness Institute
Lee Kuan Yew School of Public Policy
National University of Singapore

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Executive Summary

In the third year of COVID-19, China witnessed slower-than-expected growth. But China continued to improve its growth quality through innovation and openness. The R&D expenditure topped 2.55% of its GDP, reaching RMB 3 trillion in 2022. According to the Global Innovation Index, China's ranking improved from 29th in 2015 to 11th in 2022. In the global market, China remained the largest trading nation, registering foreign trade of RMB 40 trillion.

This tenth edition of the Annual Greater China Competitiveness report presents the latest competitiveness rankings of the 34 economies and five regions of China. In addition, it zooms into the digitalisation and digital divide in Mainland China.

Chapter 2 shows that Guangdong and Jiangsu have been the most competitive economies since 2011. Their strengths in Regional Economic Vibrancy, Attractiveness to Foreign Investors, Government Policies and Fiscal Sustainability underlie their top positions. On the other hand, Tibet has remained at the bottom position since 2000. However, it does not lag too far behind the middle performers. The *What-if* simulation would improve Tibet's ranking from 34th to 17th, after 20% of the weakest indicators are raised to the national average.

The competitiveness rankings also show persistent regional disparities (Chapter 3). The Eastern Coastal Area in China has taken the lead in all four environments since 2016. North-eastern China experienced the most significant decline from 3rd place in 2009 to 5th in 2019. It lags in Financial Deepening and Business Efficiency, Labour Market Flexibility and Productivity Performance. This highlights the urgency of industrial upgrading in this old industrial base. A case study on North-eastern China details the development trends. It shows that the region suffers from the singularity of growth drivers. In addition, due to the slow progress in industrial upgrading, it remains at the lower end of the value chain. Moreover, it faces the challenges of an ageing population and talent outflow.

Finally, Chapter 4 examines the digitalisation and digital divide in the Mainland provinces. The study constructs a framework spanning five categories: Digital Infrastructure, Core Inputs, Digital Utilisation, Digital Outputs and Institutional Capacity. It shows that the regional digital divide in China is caused mainly by imbalanced economic development across regions. The developed provinces in Eastern China have outperformed those in other regions. With higher digital competitiveness, more job opportunities emerged and more digital talents were attracted to these provinces. This process magnifies the first-order digital divide in infrastructure to the second and third-order divides in utilisation and outputs.

Acknowledgements

This year's *Digital Divide in China: Annual Competitiveness Analysis on Greater China Economies* is led by Dr Zhang Xuyao and supported by Li Jingwei and Huang Yijia.

In this book, we have updated previous sub-national and regional competitiveness studies with the latest available data. Our comprehensive approach to measuring competitiveness takes into account different factors that collectively shape the ability of a nation or region to achieve substantial and inclusive economic development over a sustained period of time. In addition, we apply a novel approach to assigning weights in the form of Shapley values to test the robustness of the findings. Furthermore, we focus on the digitalisation and digital divide in China, using a digital competitiveness framework to measure the digital development of 31 Mainland provinces.

This book would not have been possible without the support of our research and administrative colleagues. In particular, we would like to extend our sincere thanks to a competent and dedicated administrative team at ACI including Cai Jiao Tracy, Po Lai Yin Lyne, Nur Atiqah Binte Rahmat and Dewi Jelina Ayu Binte Johari.

We would also like to show our appreciation for the contributions from ACI Director Professor Paul Cheung and the research staff – Dr Xie Taojun, Dr Banh Thi Hang, Dr Ammu George, Dr Liu Jingting, Dr Lucas Shen, Dr Zhang Chi, Vaid Rohanshi, Bima Satria, Fan Litianqi, Ge Yixuan, Sumedha Gupta, Ng Wee Yang, Sengstschmid Ulrike, Tan Faith, Tan Kway Guan and Yan Bowen.

We place on record our appreciation for the encouragement we have received from Professor Danny Quah (Dean), Professor Kanti Prasad Bajpai (Vice Dean, Research and Development), Kadir Suzaina (Vice Dean, Academic Affairs), Francesco Mancini (Vice Dean, Executive Education) and other colleagues in the Lee Kuan Yew School of Public Policy, NUS.

List of Abbreviations

| | |
|----------|---|
| 5G | The Fifth Generation of (Wireless Communications Technologies) |
| ACI | Asia Competitiveness Institute |
| ASEAN | Association of Southeast Asian Nations |
| CNOOC | China National Offshore Oil Corporation |
| CNY | Chinese New Year |
| COVID-19 | Coronavirus Disease 2019 |
| CPI | Consumer Price Index |
| CPTPP | Comprehensive and Progressive Agreement for Trans-Pacific Partnership |
| CYDF | China Youth Development Foundation |
| CYL | Communist Youth League |
| DDI | Domestic Direct Investment |
| EDM | Effect Decomposition Matrix |
| FDI | Foreign Direct Investment |
| FRAND | Fair Reasonable and Non-Discriminatory |
| GBA | Guangdong–Hong Kong–Macau Greater Bay Area |
| GDP | Gross Domestic Product |
| GRDP | Gross Regional Domestic Product |
| GRP | Gross Regional Product |
| ICT | Information and Communications Technology |
| IP | Intellectual property |
| IMD | Institute for Management Development |
| LKYSP | Lee Kuan Yew School of Public Policy |
| NUS | National University of Singapore |
| PRC | People’s Republic of China |
| PRD | Pearl River Delta |
| R&D | Research and Development |
| RCEP | Regional Comprehensive Economic Partnership |
| RMB | Renminbi |
| RSVI | “Ranked” Standardised Value of Indicator |
| SAR | Special Administrative Regions |
| SD | Standard Deviation |
| SVI | Standardised Value of Indicator |
| TMT | Technology, Media, and Telecom |
| TEU | Twenty-foot Equivalent Unit |
| UK | United Kingdom |
| US | United States |
| USD | United States Dollar |
| WHO | World Health Organization |
| WTO | World Trade Organisation |
| ZB | Zettabyte |

