CHINA'S HIGH-QUALITY ECONOMIC DEVELOPMENT: THE INDUSTRIAL STRUCTURE AND UPGRADING APPROACH

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FACULTY OF BUSINESS AND ECONOMICS
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CHINA'S HIGH-QUALITY ECONOMIC DEVELOPMENT: THE INDUSTRIAL STRUCTURE AND UPGRADING APPROACH

ABSTRACT

China aims to promote its economy into a new stage of high-quality development by limiting the mismatches between the economic structure, the polarisation of social income and environmental deterioration that has restricted the sustainable development of China's economy. Industrial structure transformation and upgrading are crucial for China to achieve high-quality economic development in the coming era. This study has sought to measure the performance of China's high-quality economic development from a temporal-spatial perspective. This study used panel data from 30 of China's provinces and the "Five new development concepts" to assess China's high-quality development to model the effect of the industrial structure and upgrading on China's high-quality economic development. The five subsystems comprise; innovative development, coordinative development, green development, open development and sharing development, which has allowed this study to construct a comprehensive index determined by a combined weighting determination procedure. The index construction was followed by analysing China's high-quality economic development based on temporal-spatial perspectives. This study applied the cluster analysis method to classify China's 30 provinces into 12 groups based on the performance of high-quality economic development using absolute, relative, and fluctuating scores. This study used Moran's Index and Moran scatterplot to analyse the spatial distribution characteristics of high-quality economic development and the Geo-detector method to identify the heterogeneity of high-quality economic development among China's three economic zones.

In contrast, the Cloud model has allowed mapping of China's industrial structure rationalisation and upgrading distribution characteristics and its composite systems to measure China's industrial structure transformation and upgrading. The impacts of industrial structure upgrading, rationalisation, and composite systems on high-quality economic development were assessed by adopting the Spatial Durbin Model from national and regional perspectives. China's economy has gradually pursued a high-quality development pattern with an annual growth rate of 0.459%. However, the results showed that China's regional economic development had not followed a high-quality development path, with an average value of 0.219 indicating regional imbalances. High-quality economic development was low and regional differences were significant. Specifically, the high-quality economic development level in the central and western provinces was relatively backward compared to Eastern China. In the meantime, the spatial autocorrelation of the high-quality economic development index decreased yearly. Besides, this study indicated that the eastern region's industrial structure transformation and upgrading distribution characteristics were better than the central and western areas. Finally, the industrial structure upgrading, rationalisation, and composite systems positively affected high-quality economic development nationally and for the eastern and central regions but negatively affected the western region. This study has provided fresh evidence concerning the role of China's industrial structure transformation and its upgrading toward high-quality economic development, fulfilling a research gap. The study's results can aid China in solving its development dilemma, thereby sustaining inclusive economic development.

Keywords: High-quality economic development, Industrial structure and upgrading, Spatial analysis, China

PEMBANGUNAN EKONOMI BERKUALITI TINGGI CHINA: STRUKTUR PERINDUSTRIAN DAN PERSPEKTIF KAEDAH

ABSTRAK

China berhasrat untuk mempromosikan ekonominya ke peringkat pembangunan baharu yang berkualiti tinggi dengan mengehadkan ketidakpadanan antara struktur ekonomi, polarisasi pendapatan sosial, dan kemerosotan alam sekitar, yang menyekat pembangunan mampan ekonomi China. Transformasi dan peningkatan struktur perindustrian adalah penting bagi China untuk mencapai pembangunan ekonomi berkualiti tinggi pada era akan datang. Kajian ini bertujuan untuk mengukur prestasi pembangunan ekonomi berkualiti tinggi China dari perspektif temporal-spatial. Bertujuan untuk memenuhi jurang penyelidikan, kajian ini menyediakan bukti baharu untuk menentukan peranan transformasi perindustrian China dan peningkatan kepada pembangunan ekonomi berkualiti tinggi yang boleh membantu China menyelesaikan dilema pembangunannya, sementara mengekalkan pembangunan ekonomi inklusif. Kajian ini menggunakan data panel daripada 30 wilayah China dan "Lima konsep pembangunan baharu" untuk memodelkan kesan struktur and penaiktarafan perindustrian terhadap pembangunan ekonomi berkualiti tinggi China. Lima subsistem termasuk pembangunan inovatif, pembangunan koordinatif, pembangunan hijau, pembangunan terbuka dan pembangunan perkongsian telah membolehkan kajian membina indeks komprehensif yang ditentukan oleh prosedur penentuan wajaran gabungan. Seterusnya, kajian ini disambungi dengan menganalisis pembangunan ekonomi berkualiti tinggi China berdasarkan perspektif temporal-spatial. Kajian ini menggunakan kaedah analisis kelompok untuk mengklasifikasikan 30 wilayah kepada 12 kumpulan berdasarkan prestasi pembangunan ekonomi berkualiti tinggi menggunakan skor mutlak, relatif dan turun naik. Kajian menggunakan Indeks Moran dan plot taburan Moran untuk menganalisis ciri taburan ruang bagi pembangunan ekonomi berkualiti tinggi dan kaedah

Geo-pengesan untuk mengenal pasti kepelbagaian pembangunan ekonomi berkualiti tinggi di antara tiga zon ekonomi China. Sebaliknya, model Cloud membenarkan pemetaan rasionalisasi struktur industri dan penaiktarafan ciri pengedaran serta sistem kompositnya untuk mengukur transformasi dan peningkatan struktur perindustrian China. Kesan peningkatan struktur perindustrian, rasionalisasi dan peningkatan sistem komposit mereka terhadap pembangunan ekonomi berkualiti tinggi dinilai dengan mengguna pakai Model Spatial Durbin, berdasarkan perspektif nasional dan serantau. Secara keseluruhannya, ekonomi China mengejari corak pembangunan berkualiti tinggi dengan kadar pertumbuhan tahunan sebanyak 0.459% secara beransur-ansuran. Walau bagaimanapun, keputusan menunjukkan bahawa pembangunan ekonomi serantau China tidak mengikut laluan pembangunan berkualiti tinggi, dengan nilai purata 0.219 yang menunjukkan ketidakseimbangan serantau. Pembangunan ekonomi berkualiti tinggi adalah rendah dan perbezaan antara kawasan adalah ketara. Secara khususnya, tahap pembangunan ekonomi berkualiti tinggi kawasan tengah dan barat adalah mundur berbanding dengan kawasan timur. Malah, autokorelasi spatial bagi indeks pembangunan ekonomi berkualiti tinggi menurun tahun demi tahun. Kajian menunjukkan bahawa transformasi struktur perindustrian kawasan timur dan menaik taraf ciri taburan adalah lebih baik daripada di kawasan tengah dan barat. Kajian ini telah memberikan bukti baru tentang peranan transformasi struktur dan peningkatannya perindustrian China ke arah pembangunan ekonomi berkualiti tinggi, demi memenuhi jurang penyelidikan. Keputusan kajian boleh membantu China dalam menyelesaikan dilema pembangunannya and mengekalkan pembangunan ekonomi yang inklusif.

Keywords: Pembangunan ekonomi berkualiti tinggi, Struktur dan peningkatan perindustrian, Analisis spatial, China

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LIST OF SYMBOLS AND ABBREVIATIONS

APEC	:	Asia-Pacific Economic Cooperation
ARDL	:	Autoregressive Distributed Lag
AS	:	Absolute Score
CD	:	Coordinative Development
CO_2	:	Carbon Dioxide
CP	:	Per Capita Capital Stock
CPC	:	Communist Party of China
DCS	:	Dual Circulation Strategy
DEA	:	Data Envelopment Analysis
DMU	:	Decision-Making Unit
EI	:	Education Input
EKC	:	Environmental Kuznets Curve
EPU	:	Economic Policy Uncertainty
EU	:	European Union
FDI	:	Foreign Direct Investment
FS	:	Fluctuating Score
GD	:	Green Development
GDP	:	Gross Domestic Product
Geo-detector	:	Geographical Detector
GVA	:	Global Value Chain
HCT	:	Homogeneous Corporate Trade
HQD	:	High-Quality Economic Development
HQEI	:	High-Quality Economic Development Index
ICT	:	Information and Communication Technology
ID	:	Innovative Development
IS	:	Industrial Structure Composite System
ISR	:	Industrial Structure Rationalisation
ISTU	:	Industrial Structure Transformation and Upgrading
ISU	:	Industrial Structure Upgrading
ITR	:	Industrial Technology Revolution
KMO	:	Kaiser-Meyer-Olkin
LD	:	Learning by Doing
MI	:	Marketisation Index
MNCs	:	Multinational Corporations
NBSC	:	National Bureau of Statistics of China
NEGM	:	New Economic Growth Momentum
NIE	:	Newly Industrialised Economy
OD	:	Open Development
OLS	:	Ordinary Least Square
ORS	:	Online Retail Sales
P2P	:	Peer-to-Peer
PCA	:	Principal Component Analysis
PSM-DID	:	Propensity Score Matching and Difference-in-Difference
R&D	:	Research and Development
RE	:	Rural E-commerce
RGDP	:	Real Gross Domestic Product
RP	:	Research and Development Personnel
RPCDI	:	Rural Per Capita Disposable Income
RS	:	Relative Score

S&T	:	Science and Technology
SBM-ML	:	Slack-Based Measure & Malmquist Luenberger
SD	:	Sharing Development
SDA	:	Structural Decomposition Analysis
SDGs	:	Sustainable Development Goals
SDM	:	Spatial Durbin Model
SE	:	Sharing Economy
SEM	:	Spatial Error Model
SHA-DE	:	Share-Development
SLM	:	Spatial Lag Model
SLM	:	Spatial Lag Model
SSSR	:	Supply-Side Structural Reform
Super-SBM	:	Super Slacked-Based Measure
SYS-GMM	:	Systematic Generalised Method of Moments
tce	:	Tons of coal equivalent
TEC	:	Total Energy Consumption
TFC	:	Technology Frontier Curve
TFP	:	Total Factor Productivity
TI	:	Technological Innovation
TOPSIS	:	Technique for Order Preference by Similarity to Ideal Solution
UNCTAD	:	United Nations Conference on Trade and Development
UNIDO	:	United Nations Industrial Development Organisation
UPCDI	:	Urban Per Capita Disposable Income
U.S.	:	United States
URID	:	Urban-Rural Income Disparity

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 Introduction

Development concerns the people's interests, and human development cannot proceed without economic growth. The communist party of China (CPC) has permanently attached great importance to economic development and has vigorously promoted economic development as an essential part of its advancement. In the 19th CPC National Congress report, China's President Xi announced that socialism with Chinese characteristics had entered a new era. With the new ordinations, sustainable economic growth and social development have remained crucial in satisfying China's population's growing and diversifying needs, providing better lives while embarking on a new journey to establish a modern socialist country.