List of Economies

| | Name of Economies in English | Name of Economies in Chinese |
|----|------------------------------|------------------------------|
| 1 | Anhui | 安徽 |
| 2 | Beijing | 北京 |
| 3 | Chongqing | 重庆 |
| 4 | Fujian | 福建 |
| 5 | Gansu | 甘肃 |
| 6 | Guangdong | 广东 |
| 7 | Guangxi | 广西 |
| 8 | Guizhou | 贵州 |
| 9 | Hainan | 海南 |
| 10 | Hebei | 河北 |
| 11 | Heilongjiang | 黑龙江 |
| 12 | Henan | 河南 |
| 13 | Hong Kong | 香港 |
| 14 | Hubei | 湖北 |
| 15 | Hunan | 湖南 |
| 16 | Inner Mongolia | 内蒙古 |
| 17 | Jiangsu | 江苏 |
| 18 | Jiangxi | 江西 |
| 19 | Jilin | 吉林 |
| 20 | Liaoning | 辽宁 |
| 21 | Macau | 澳门 |
| 22 | Ningxia | 宁夏 |
| 23 | Qinghai | 青海 |
| 24 | Shaanxi | 陕西 |
| 25 | Shandong | 山东 |
| 26 | Shanghai | 上海 |
| 27 | Shanxi | 山西 |
| 28 | Sichuan | 四川 |
| 29 | Taiwan | 台湾 |
| 30 | Tianjin | 天津 |
| 31 | Tibet | 西藏 |
| 32 | Xinjiang | 新疆 |
| 33 | Yunnan | 云南 |
| 34 | Zhejiang | 浙江 |

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Chapter 1

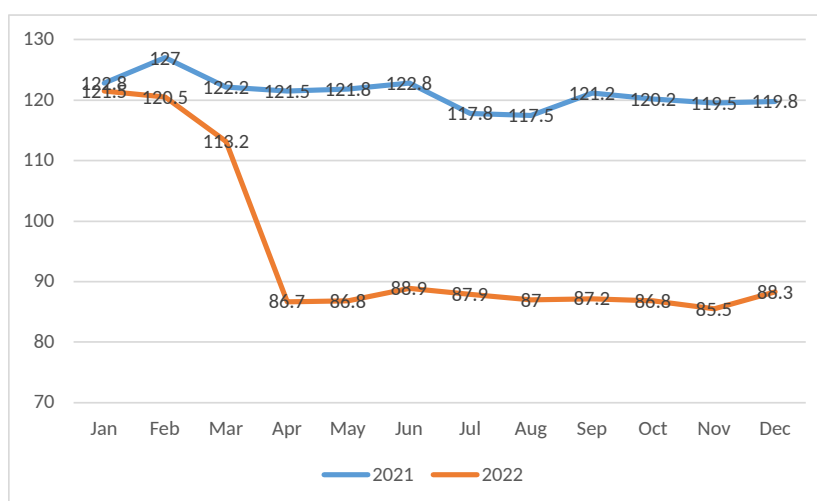
Introduction

1.1 China in 2022: Challenges and Opportunities

In 2022, the third year of the COVID-19 pandemic, China experienced a V-shaped GDP growth. Despite the second quarter growth dropping to 0.4%, the economy expanded by 3.0% at the end of the year. It was below the official target of 5.5%, but still outperforming other major economies, such as the US (2.1%) and Japan (1.3%).

The lockdown restrictions imposed due to the outbreak of the Omicron sub-variant in the second quarter are the main causes of this slower-than-expected growth. Most of the mainland provinces registered a lower than 3% growth. Five provinces even experienced negative growth. In particular, Shanghai's GDP dropped by 13.7% compared to the second quarter of 2021 (ChinaNews, 2022). The lockdown seriously affected business activities and people's daily lives. For example, in Shanghai, social retail sales dropped 48.3% in April compared to 2021. In the manufacturing industries, car production plunged 74.8% in the same month to 53,507 units(SCMP, 2022a).