Since introducing its reform and opening-up policy, China has maintained a long period of rapid economic expansion. The nation's dramatic achievements have been powered primarily by excessive factor inputs to maintain high-speed economic growth. At the same time, resource shortages have been observed in addition to constraints on environmental carrying capacity and labour costs. Besides, problems, such as mismatches between the economic structure, the polarisation of social income and environmental pollution have restricted the inclusive development of China's economy. Structural reforms require improving efficiency and the quality of economic development and cultivating the new economic growth momentum (NEGM). Strengthening and cultivating the NEGM while upgrading the old structure and optimising the industrial structure provides outstanding support for China to realise high-quality development (HQD). The new era, considering these concerns, has required the Chinese government to change its mindset from "quantity priority" and concentrate more on enhancing economic development to maintain the steady growth of China's economy.

The intrinsic channel for exploring economic development can be traced back to the division of labour proposed by Adam Smith, who contended that the division of labour accelerates national wealth accumulation. Later studies have also rested upon the neoclassical and endogenous growth theories. For example, stimulating factor inputs and promoting technological innovation (TI) are conducive to stabilising economic growth. The Harrod-Domar model is a quantitative model used for assessing economic growth and is often adopted to discuss the necessary conditions required for balanced and long-term economic growth. The core of the Harrod-Domar model lies in capital accumulation and, thus, causes capital fundamentalism in research and economies. Solow (1956) further improved the assumptions of the Harrod-Domar model and held that economic growth relied not only upon capital accumulation but also on technology advancement. Note that the neoclassical economic growth theory treats TI as an exogenous shock, thereby carrying little significance in guiding practice. Later, Romer (1986, 1990) and Lucas (1988) considered TI as an endogenous variable and developed an endogenously theoretical model that identified TI's vital role and knowledge accumulation in stimulating economic growth.

Specifically, the endogenous growth model highlighted that long-term economic growth was either endogenous or triggered by human decisions (Jones, 2002). Simultaneously, the model argued that government subsidies in education and R&D activities could foster a country's long-term economic growth (Kopf, 2007). The first endogenous growth model developed by Lucas (1998) revealed that endogenous human capital produced both labour-augmenting technology and total factor productivity (TFP). At the same time, the most crucial characteristic lies in its ability to identify the empirical regularities in economic growth data that are difficult for neoclassical models to interpret, in particular, the absence of long-term convergence, including either conditional or absolute convergence (Ben-Gad, 2012).

As mainstream economic growth theory has mainly concentrated on results rather than processes, social capital accumulation, increased labour supply, and TI have been considered the engines that have stimulated economic growth (Luo et al., 2014; Zhang et al., 2022; Li & Solaymani, 2021). Technical progress leads to and does require the corresponding structural change in the economic development process (Cozzi, 2022). Under certain technological conditions, a country's economic system can produce industrial structure adjustment, reflecting the level and quality improvement of its economic development and relating directly to national TFP. However, economic growth determines industrial structure optimisation in a certain sense, especially in China's current transition period. Therefore, accelerating industrial structure optimisation has become necessary for a country's inclusive economic development. Besides, accelerating the transformation and adjustment of industrial structure is crucial for a country to change its economic development model. This outcome is because development efficiency heavily depends on the; nature, role and position of individual industries within a country's economy and interrelated collaborative relationships among various industrial sectors (Wang et al., 2022).

According to Syrquin (1988), a country's industrial structure will significantly change during economic growth. The observed changes in the industrial structure will include three points. Firstly, the industrial composition of the manufacturing sector will change. Secondly, the labour force will be significantly reallocated from the agricultural sector to the manufacturing and service sectors. Thirdly, the service sector will expand, especially the producer-service sector[1] driven by rapid economic growth.

In essence, industrial structure change is the redistribution of economic resources among different industrial sectors, implying an essential shift from secondary sector-led

[1] The producer-services sector regulates the intermediate inputs used for producing final products in the production process. Producer services sector contains professional and business services (such as data processing, management consulting), real estate service, insurance and financial services etc.

resource allocation to tertiary sector-led resource allocation. In contrast, such a shift entails different resource utilisation and allocation efficiency. With the rise of specialised and emerging industrial sectors, high-skilled workers will swarm to secondary and tertiary industries because of the expected wage differentials, thus, realising higher labour productivity than pre-industrial levels. Consequently, increases in labour productivity will force the country's economy to undergo rapid growth caused by the so-called "structural bonus".

Unsurprisingly, the study conducted by Peneder (2003) clearly stated that productivity levels and growth rates varied in different industrial sectors. Still, the empirical work by Maddison (1987) also proved that industrial structure was one of the vital factors for stimulating economic growth. The latter economic growth theory still emphasises the importance of structural change in the productivity growth process (Grossman & Helpman, 1994). In contrast, structural change is an inevitable outcome of tremendous shocks, such as; technological advancements, revolutions, plagues, etc. Structural change is an intertwined and sophisticated phenomenon. This situation is because economic development produces complementary changes in various aspects of the economy, such as; legal institutions, sectoral compositions of employment and output, wealth and income distribution, and also because these changes could, in turn, influence the growth process. Earlier studies have tried to construct stylised facts, i.e., the development patterns followed by most countries. Among the most well-known are; Fisher (1939), Clark (1940), Kuznets (1966) and Chenery & Syrquin (1975), who posited that, as an economy develops, its production shifts from the primary (agriculture, forestry, mining, fishing) to the tertiary (services) through the secondary sector (construction, manufacturing). Also notable is Rostow's (1960) study, which further argued that an economy passes through various development stages, from the traditional stage to the mass production process through the take-off stage. While this work tried to provide a sweeping view of the development process, it was mostly descriptive, emphasising the multifaceted nature of structural change.

Recently, a new wave of growth models representing useful frameworks to understand the mechanisms behind structural change and economic growth has been developed. Some have found harmony between structural change and the extensive modes of balanced aggregate growth (Gabardo et al., 2017). With theoretical analysis, numerous empirical works have demonstrated the vital role of structural change in promoting economic growth. For example, Fan et al. (2003) explored China's economic growth sources by extending the traditional Solow model. They pointed out that structural change significantly contributes to economic growth by reallocating resources from sectors with low-productivity levels to high-productivity ones, thus, rejecting the "structural burden" hypothesis. Still, taking 19 Asian economies as an example, Vu's (2017) results demonstrated that effective structural change strongly affected productivity growth.

HQD requires an economy to continuously expand from existing industrial sectors to new ones with higher capital intensity to facilitate ISTU. When a country constantly restructures its economy to maximise the comparative advantage of its factor endowments, its economic dynamism will continue to increase. Its economic surplus will boost accordingly, and thus, the economy will realise strong competitiveness. In transforming a country's industrial structure, the market mechanism of free competition is considered the best mechanism for directing resource factor endowments towards high-tech industries.

Taking the discussion to the micro level, when enterprises decide to enter their industries and adopt advanced technologies that align with the competitive advantage determined by the changes in one country's factor endowments (Lin, 2011), thus, the country's economy is the most competitive. As competitive enterprises and industries grow, they will claim larger domestic and international market shares and create the highest possible economic bonus in salaries and profits. Subsequently, reinvested surpluses can obtain the greatest possible returns because the existing industrial structure is ideal for that factor endowment. Thus, this approach allows the economy to accumulate more capital (including both human and physical capital). This situation will advance the industrial structure and the factor endowment structure, making domestic enterprises more competitive in skill- and capital-intensive products.

Enterprises focus on maximising their profits. For them to voluntarily enter industries and adopt advanced technologies consistent with a country's competitive advantage, the corresponding price mechanism must reflect the relative scarcity of the country's factor endowments. This process often occurs in an economy with a competitive market (Lin & Chang, 2009). In other words, a competitive market can be considered the underlying mechanism for allocating production factors at various levels of economic development.

Industrial structure and economic growth are inextricably linked (Zhou et al., 2021). On the one hand, the results of this study have provided theoretical evidence and empirical findings to support future research, as the existing academic research on China's HQD is still at an exploratory stage. On the other hand, this study has shed new light on promoting China's HQD from the ISTU perspective. As previously mentioned, China's most pressing issue still lies in adjusting and transforming its economic structure (Xue et al., 2022; Su & Fan, 2022). The following section first revisits China's economic development status and then lists several stylised facts to illustrate the importance of China's economy undertaking HQD.

The following section aims to identify the problems in past economic development to address the importance of implementing HQD in China. It lists a set of stylised facts, such as China's economic performance since 1978, inefficiency, environmental and uncoordinated development issues, and China's Five-Year Plans. Subsequently, the connotations of HQD are discussed.

1.1.1 Review of China's Economic Development

China's economic development has a spectacular history. It has been 42 years since the Third Plenary Session of the 11th Central Committee of the CPC formally proposed the forward-looking policy of reform and opening-up in 1978. China's economy has grown with tremendous vitality; the Real Gross Domestic Product (RGDP) has sharply risen from RMB 267.79 billion in 1978 to RMB 87.50 trillion in 2018, a rise of 220 times (NBSC[2]). China has also become an integrated part of the global economy. Its GDP in 2019 contributed 16.34% to the global GDP, second only to the US and almost tripling Japan's contribution, which ranked third[3]. Such a tremendous achievement has become known as the "China miracle" because, on the one hand, China has successfully realised a giant leap from a low-income country to a middle-income country. While on the other hand, China has also led its people to abolish absolute poverty in 2019.

Over the last two decades, China's growth has been unprecedented on the global economic scene. This accomplishment has dramatically contrasted with the depressing performance of other transitional economies in Eastern Europe and the former Soviet Union (Lin, 2011). It is widely acknowledged that the GDP refers to the final products produced by all resident units in a country during a specific period (NBSC, 2019)[4]. Thus, it can reflect the overall development of a country's economy. This study separated the growth stage of the Chinese economy into three crucial periods. It then analysed its growth features in each period to understand China's economic development

[2] See http://www.stats.gov.cn/.
[3] See https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.
[4] See http://www.stats.gov.cn/.

characteristics.

The period from 1978 to 1990 was the first period discussed. During this period, the most significant economic growth rate was 15.2%, which occurred in 1984, and the smallest was 3.9% in 1990 (see Figure 1.1), a difference of about four times. The annual average growth rate during this period was 7%. Accordingly, the following conclusion can be drawn. Compared with the early days of the founding of the People's Republic of China, the reform and opening-up policy injected a strong impetus for sustaining China's economic growth. However, such growth has been characterised by large fluctuations as the GDP growth rate was not stationary and has exhibited a significant downward trend since 1984.

The period from 1991 to 2007 was the second period analysed. The 6th Plenary Session of the 13th Central Committee of the CPC was held on 3 December 1990. The CPC proposed that "we need a force that can be united and further deepen the reform's fruits". Consequently, China's central government issued the policy of Approval on the Development and Opening-up of Pudong on 18 April 1990. This initiative accelerated the construction of the Shanghai economic zone and injected tremendous energy into promoting China's economy. By 1992, China's economic system had transformed from a planned economic system to a socialist market economic system. China's transformation decentralised power from the central government and empowered the market to play a full role in allocating economic resources and adjusting and determining prices. As depicted in Figure 1.1, the RGDP growth rate rose from 3.9% in 1990 to 14.2% in 1992, presenting exponential growth, while it displayed a "U-shaped" trend after 1992. Besides, the annual average of the RGDP growth rate was 10.7%, 3.7 percentage points higher than that of the growth rate in the first period (7%). Correspondingly, the following conclusion was derived: under national policy support, China's economy was rejuvenated by continuously strengthening and deepening reforms; however, its economic growth still showed slight fluctuations.

The period from 2008 to 2018 was the third period reviewed. As depicted in Figure 1.1, the RGDP growth rate in 2008 was 9.7%, and it first fell below 8% in 2012. The Chinese economy underwent economic depression caused by the global financial crisis in 2008, despite its growth rate being higher than global economic growth[5]. The growth rate fluctuated between 6% to 7% between 2014-2018. Under such a background, China's President Xi proposed the "new normal" terminology in 2012. He further illustrated its connotations in the 2013 APEC meetings, where the "new normal" contained three meanings. Firstly, China's economy had shifted from high-speed growth to medium-to-high speed growth. Secondly, China's economic structure was being upgraded and improved progressively. Thirdly, the economy was driven by technological innovation instead of investment and factor inputs. However, the term "new era", proposed in the 19th CPC National Congress report, had different connotations than the term "new normal". The reason was that, on the one hand, Chinese society's principal issues had changed totally.

While on the other hand, the former concentrated more on people's needs as their material and cultural demands grew. Their needs for; democracy, the rule of law, security, fairness and justice, and a better environment have also increased. In other words, the new era concentrates more on enhancing the quality of economic development instead of quantity expansion concerning economic development. From this proposition, it can be concluded that the CPC realised that it would be difficult for China to continue adopting the previous economic development model to stimulate economic growth further. Thus, maintaining steady growth while gradually achieving HQD has been a pressing problem

[5] See https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

facing the Chinese central government.

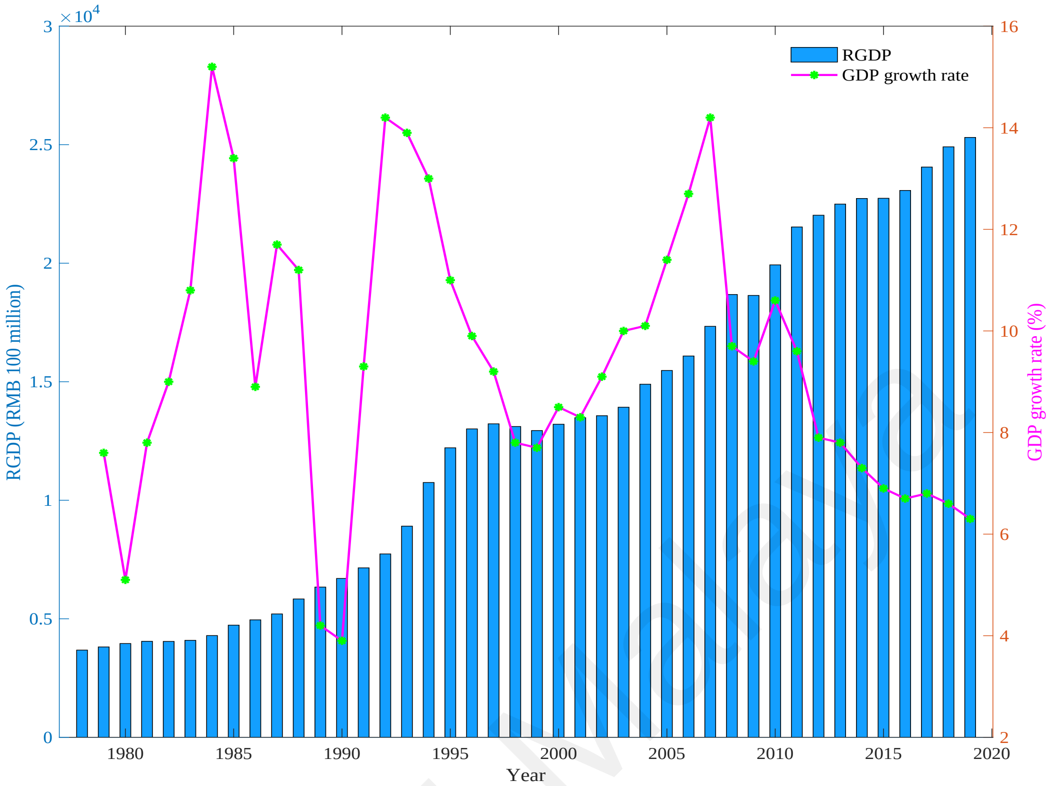

Figure 1.1: China's RGDP and Growth Rate, 1978-2019
Source: National Bureau of Statistics (1979-2020)

1.1.2 Review of China's Development Status

China's extensive economic growth model has made the marginal output of production factors much greater than the marginal inputs in the short term, giving China the title of the "world's factory". It is believed that such growth has promoted economic growth and lifted thousands of people out of poverty. According to the definition of social sustainability (World Bank, 2020)[6]: "social sustainability is about expanding the opportunities for all people today and tomorrow. Together with economic and environmental sustainability, it is crucial for poverty reduction and shared prosperity". Therefore, whether such an extensive economic development pattern aligns with social sustainability requirements should be explored. This study has listed a set of stylised facts

[6] See https://www.worldbank.org/en/news/feature/2020/09/02/five-things-about-social-sustainability-and-inclusion.

to argue China's past economic development model and further address the importance of economic structure transformation for China's future economic development.

(i) Stylised Fact I: Inefficiency Problems

First, this study plotted the total efficiency and energy consumption per unit of the RGDP to examine the efficiency issue faced by the Chinese economy. According to Figure 1.2, China's total energy consumption has shown a significantly increasing trend since 1978. Specifically, total energy consumption in 1978 and 2018 were 571.44 million tons of standard coal and 4.87 billion tons of standard coal, respectively, a difference of about nine times. Conversely, the energy intensity of the RGDP exhibited a decreasing trend; that is, the larger the economy grew, the lower the amount of energy consumed. Unfortunately, such a derived conclusion is not appropriate.

On the one hand, the RGDP was treated as the denominator; thus, to a certain extent, the growth rate of total energy consumption was lower than that of the RGDP. Therefore, the index of energy intensity of the RGDP displayed a downward trend. Thus, the index of energy intensity of the RGDP displayed a downward trend.

On the other hand, according to the NBSC (2019)[7], energy consumption efficiency is an essential indicator of the current condition of; energy consumption transformation equipment, production techniques, and management. It can be seen that the average value of China's efficiency of energy transformation was 69.68% between 1978 and 2018, even though the index has shown a slight upward trend in recent years. This outcome means that approximately one-third of the production factors have not been converted into final products and circulated.

[7] See http://www.stats.gov.cn/.

Consequently, two implicit influences have been derived. Firstly, natural resources will become rarer because of limitations, resulting in malicious competition and damaging market price mechanisms. Secondly, industries (i.e., enterprises located in the old-industrial base) cannot successfully realise transformation towards the capital- and skill-intensive industries because of the limitations of the internal and external influences (i.e., sufficient financial support, affluent technology resources). Therefore, a sharp increase in aggregate output means the massive investment of production factors[8], thus, accelerating pollution emission accumulation. Prakash et al. (2021) stated that low energy utilisation efficiency would cause low social output and reduce social capital accumulation, decelerating economic growth and negatively impacting social development.