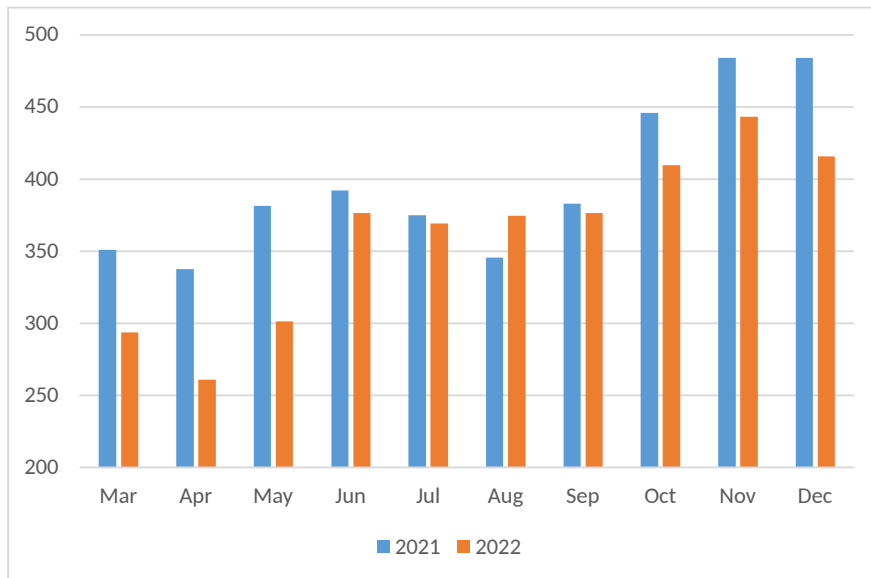
Figure 1.1: Consumer Confidence Index 2021 and 2022



Source: ACI based on information retrieved from the National Bureau of Statistics of China

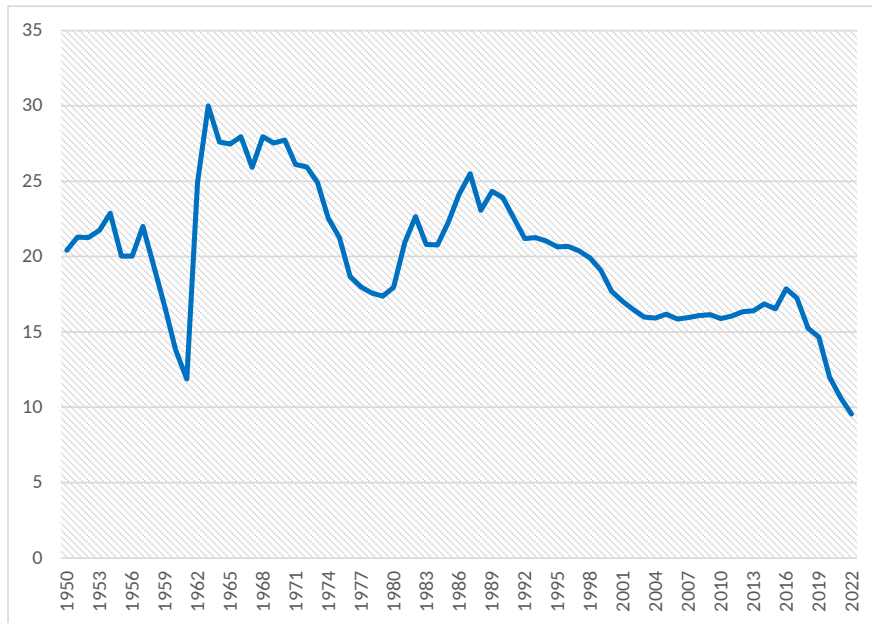
Consumer confidence was seriously shaken by these lockdowns (Figure 1.1). The consumer confidence index dropped sharply in March and remained at around 87 for the rest of the year. The low consumer confidence is also reflected in the per capita consumption expenditure. It decreased by 0.2% in 2022, dropping to RMB 24,538. For example, during the Labor Day national holiday, tourist spending registered a 43% decrease to RMB 64.7 billion, compared to RMB 113.2 billion in 2021. The catering revenue, as shown in Figure 1.2, was also hit hard by the COVID-19 restrictions, especially from March to May.

Figure 1.2: Catering Revenue (RMB: billion)

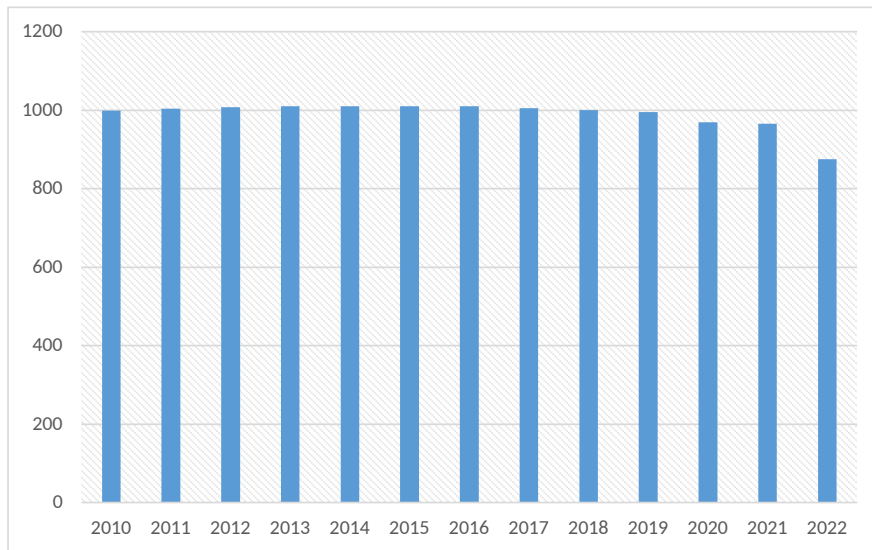


Source: ACI based on information retrieved from the National Bureau of Statistics of China