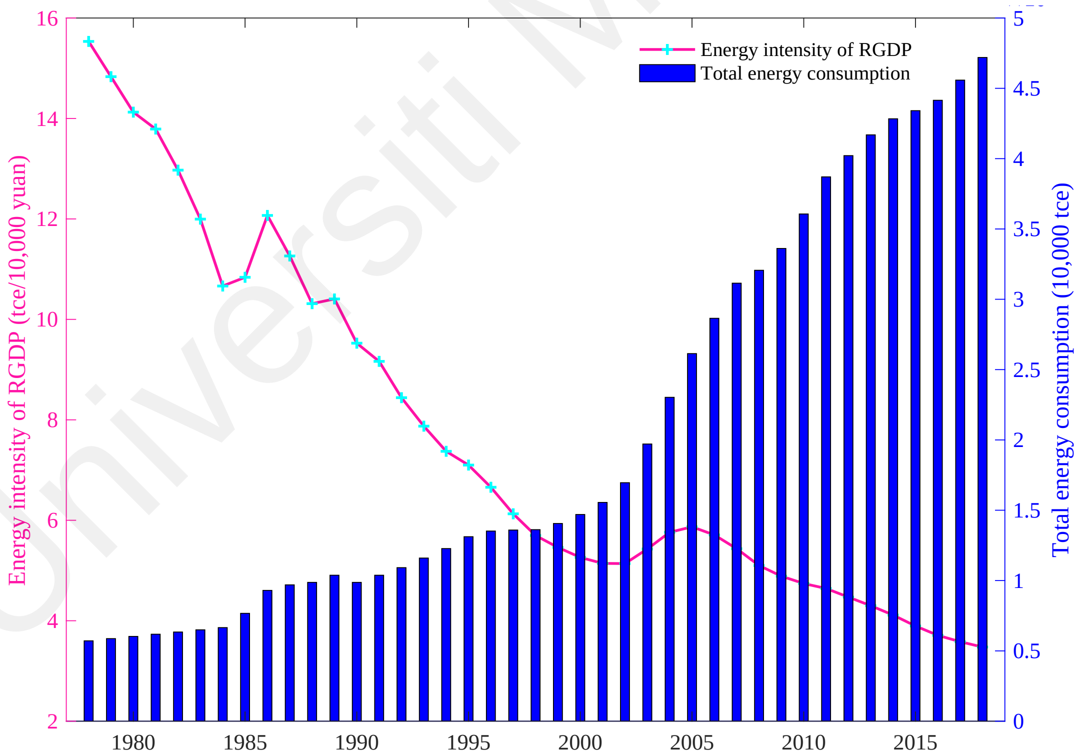

Figure 1.2: Energy Intensity and Total Energy Consumption, 1978-2019
Source: National Bureau of Statistics (1979-2020)

[8] The technological frontier in a given country at a specific time is fixed.

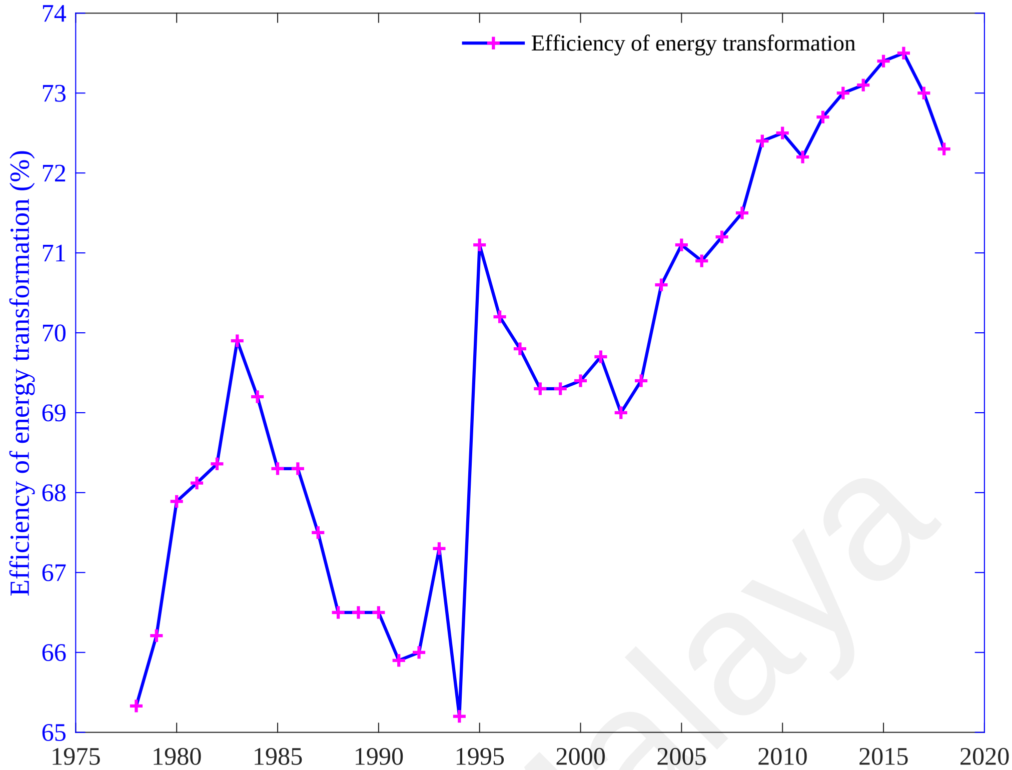

Figure 1.3: Energy Efficiency Transformation, 1978-2019
Source: National Bureau of Statistics (1979-2020)

(ii) Stylised Fact II: Environmental Problems

Sustainable development depends on nature's provision to satisfy the demands of economic and social development (Lim et al., 2018). The 2030 Agenda on Sustainable Development Goals (SDGs) proposed by the United Nations General Assembly in 2015 has become the world's dominant response to the urgent problem of declining sustainability (Dickens et al., 2020). 17 SDGs and 169 targets have been included in the proposed SDGs. Simultaneously, they cover the three pillars of sustainability: social, environmental, and economic development. Although the three pillars are equally important, achieving sustainable development needs the balanced and coordinated development of these three pillars (Wei et al., 2021). The SDG progress report concentrates mainly on economic and social problems (Dickens et al., 2020). However, the ecological and environmental dimension has increasingly been regarded as the foundation for sustainable development. As Moldan et al. (2012) stressed, achieving environmental sustainability is the prerequisite for economic and social sustainability because of the increasing scarcity of natural resources and ecological degradation.

Environmental problems have created a significant barrier for China in realising the SDGs (Wang et al., 2021). Concurrently with its rapid economic growth, China has encountered many environmental issues. Water scarcity (Lv et al., 2020), climate change (Tang et al., 2021), and air pollution (Chen & Chen, 2021) are all associated with environmental issues. It is widely acknowledged that global warming and greenhouse gas emissions are among the world's most challenging problems with the capability to pose existential threats and challenges to humanity. With economic growth and rapid population expansion, carbon dioxide (CO_2) emissions from energy consumption have increased tremendously over the last decades. As the largest developing country worldwide, China has become the world's largest emitter of CO_2 emissions (Zhang & Zhou, 2016). As depicted in Figure 1.4, the total volume of China's CO_2 emissions has exhibited a significantly increasing trend since 1960. Specifically, China's total CO_2 emissions in 1960 comprised 780,726.302 Kt and 10,313,460 Kt in 2018, a difference of approximately 13.21 times, accounting for 8.25% and 30.30% of the world's CO_2 emissions, respectively.

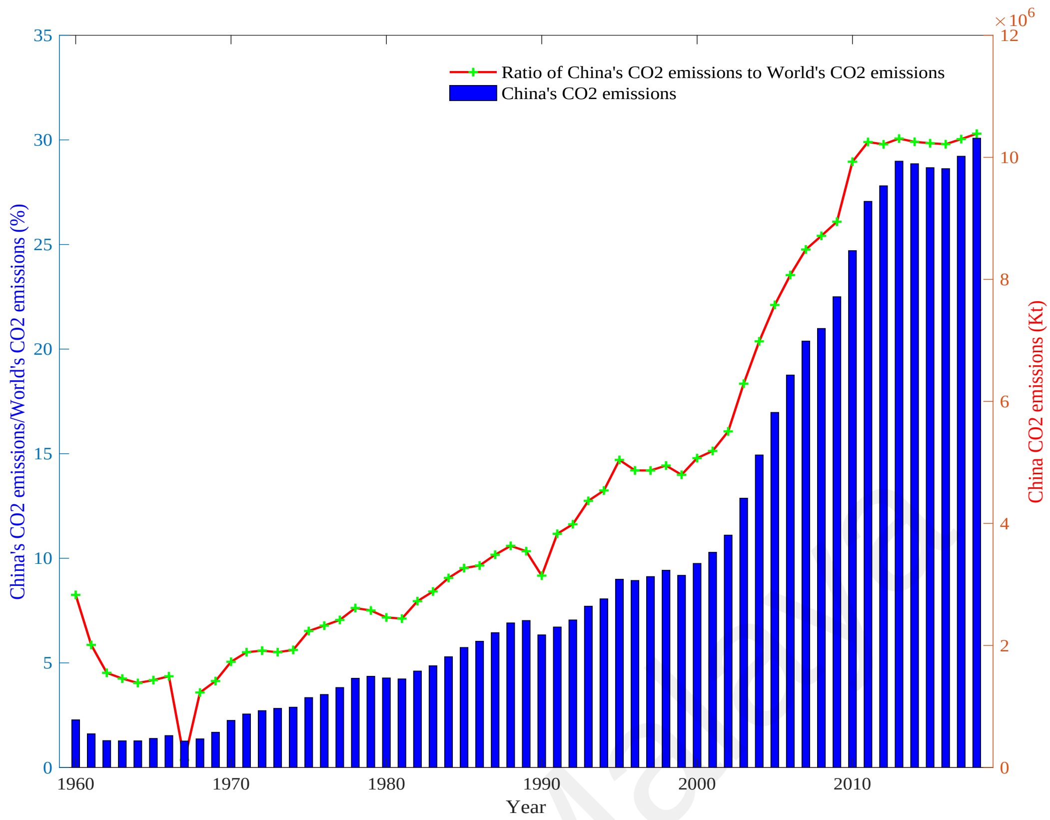

Figure 1.4: China's CO_2 Emissions, 1960-2018
Source: World Bank Database[9] (2020)

In his speech entitled "Work Together to Build a Win-Win, Equitable and Balanced Governance Mechanism on Climate Change" at the Paris Climate Change Conference, China's President Xi reaffirmed China's Intended Nationally Determined Contributions; pledging to peak its CO_2 emissions by 2030. Further, he stated that China would strive to realise the goal as soon as possible by reducing its CO_2 emissions per unit of GDP by 60~65% from the 2005 level by 2030. Meanwhile, China will be increasing the share of non-fossil fuels in its primary energy consumption to approximately 20% and increasing its forest stock by approximately 4.5 billion cubic meters against the 2005 level. Peaking CO_2 emissions by 2030 and achieving carbon neutrality in 2060 are two crucial national goals China committed to in the Paris Agreement.

For example, China has proposed raising the average days' percentage of air quality to be equal to or above Grade II in its principal cities. Overall, the air quality of

[9] See https://data.worldbank.org/indicator/EN.ATM.CO2E.KT.

the principal Chinese cities has not improved fundamentally over the past few decades. According to Figure1.5, on the one hand, the average value of this indicator was 73.8%, indicating that for nearly one-third of the year, air quality was not good. On the other hand, in 2010, the index peaked at 84%, while it troughed at 57% in 2019. At the same time, it is worth mentioning that only 60 days met the Grade II standard in Chongqing in 2010. This result was not surprising because the CPC strongly advocated prioritising the development of heavy industry in China's First through Third Five-Year Plans, an initiative that lasted about 15 years. Although the economic growth rate has been surprising, the negative impacts imposed by heavy industry are evident, suggesting that the issues of environmental pollution and ecological deterioration should not be neglected. Xi proposed that "lucid water and lush mountains are valuable assets", also known as the "Two Mountains Theory, " which again emphasises the importance of environmental protection.

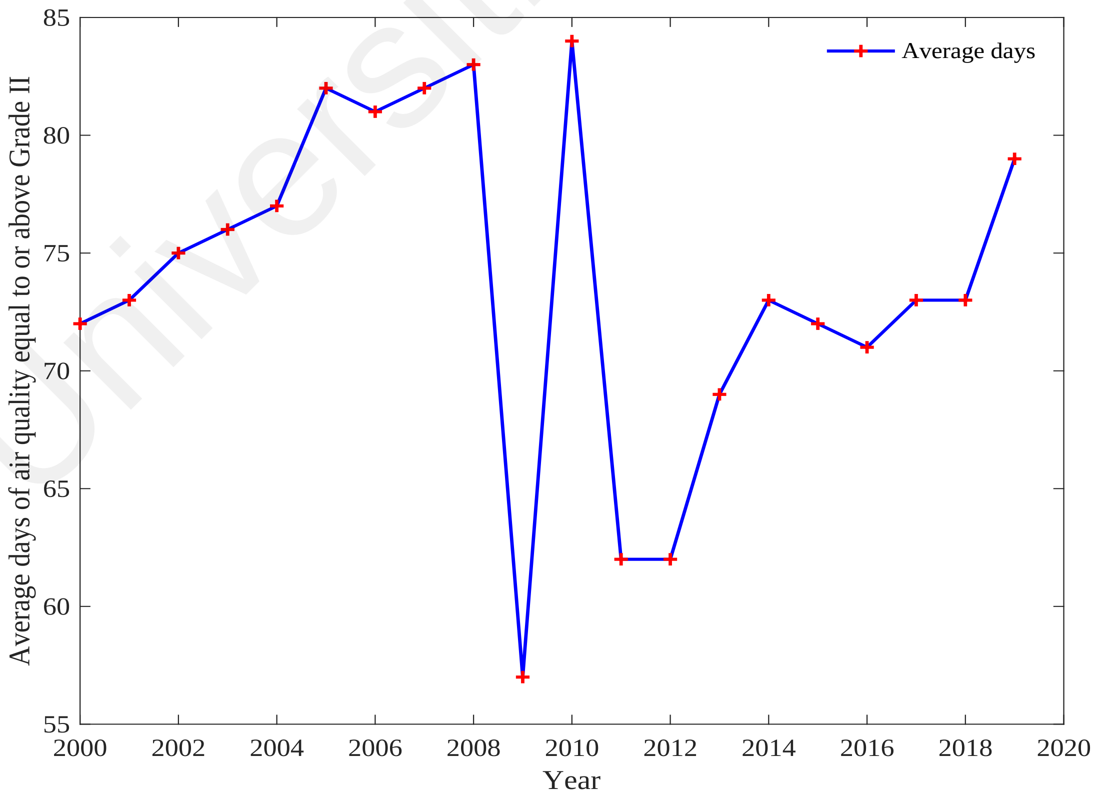

Figure 1.5: Average Days of Air Quality Equal to or Above Grade II of China's Principal Cities, 2000-2018
Source: National Bureau of Statistics (2001-2019)

Huan et al. (2022) highlighted that the rapid expansion of China's economy has led to its large economic size since 1972, an approximate constant proportion of industrial value addition, and a large share of CO_2 emissions in the world total. To this end, China must change its current economic development pattern and adopt a more sustainable and inclusive model to maintain its economic development further, thereby reducing environmental pollution and enhancing economic quality (Zheng et al., 2022).

(iii) Stylised Fact III: Uneven and Uncoordinated Development Problems

Uneven and uncoordinated regional development with significant socioeconomic disparities has become a prominent issue in the contemporary world. At the same time, it has also been recognised as one of society's main challenges in the United Nations, 2030 Agenda for Sustainable Development (Zhang et al., 2020). As a leading contributor to the world's economy, China has witnessed a rapid increase in disparities concerning economic development across various regions, natural resources, food supply, reliable energy, etc. The World Inequality Report[10] (2018) stated that in 1978, China's top 10% of earners captured 27% of the national income, increasing to 41% in 2015. Moreover, according to the NBSC (2018)[11] statistics, China's eastern coastal provinces, covering approximately 10% of the country's total land, consumed 44% of the country's energy, 29% of arable land, and 35% of the country's water. The eastern region comprises abundant resource endowments compared with other economic zones.

China's extraordinarily rapid economic growth has improved its people's living standards while at the same time leading to unbalanced and inadequate development. China has embarked on a path of modernisation from an agricultural state to an industrial one. However, the long-term dual urban-rural economic structure remains a bottleneck

[10] See https://wir2018.wid.world/files/download/wir2018-summary-english.pdf.
[11] See http://www.stats.gov.cn/.

for China to achieve balanced and coordinated development. Income inequality remains high, and the urban-rural dual economic structure is still significant (Xie & Zhou, 2014). This situation remains despite China enacting robust initiatives to revitalise rural areas, for example, the "Rural Revitalisation Strategy", "two frees, one subsidy" (Liang Mian Yi Bu) and the "Targeted Poverty Alleviation Strategy". Increasing income disparities will curb long-term economic development or result in resource misallocation (Wang & Ouyang, 2008). Figure 1.5 plots the disposable income of urban and rural residents and the Theil Index[12]. Overall, the value of the Theil Index has exhibited a significant downward trend since 1997, after considering the demographical elements, suggesting that income inequality between urban and rural areas had declined gradually. Still, the histogram depicted in Figure 1.6 demonstrates a large gap between urban and rural residents concerning their income levels, with a difference of about RMB 26,338, which was 125.54 times higher than in 1978[13]. The results show that China should concentrate more on balanced development to play a better role in redistributing its national income, thus, gradually mitigating income disparities and then achieving shared prosperity progressively.

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[12] The Theil Index is a measurement scheme that was used for measuring income inequality between China's urban and rural areas. To the best of this study's authors knowledge, there are two representative methods to measure income disparity, one is the ratio of disposable income of urban residents to the disposable income of rural residents. However, such a measurement does not consider the demographical elements in a certain period, leading to inaccurate results. Conversely, both demographical elements and income levels between urban and rural areas were included in the Theil Index. Correspondingly, the formula is as follows: $\text{Theil Index}_{it} = (I_{ijt}/I) \times \ln[(I_{ijt}/I)/(P_{ijt}/P)]$, where Theil Index_{it} denotes the income disparity index between urban ($j = 1$) and rural ($j = 2$) areas in province i for year t; I_{ijt} is the disposable income of urban ($j = 1$) or rural ($j = 2$) areas; similarly, P_{ijt} represents the population of urban ($j = 1$) or rural ($j = 2$) areas. The higher the value of the Theil Index, the larger the gap between urban and rural areas will be.

[13] The difference in disposable income disparity between urban and rural residents was 209.80 RMB in 1978.

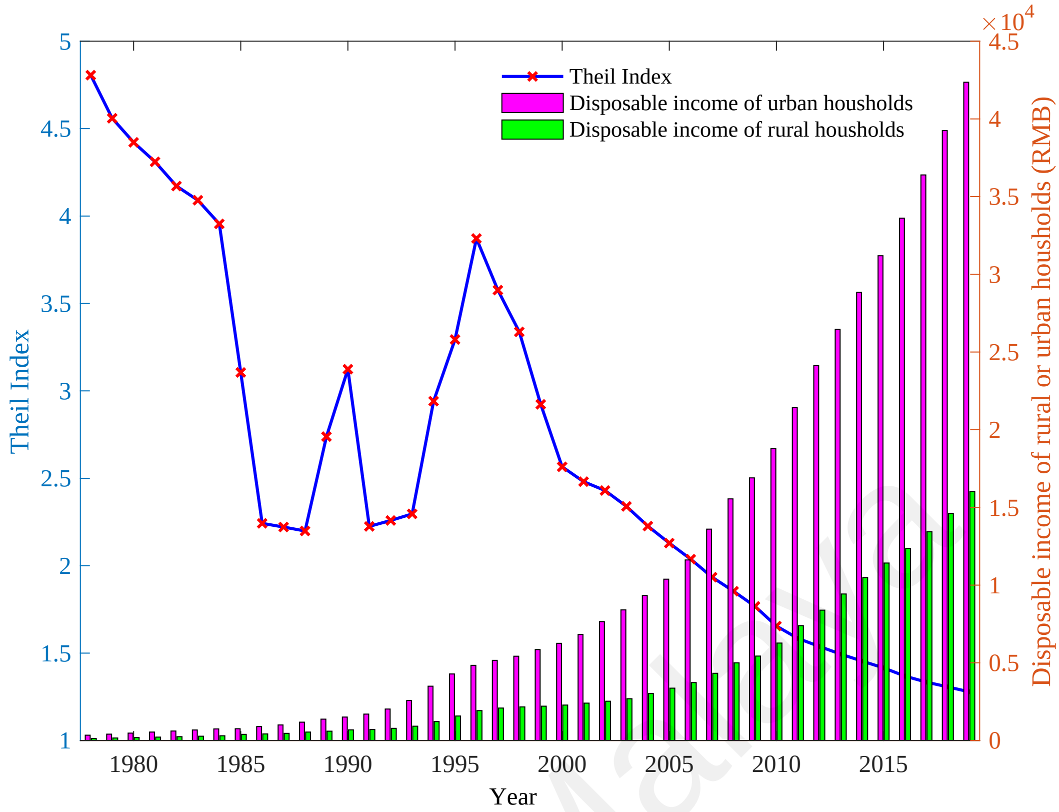

Figure 1.6: Disposable Income of Rural and Urban Residents and the Theil Index, 1978-2019
Source: National Bureau of Statistics (1979-2020)

Some light should also be shed on uncoordinated regional development. It is acknowledged that China's eastern region has performed better than the central and western regions concerning economic strength, economic resources, and technological levels. According to Figure 1.7, although households' per capita disposable income values in China's three major regions have increased significantly, income disparity across the three Chinese economic zones has expanded gradually. The income gap has increased, and the western region has lagged significantly, as Ratios 1 and 2, plotted in Figure 1.7, exhibited increasing trends over time. Moreover, the results of the western region were far removed from those of the central region.