In addition, China experienced the first decline in population in six decades. The population fell by 850,000 to 1.41 billion. Despite lifting birth control measures since 2016, 9.56 million babies were born in 2022, lower than the 10.62 million in 2021 (Figure 1.3). A falling population, especially a falling working-age population (Figure 1.4), is likely to deepen China's ageing problem and drag down economic growth (Bai and Lei, 2020). The government has identified two solutions to mitigate such losses. Firstly, it has placed an emphasis on education to improve labour productivity over the years. For example, in 2022, the number of China's population with higher education exceeded 240 million, and the average years of schooling of the new workforce also increased to 14 years. Secondly, the government is seeking suitable plans for extending the retirement age from 60 years old for men and 55 for women to 65 years old for both.

Figure 1.3: China's Births in Millions from 1950

Source: ACI based on information retrieved from the National Bureau of Statistics of China

Figure 1.4: Working-age Population in China from 2010 (million)

Source: ACI based on information retrieved from the National Bureau of Statistics of China

Apart from the aforementioned challenges, 2022 also came with opportunities. Internationally, as the Regional Comprehensive Economic Partnership (RCEP) agreement came into force on the first day of 2022, China's trade with the RCEP members achieved an annual increase of 7.5% to RMB 12.95 trillion, accounting for 30.8% of the country's

total trade volume (China SCIO, 2023). So far, 19 free trade agreements have been formed between China and 26 nations and regions, encompassing Asia, Latin America, Europe and Africa (People's Daily, 2023). China's annual foreign trade value exceeded RMB 40 trillion for the first time in 2022.

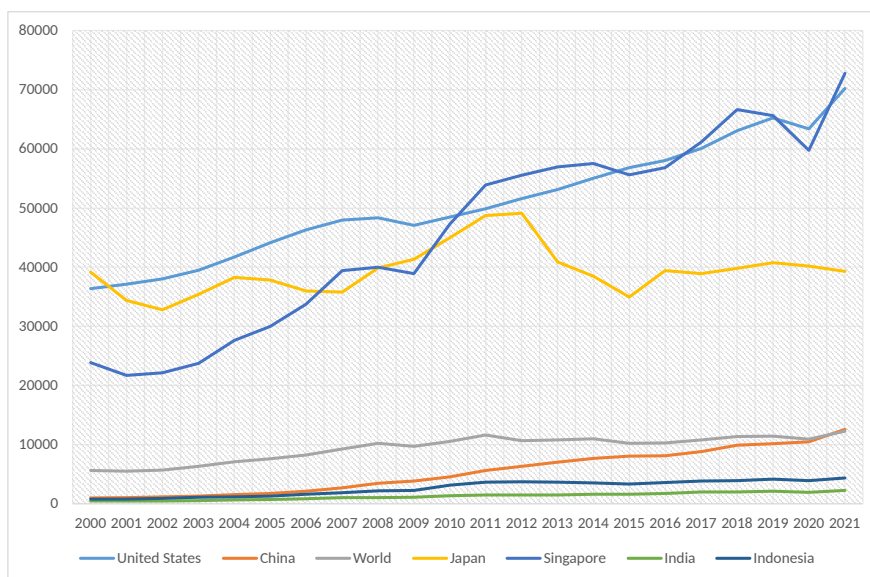
In addition, many COVID-19 restrictions were lifted in November considering the milder nature of the Omicron variant of the virus and the increasing vaccination rate in China. Moreover, China is gradually reopening its borders from January 8th, 2023. This is expected to further revitalise its domestic economy and the global economy as China resumes full production capacity in agriculture, manufacturing and general services (China Daily, 2023a).

The remaining sections of this chapter will look at the trends and policies in China in 2022 and discuss their impact and implications for China's economy.

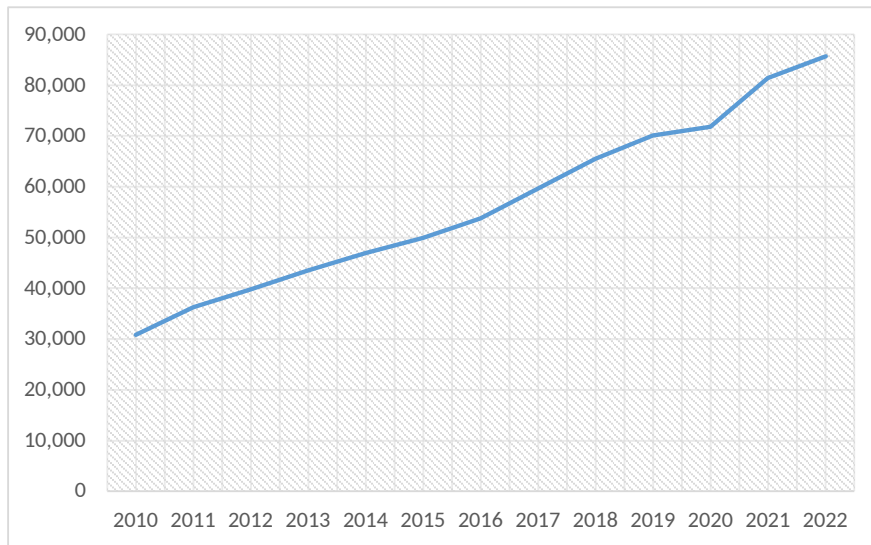
1.2 A Macroeconomic Overview of China's Economy

China's economy achieved a 3% increase in 2022. As shown in Figure 1.5, although there is still a gap between China and developed countries in GDP per capita, China is taking the lead among developing countries and catching up with the world average. China's GDP per capita has doubled in less than one decade exceeding RMB 85,000 in 2022 (Figure 1.6).

Figure 1.5: GDP per Capita, China and the other Countries (USD)



Source: ACI based on information retrieved from World Bank

Figure 1.6: China's GDP per Capita

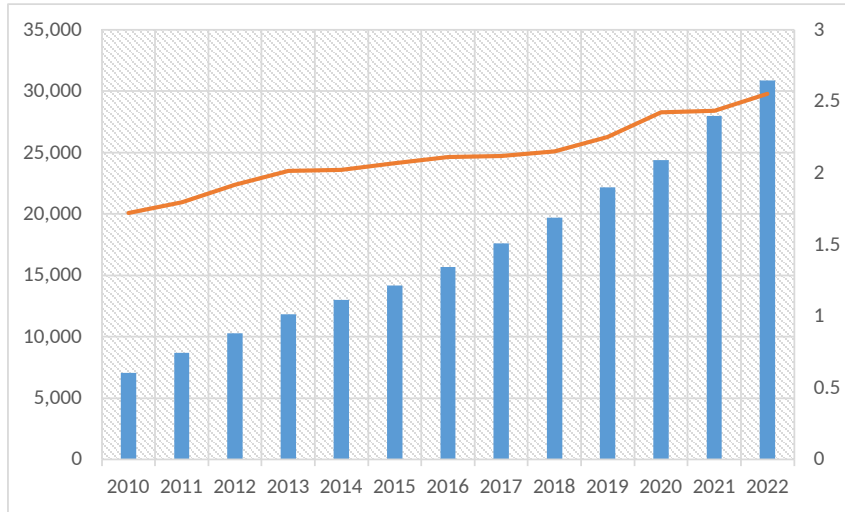
Source: ACI based on information retrieved from the National Bureau of Statistics of China

As China shifts away from high-speed growth, a key focus in the 14th Five-Year Plan is to continue promoting high-quality growth. China is implementing a new blueprint where “innovation is the primary driver, coordination is an endogenous trait, eco-friendly growth prevails, openness to the world is the only way, and share growth is the ultimate goal.” (Xinhua News Agency, 2022a).

On the innovation front, based on the Global Innovation Index, China has improved its ranking from 29th place in 2015 to 11th in 2022 (WIPO, 2022a), the only middle-income economy in the top positions. R&D expenditure continues to grow. In 2022, China's R&D expenditure topped 2.55% of its GDP, amounting to RMB 3 trillion and achieving a yearly increase of 10.4% (Figure 1.7). Expenditure on fundamental research amounted to RMB 195.1 billion, indicating a 7.4% increase from 2021 and constituting 6.32% of the overall R&D expenditure (Xinhua News Agency, 2023b). China saw a total of 4.21 million invention patents filed last year, with inventors from mainland China holding 3.28 million of them (SCMP, 2022b). Additionally, China also strengthened the protection of intellectual property rights. By 2025, according to the “*Guidelines for Building a Powerful Country with Intellectual Property Rights (2021-2035)*”, China aims for its patent-intensive sectors to contribute to 13% of its GDP.

Furthermore, the country is seeking more collaborations globally. A series of policies will be rolled out to promote foreign-funded R&D in 2023. These include promoting fundamental research at foreign-funded R&D centres, authorising their use of reports and data gathered by national research programs and major equipment, and reinforcing support for infrastructure and operational funding (China Daily, 2023c).