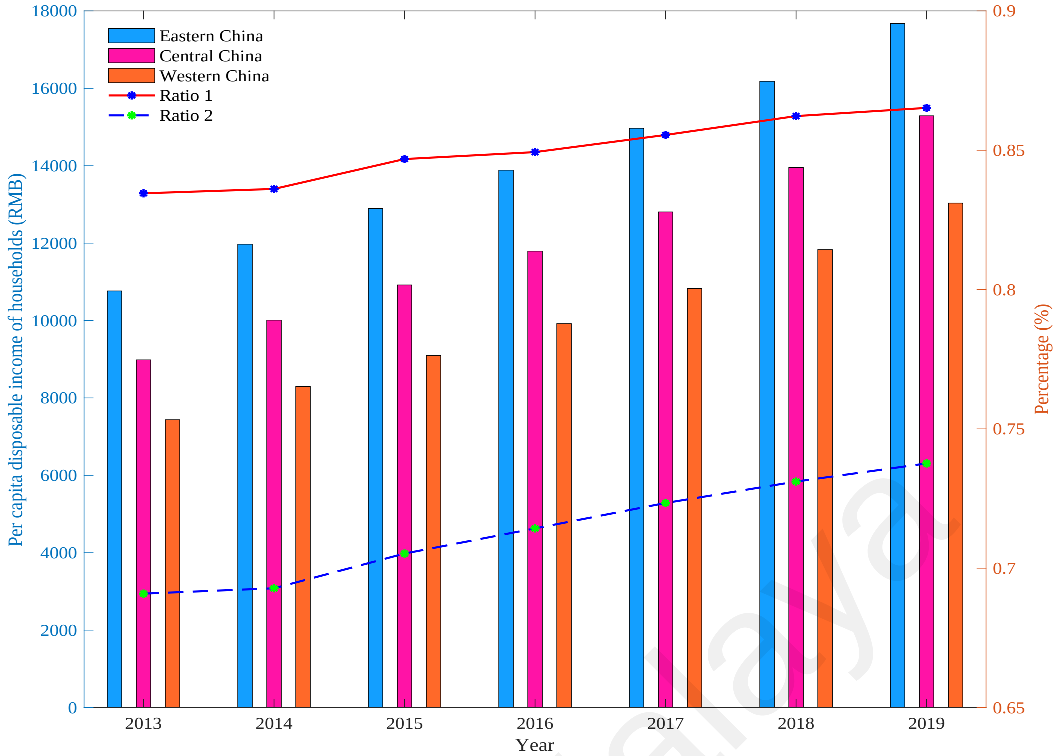

Figure 1.7: Per Capita Disposable Income of Households in China's Eastern, Central and Western Regions[14]
Source: National Bureau of Statistics (2014-2020)

Concurrently with its rapid economic expansion, China's three major industries have also developed quickly. The proportion of the contributions of the three sectors, namely the agriculture, industrial and tertiary sectors, transformed from 27.7%, 47.7%, and 24.6% in 1978 to 7.1%, 39.0% and 53.9% in 2019, respectively (NBSC, 2018)[15], with the contribution of the tertiary industry (exceeding 50% in 2015 (Figure 1.8)), indicating that China's industrial structure has been in the process of optimisation and adjustment. China's industrial structure evolution has been consistent with Petty Clarke's Law. Namely, the industrial structure will shift from "primary, secondary, tertiary", "secondary, tertiary, primary", to "tertiary, secondary, primary" (Xiao et al., 2018). However, it is acknowledged that China is predominantly an agricultural country. The share of the primary output value in the GDP has exhibited a significant decreasing trend over recent

[14] Where Ratio 1 in Figure 1.7 regulates the ratio of per capita disposable income of households in the Central region to per capita disposable income of households in the eastern region. Similarly, Ratio 2 denotes the ratio of per capita disposable income of households in the western region to per capita disposable income of households in the eastern region. Moreover, considering the data availability, this research just reports the period from 2003 to 2019.

[15] See http://www.stats.gov.cn/.

years. In contrast, the ratio of output values of the secondary and tertiary industries in the GDP has shown an increasing trend (see Proportions 1, 2 and 3 in Figure 1.7). Consequently, unbalanced development in the industrial structure has again injected uncertainty into China's HQD. Again, a balanced industrial structure is necessary for China's future economic development.

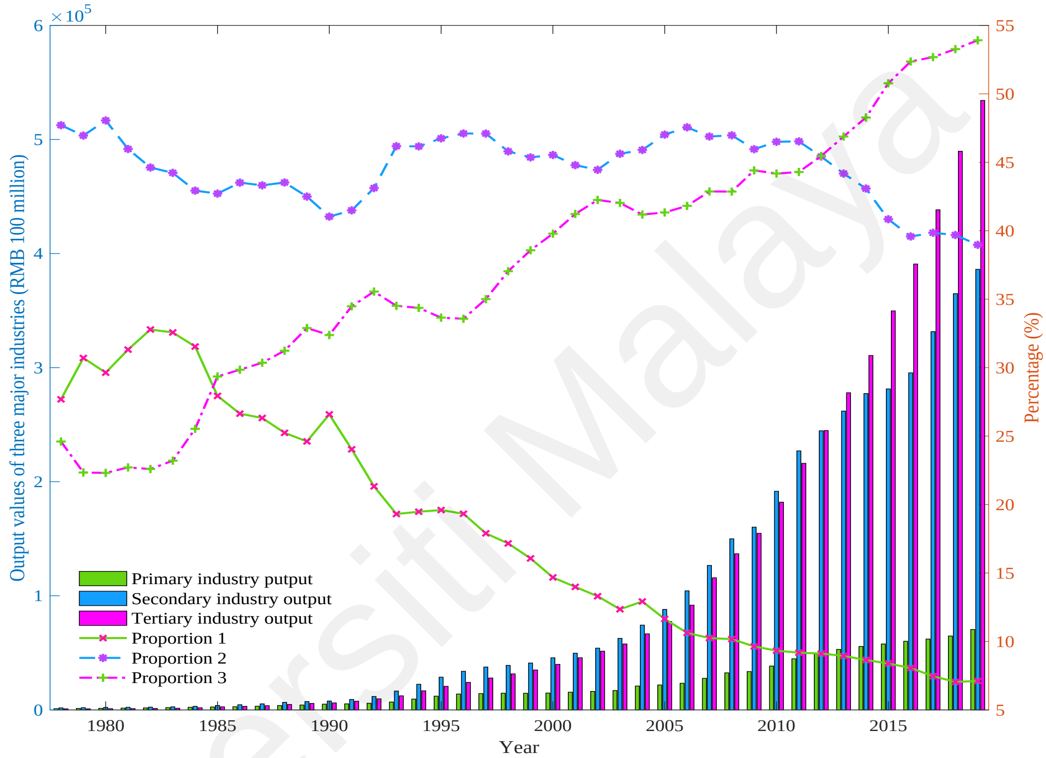

Figure 1.8: Output Values of the Three Major Industries and the Proportion of Each Industry to GDP, 1978-2019
Source: National Bureau of Statistics (1979-2020)

(iv) Stylised Fact IV: Review of China's Five-Year Plan

China's Five-Year Plan is a plan for major national construction projects and product distribution, including goals and visions for future economic development in China. It is necessary to illustrate further how the CPC guides China's economic development in each period.

The CPC has configurated a specific target for the nation's GDP growth rate since the beginning of the Sixth Five-Year Plan. For example, the GDP growth rate was stipulated at 6% in the Eighth Five-Year Plan. Still, the specific target was corrected to 8%~9% immediately, and the actual operational result was 12.3%, which was 3.3% ~ 3.4% above the adjusted target. Moreover, in the 11th Five-Year Plan, the GDP growth rate was set at 7.5%, and the outcome was 11.2%, which was 3.8% above the prescribed goal. Consequently, it can be concluded that the Chinese economy achieved results beyond the prescribed targets (Figure 1.9).