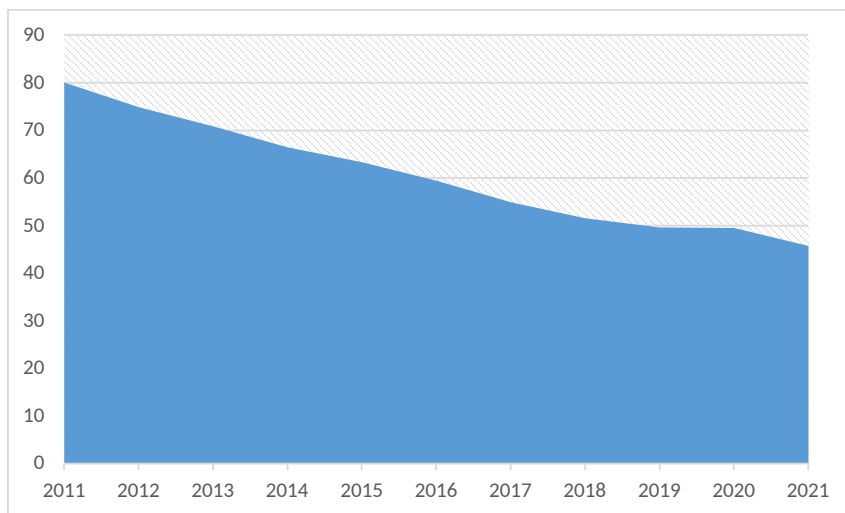
Figure 1.7: R&D Expenditure (Left, 100 Million Yuan) and R&D Expenditure/GDP (Right)



Source: ACI based on information retrieved from the National Bureau of Statistics of China

To ensure eco-friendly growth, China has stated that it will work towards peaking carbon dioxide emissions by 2030 and reaching carbon neutrality by 2060. From 2011 to 2021, China's energy consumption per GDP dropped by over 30%, one of the fastest reductions in the world (Xinhua News Agency, 2021b) (Figure 1.8). In 2021, clean energy comprised 25.3% of total energy consumption (Xinhua News Agency, 2022b). As a result, the annual average concentration of particulate matter (PM2.5) in large cities decreased by 57% over the past ten years (Xinhua News Agency, 2023d).

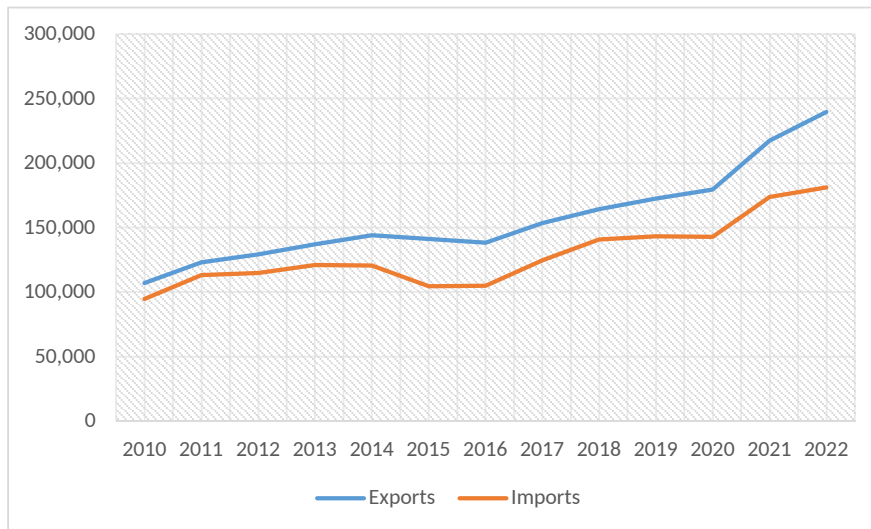
Figure 1.8: China Energy Consumption per GDP (TCE/MN RMB)



Source: ACI based on information retrieved from the National Bureau of Statistics of China

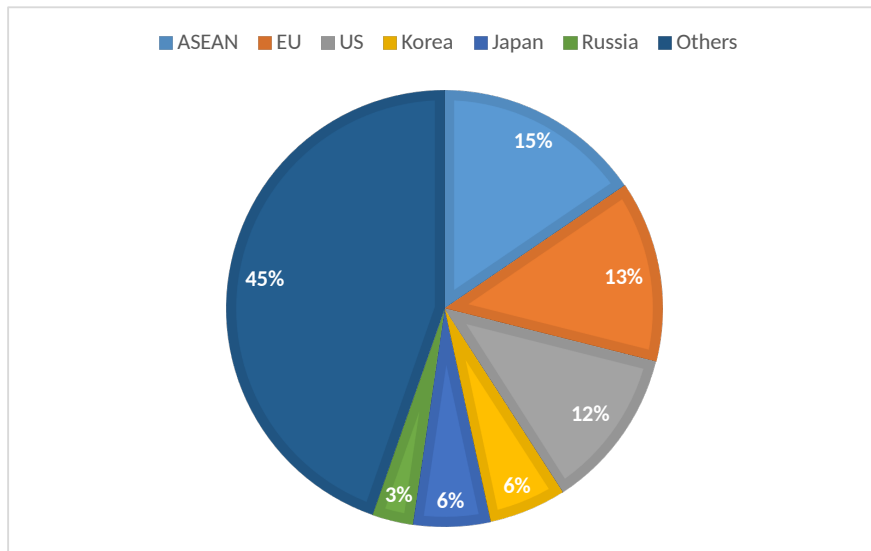
Regarding trade openness, despite border closures during the pandemic, China's trade has increased steadily since 2016 (Figure 1.9). Over the past five years, the country proactively promoted foreign trade. In terms of customs clearance facilitation, import and export clearance time was reduced by 67% and 92% respectively. The total tariff level was reduced from 9.8% to 7.4% (ibid.). The annual foreign trade value reached RMB 40 trillion in 2022, and the country held the title of the largest trading nation in the world for six years (Xinhua News Agency, 2023c). Moreover, in 2022, its trade surplus and trade openness exceeded RMB 5.8 trillion and 35% respectively.

Figure 1.9: China's Exports and Imports (RMB 100 Million)



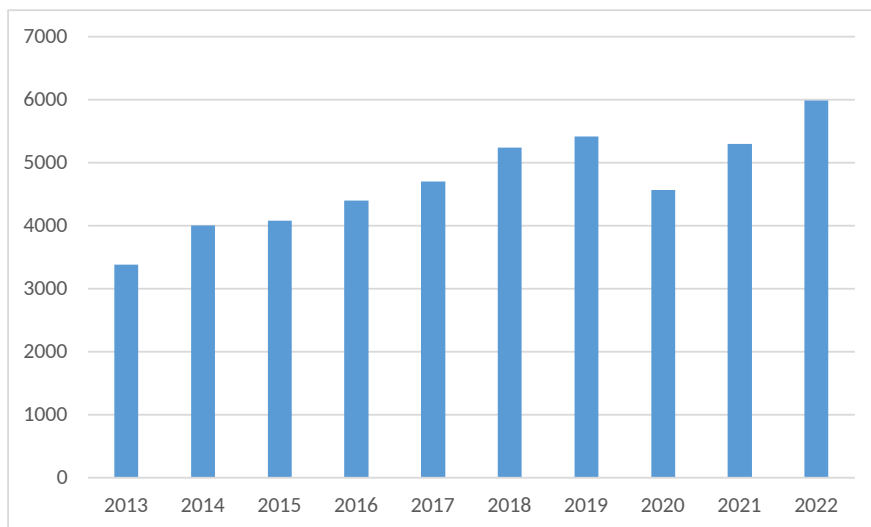
Source: ACI based on information retrieved from the National Bureau of Statistics of China

Figure 1.10 shows China's major trading partners in 2022. ASEAN, the EU and the US occupied about 30% of China's total trade volume. In particular, China's trade with ASEAN and the European Union increased by 15% and 5.6% respectively. Even though China was no longer the largest trading partner of the US, trade between China and the US reached a record high of \$690.6 billion in 2022.

Figure 1.10: China's Top Trading Partners in 2022

Source: ACI based on information retrieved from the National Bureau of Statistics of China

Looking at trade in services, 2022 registered a yearly increase of 12.9%, reaching RMB 5980.2 billion (Figure 1.11). The export of knowledge-intensive services, driven by intellectual property royalties and computing and information services, surged by 12.2% to reach RMB 1.42 trillion (Xinhua News Agency, 2023a).

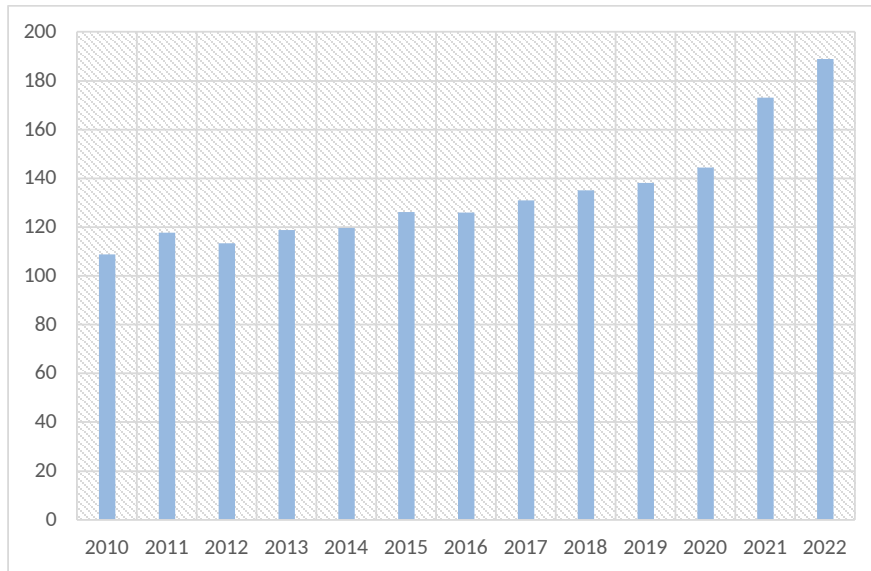
Figure 1.11: China's Trade in Services (RMB: billion)

Source: ACI based on information retrieved from the National Bureau of Statistics of China

China continues its efforts to attract foreign investment by allowing access to more sectors, enhancing the business environment and lowering tariffs (Xinhua News Agency,