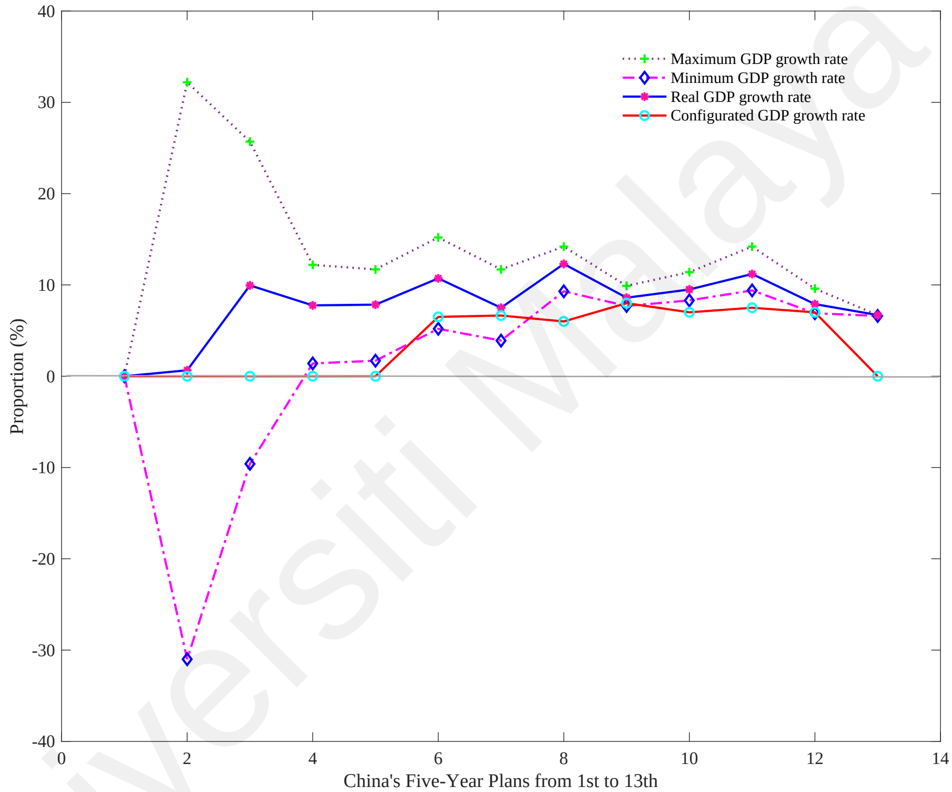

Figure 1.9: China's GDP Growth Rate Review Based on the Five-Year Plans
Source: The State Council of the People's Republic of China (1953-2020)

Furthermore, Figure 1.10 displays an analysis of the frequencies of terminologies, such as the three industries; environmental protection, technological reform, people's livelihoods, and industrial structural transformation used in the Five-Year Plans. The analysis shows that higher frequencies of primary and tertiary industries' terminology are used, while a downward trend was recorded for secondary industries. Based on the Five-Year Plan, it can be inferred that the Chinese central government was aware of the negative effects caused by secondary industries, especially the steel and cement industries, which are high energy consumers and high pollution emitters. Secondly, it is worth mentioning that terminologies related to industrial structure transformation were first mentioned in the 12th Five-Year Plan, exhibiting an increasing trend. This outcome shows that the CPC has been concentrating more on re-articulating and adjusting China's industrial structure, thus, gradually shifting the nation's economic development model from extensive to intensive.

Interestingly, the Chinese central government has not configurated specific GDP growth targets since the 13th Five-Year Plan. At the same time, the terminologies related to environmental protection and people's livelihoods have been mentioned increasingly. Subsequently, the main conclusions have been drawn: the above phenomenon reflects that the CPC has striven to create a new environment to enhance people's living standards further and improve the quality of economic development by vigorously implementing policies and transforming China's economic structure.

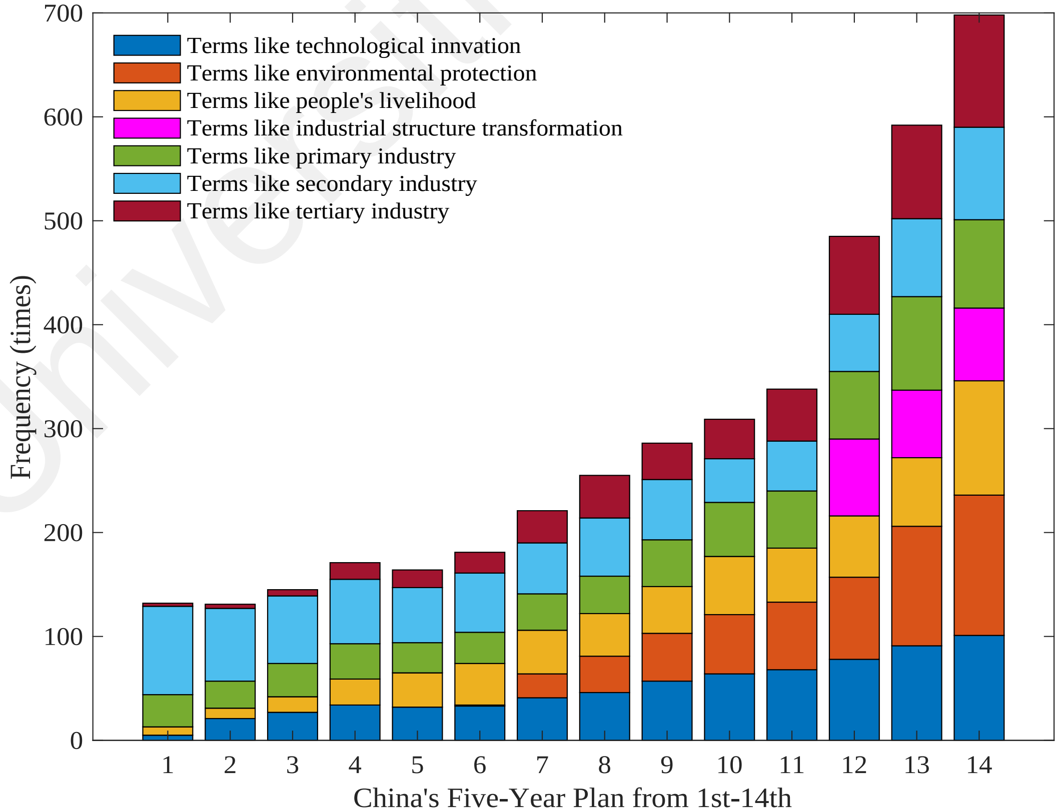

Figure 1.10: Related Words or Sentences Frequency in China's Five-Year Plans
Source: The State Council of the People's Republic of China (1953-2020)

1.2 China's High-Quality Economic Development

As China steps into its new era of HQD, it embodies a vital phase for adjusting its economic growth model, enhancing its economic structure, and fostering new engines for economic growth. From the theoretical perspective of economics, the "high-speed growth" concept is relatively easy to explain. It can be easily grasped and intercepted statistically (albeit with some technical issues). The terminology of "HQD" is seemingly simple, but it is difficult to comprehend and poses a new challenge. China's economic development is increasingly important and must live up to its "nature," which will help lead China out of the current development dilemma while continuously meeting its people's diversifying and increasing needs for better lives.

This study stresses the vital essence of China's HQD based on three perspectives: TI, coordinative development, and people's ever-growing needs.

First, according to Cheng (2018), emancipating and developing productive forces (PFs) is the principal task in building a socialist country because the PFs are the most revolutionary elements stimulating economic growth. Generally, TI is a dynamic component of productivity (Hu, 2021), and it plays a crucial role in pushing production development forward (Cheng, 2018). Still, the empirical evidence from Chen et al. (2021) demonstrated that TI positively affected energy efficiency[16], whereas growth in the shadow economy had a detrimental effect on energy efficiency[17]. In this regard, TI can be regarded as a primary driver for propelling China's economic development in its new era. Thus, one of the essences of HQD is strengthening the country's independent,

[16] For example, Sohag et al. (2015) investigated the impact of TI (proxied by patent applications) on energy use, and further stressed that technological innovation enhanced energy efficiency during the production process. Moreover, Wang & Wang (2020) showed that there was a positive correlation between TI and total factor energy efficiency, indicating that TI contributed to energy efficiency improvements.

[17] It is meaningful to point out that the study also provided strong evidence that the structural transformation of an economy significantly contributes to energy efficiency improvements.

innovative capability to inject new growth momentum into China's economic development.

Second, according to Cheng (2018), to ensure balanced and coordinated development among various economic relationships, the total social labour embodied in; human capital, social capital stock, and social wealth accumulation should be allocated proportionately. Based on this illustration, the so-called "coordinative development" is not limited to several aspects: balancing urban and rural development, eliminating development disparity across different regions, etc. The abovementioned aspects are fundamental. However, HQD requires a higher level of "coordination" or "harmonisation" among various economic relationships. As illustrated, the second essence of HQD strengthens the top-level design to integrate the economy, environment, society, culture, and the law.

Third, socio-economic development, as continuous progress, is staged. That is, economic development in different historical stages exhibits distinct characteristics. Since China implemented its economic reform and opening-up policies, rapid expansion in scale and quantity has become the keyword to portray China's economic development. However, the new era implies that high-speed growth has fulfilled its mission, and the Chinese economy has now turned to the HQD stage.

In the 19th CPC National Congress report, China's President Xi proclaimed that the central conflict faced by Chinese society had evolved. He stated, "what we now face is the contradiction between unbalanced and inadequate development and the people's ever-growing needs for a better life" had become the primary conflict. In short, the "backwardness" issue was solved when the quantity problem was solved while the quality of economic development loomed. According to Yu & Wang (2021), China's past extensive economic development model, characterised by massive inputs of social capital and abundant resources, has led to an excessive supply of primary products but a shortage of high-end products. Unfortunately, the relationship between low-end supply and high-end demand is expected to escalate, increasing pressure on the Chinese economy's sustainable and inclusive development (Liu et al., 2020; Wang & Liu, 2020).

The above propositions question whether the provided products meet the increasing and diversifying "real needs" of the people. This outcome is because people's needs are "dynamic" in different development stages, and such phenomena are mainly reflected on the supply side. Of course, structural issues also exist on the demand side but mainly manifest in quality demand. Therefore, HQD in the new era has a strong dynamic connotation from the social conflict perspective.

Conclusively, economic vitality will continue to improve. The economic surplus will continue to increase. The entire economy will be revitalised when the country constantly optimises its economic structure to maximise the comparative advantage of factor endowments in the production process. Fundamentally, in the era of HQD, it will become more crucial to reflect the authentic nature of economic development and concentrate more on the supply side of the economic structure better to satisfy the growing demands of the Chinese people. Correspondingly, the third essence of HQD is continuously dealing with backward production capacity [18], improving economic efficiency, and satisfying people's growing needs through continuously advancing and optimising the economic structure.

Guided by the 19th CPC National Congress report, China's HQD is an organic whole composed of five subsystems: innovative, coordinative, green development, open and sharing development, in which innovation becomes the primary power, coordination

[18] Overcapacity has become a common issue faced by China in the new normal (Chen & Groenewold, 2019).

becomes the endogenous characteristic, green becomes the universal form, openness becomes the only way, and sharing becomes the fundamental goal.