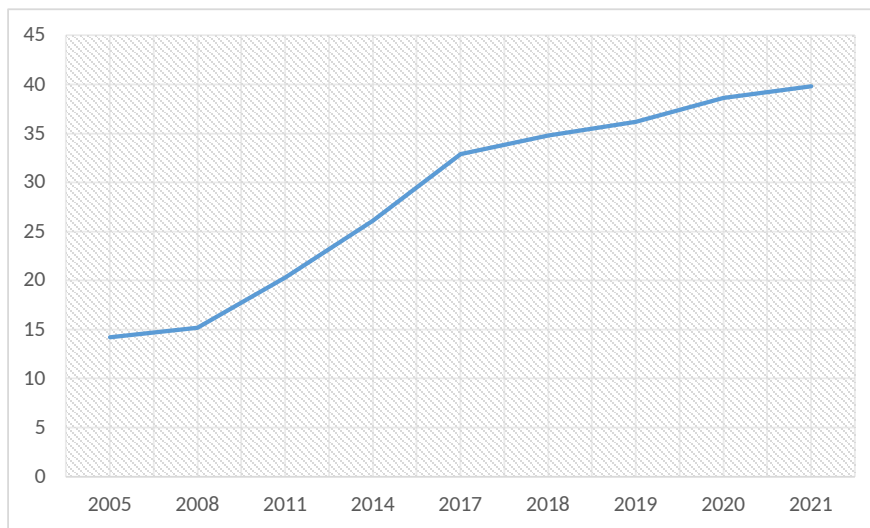
2022b). The number of items on the country's negative lists for foreign investment decreased by 51%. In particular, this number dropped by 72% over the last five years for pilot free trade zones. Foreign investors now have greater access to the service sectors and high-tech industries. The hi-tech industry saw an FDI inflow increase of 28.3% compared with 2021, reaching RMB 444.94 billion. As shown in Figure 1.12, China's total FDI exceeded USD 180,000 million in 2022.

Figure 1.12: China's Foreign Direct Investment (USD billions)



Source: ACI based on information retrieved from the National Bureau of Statistics of China

Last but not least, we would like to highlight the latest trend in digital development in China, which will be further elaborated on in Chapter 4 of this book. As noted in the 14th Five-Year Plan, China planned to increase the output of its core digital economy industries to 10% of the country's GDP by 2025, up from 7.8% in 2020. The development of China's digital economy surged between 2008 and 2017. As a key growth engine, it contributed to 39.8% of the GDP (Figure 1.13) or RMB 45.5 trillion in 2021. The nation boasts the largest 5G network in the world and is a pioneer in 5G standards and technology. By the end of 2022, there were 2.31 million (5GWorldPro, 2023) 5G base stations in China. In addition, China's online retail sales expanded by 4% this year, reaching RMB 13.8 trillion. Cross-border e-commerce in China generated RMB 2.11 trillion in revenue, achieving an annual increase of 9.8%.

Figure 1.13: Digital Economy to GDP Ratio

Source: ACI based on information retrieved from the National Bureau of Statistics of China

In summary, high-quality development will continue to be the goal for the country's economic and social modernisation in subsequent years. The report from the 20th National Congress of the Communist Party of China in October stated that innovation would remain at the core of China's development drive. And the country is striving to strike a balance between advancing its domestic innovation and promoting international collaboration (China Daily, 2023b). Technological advances, digital transformation and a green economy are expected to ensure a robust, stable and sustainable path toward China's modernisation in the coming years.

1.3 Motivation and Roadmap of the Book

This final section discusses the motivation of this project and outlines the roadmap of the book.

It is said that regional disparity is a natural outcome in China, given a vastly different population distribution, resource allocation and social conditions across the country. Without a deep understanding of each region's strengths and weaknesses, policymakers can hardly tackle the problem of unequal development. However, the country's dazzling economic achievement often obscures the disparity that exists. In the spirit of highlighting China's sub-national disparity and facilitating sustainable and inclusive growth, ACI has crafted a comprehensive methodology and framework to assess competitiveness at the sub-national level. The methodology is employed in this book and ACI's previous publications on Greater China, Indonesia, India, and ASEAN. Our work and publications make a distinctive contribution to the literature on economic development in the region by focusing on competitiveness analysis and rankings at the sub-national level, beyond the traditional analysis at the national level.

Since the publication of ACI's inaugural volume on the Greater China economies, ACI's comprehensive competitiveness index has been used to rank the 34 Greater China economies in various aspects. ACI aims to provide an annual update and this updated book includes data from 2000 to 2019, which was the latest available at the time of data collection in 2022.

This book consists of four chapters. Chapter 1, as we have seen, presents an introduction to China's economy in 2022. An investigation of the policies and macroeconomic trends is provided in view of China's challenges and opportunities in the post COVID-19 period.

Chapter 2 elaborates on the research methodology deployed in this project, starting with the literature review on competitiveness, followed by the details of the research framework that underpins ACI's study of Greater China's competitiveness at the sub-national level. The provincial competitiveness rankings and scores for the overall index and the four environments are also presented in this chapter.

Chapter 3 discusses the regional level analysis. This chapter also includes a case study of Northeastern China, given the provinces' recent development trends in competitiveness ranking. Based on data from various indicators in 2019, Chapters 2 and 3 further include the *What-if* Competitiveness Simulation analysis and Shapley Weight robustness check to offer more insights into effective policy responses and how they facilitate competitiveness.

Chapter 4 presents an insightful study on digitalisation and the digital divide in China. A framework, including five environments with 25 indicators, was developed to measure the digital competitiveness of 31 provincial administrative regions in Mainland China.

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