1.3 Problem Statement

China's industrial economy has developed dramatically and made great achievements since 1978. However, rapid resource consumption and high pollutant emissions have become the dominant features of its industrial sector. However, consuming economic resources to stimulate economic growth cannot aid China in achieving long-term economic growth, especially in the crucial transition period. China's industrial structure is experiencing a complex transformation and adjustment. Based on gross industrial economic development, the contribution of industrial added value to the GDP has decreased from 46.5% in 2011 to 40.1% in 2016. However, it maintained around 40.0% in 2018 (NBSC, 2019)[19]. As IED presented a decreasing trend in recent years, China's industrial economy has lacked dynamism. From the perspective of the added value of various industrial sectors, the high-tech manufacturing industry in China has undergone continuous growth, yet the growth of traditional industries (i.e., the mining industry) has exhibited a slightly downward trend. According to the available statistics (NBSC, 2019)[20]. The share of the equipment manufacturing and high-tech manufacturing industries in the total added value of industrial enterprises above a designated value has shifted from 37.6% to 45.3% from 2012 to 2016, while traditional industries fell from 43.5% to 35.3%. The growth in the decline in traditional industry has been about 5% higher than that of the rate of the equipment manufacturing and high-tech manufacturing industries. Overall, China has a long path to upgrade and transform its industrial structure because of the sluggish growth of high-tech-related industrial sectors.

[19] See http://www.stats.gov.cn/.
[20] See http://www.stats.gov.cn/.

First, countries worldwide have been re-articulating their economies, especially their industrial structures, to realise sustainable and inclusive development (Buzdugan & Tüselmann, 2018). However, choosing between economic growth or environmental protection has long troubled emerging markets. The core of China's rapid economic expansion since introducing its reform and opening-up policy lies in excessive energy and resource consumption. On the one hand, the fast development of economic development and industrialisation has created material wealth and raised people's living standards. On the other hand, it also intensifies the contradiction between humans and nature. For example, increases in air pollution in small- and middle-sized cities have caused great harm to public health (Wang et al., 2020; Wang & Ma, 2018). Therefore, sustainable HQD has become an inevitable trend. Simply put, people's needs for a better ecological environment and the maintenance of environmental protection have grown tremendously. This situation implies that environmental issues cannot be ignored in the process of China's HQD.

Developed economies with advanced industrial sectors are generally more eco-efficient than emerging economies at the lower end of the global industrial value chain. Referring to Amankwah-Amoah et al. (2018) and You et al. (2019), TI is essential in promoting productivity and economic growth, especially in emerging markets. TFP is the portion that cannot be fully explained by the number of factor inputs used in the production process. Therefore, its level is determined by how efficiently and intensively the number of factor inputs are utilised in production. TFP is usually measured by the Solow residual. Therefore, by linking innovation and TFP growth, endogenous growth models shed light on the potential determinants of TFP growth. For example, adequate R&D support and relatively abundant skilled labour can reduce the marginal cost of R&D activities and facilitate progress in technological innovation, thereby contributing to TFP growth. In addition, expanding markets are expected to increase investors' revenues, leading to more innovation and high-level TFP.

In contrast, the connotation of green TFP is richer than TFP because green TFP takes economic and environmental factors into account (Chung et al., 1997). More specifically, referring to Rusiawan et al. (2015), green TFP is derived from two crucial developmental strategies: productivity enhancement and environmental protection. The former provides a framework for continuous enhancement, while the latter provides the foundation for inclusive development. Thus, minimising environmental pollution while maximising productivity could be considered an eco-efficient economy. Most recent studies have discussed green TFP based on different perspectives, such as; China's carbon trading scheme (Zhang et al., 2021), outward direct investment (Wu et al., 2020), green finance (Lee & Lee, 2022), etc.

However, the connotations of China's HQD go beyond the green TFP mentioned above. Referring to Pan et al. (2021), the connotation of HQD is a comprehensive ideology distinguished from economic growth. This outcome suggests that a single indicator cannot directly measure HQD, such as TFP, GDP growth rate, total GDP, or per capita GDP. In other words, the HQD assessment system should be practical and synthetic (Tian et al., 2022). Therefore, exploring how to construct an assessment system for quantifying China's HQD from the "Five new development concepts" perspective is necessary, namely, innovative development, coordinative development, green development, open development, and sharing development.

Second, in terms of ISTU's measurement schemes, scholars have mainly discussed the crucial role of industrial structure upgrading (ISU) on economic growth but have failed to consider industrial structure rationalisation (ISR) and ISTU composite systems (IS). For example, the empirical findings of Jorgenson & Timmer (2011) demonstrated that service accounted for approximately three-quarters of total value-added, contributing to productivity growth in the US and Japan. Rodrik (2013) proved a strong unconditional convergence in labour productivity, indicating that a country with a higher share of manufacturing would exhibit a higher economic growth rate, thus, in turn, demonstrating that industry is an enabler for driving economic growth. Industrial structure segmentation or fragmentation could negatively impact countries from world practice. Specifically, it can reduce the share of production in countries (Rocha, 2018). Besides, Rocha (2018) found that the manufacturing industry had some unique attributes that could not be found in other industrial sectors but were vital for sustainable economic development. This finding again highlights the importance of the manufacturing sector as a locus of technological progress since the first industrial revolution.

Additionally, although China has maintained long-term economic growth since 1978, problems, such as declining marginal returns of capital investment, increasing downward pressure on economic development, and weakening demographic dividends, have posed a pressing need to carry out supply-side structural reform (SSSR) in China. SSSR is a government-organised, initiated, and enforced reform package considered revolutionary for China's socialist market economy theories and practices (Zhang et al., 2018). In essence, SSSR requires improving the efficiency and quality of economic development by transforming the momentum. Existing studies have also highlighted the necessity and importance for China to optimise its economic structure by firmly carrying out SSSR (Wang & Ren, 2018). According to UNCTAD (2019b), industrial structural transformation and optimisation can be regarded as a core process of economic development. Not all countries will deliver on the 2030 Agenda for Sustainable Development without improving the productive capacity and shifting resources to higher productivity sectors. Besides, Gryshova et al. (2020) also asserted that a progressive industrial structure promoted the economy's sustainable development and enhanced the population's quality of life. Furthermore, livelihoods in modern societies have been established on the economic foundations created by the industrial revolution (UNIDO, 2015).

While current studies[21] (Hao et al., 2020; Wang & Wang, 2021) have mainly focused on the promoting effect of tertiary industry on economic growth, designating that continuous ISU can improve productivity, thereby maintaining economic growth and increasing people's well-being. In contrast, Che et al. (2019) provided empirical evidence demonstrating that ISU could negatively affect China's economic development after reaching a threshold value, thus, degrading HQD. According to Gan et al. (2013), ISR reflects how resources are utilised and allocated effectively compared with ISU. This outcome means that ISR is equally important as ISU and should not be neglected.

Third, based on the above analysis, this study holds that ISU and ISR are composite systems, highlighting that both should be entirely undertaken when exploring the impacts of ISTU on China's HQD. Furthermore, the measurement schemes concerning ISTU must reflect the dynamic characteristics because the evolution of industrial structure is a dynamic process. Importantly, a study (Zhu et al., 2019) did not conduct an in-depth exploration of the distribution characteristics of ISTU.

The contents above gave this study great incentive and impetus to provide integrated research to investigate the role of ISTU in China's HQD, thereby sharing wisdom concerning the sustainable development of China's HQD.

[21] Where some typical cases have been cited to illustrate the scholar's preference of ISU, Hao et al. (2020) strongly highlighted the role of ISU (proxied by the ratio of secondary industry output to GDP and the ratio of tertiary industry output to GDP) in the incentive role of urbanisation increasing environmental pollution. Moreover, Wang & Wang, (2021) adopted two different methods to measure interprovincial ISU levels but neglected the role of ISR. Still, work from Zhao et al. (2021) showed that ISR negatively affected green TFP, while the effect of ISU on green TFP was positive.

1.4 Research Questions and Research Objectives

1.4.1 Research Questions

In general, this study sought to investigate the impacts of ISTU on China's HQD. Specifically, the research questions of this study were as follows:

(1) What is the state of China's high-quality economic development from the temporal and spatial perspectives? Are there any regional variabilities or disparities in China's high-quality economic development, and what accounts for these differences?

(2) What are the levels of interprovincial industrial structure upgrading, rationalisation and composite systems for China and its regions? And what are the distribution characteristics of China's industrial structure upgrading, rationalisation and composite systems?

(3) What impacts do industrial structure upgrading, rationalisation, and composite systems have on China's high-quality economic development? And is there any regional heterogeneity in its impacts?

1.4.2 Research Objectives

Correspondingly, the research objectives were as follows:

(1) To explore the temporal-spatial development features of China's high-quality economic development and the reasons for the differences in regional high-quality economic development.

(2) Assess China's industrial structure upgrading, rationalisation and composite system levels, and distribution characteristics at regional and national levels.

(3) To examine the impact of China's industrial structure upgrading, rationalisation and composite systems on high-quality economic development at regional and national levels.

1.5 Significance of the Study

In the context of the new economic normal, a pressing issue faced by China has been how to promote the transformation and optimisation of its industrial structure to provide a new impetus for promoting HQD.

First, considering theoretical significance, a comprehensive index captures much more information than a single indicator. Thus, this study constructed a multidimensional assessment system to examine China's HQD, laying a theoretical foundation for future studies related to HQD. Second, since this study examined the effects of ISTU on HQD, it could help share wisdom and provide insightful information on the direction of China's future ISTU.

This study may first help the government construct an HQD assessment system in terms of practical significance. The assessment system constructed in this study was based on a systematically theoretical justification, thus, avoiding subjectivity and repeatability. Second, the relevant policy implications were derived according to the empirical findings. Based on China's reality, the proposed policy implications may aid regions in narrowing development disparities progressively and further accelerate balanced and coordinated development. Third, this study may be helpful for regions to determine the advantages and disadvantages of pursuing HQD, thus, formulating a strategic plan in line with the region's realities.

1.6 Organisation of the Study

Specifically, this study is structured as follows. Chapter 2 discusses the existing literature on HQD concepts, the current HQD assessment system, industrial structure and economic growth. Chapter 3 provides the theoretical justification for the HQD assessment system through "Five new development concepts": innovative development, coordinative development, green development, open development, and sharing development. Chapter 4 outlines the research methodology, framework, and data sources used in this study. Chapter 5 discusses China's HQD performance from temporal-spatial perspectives.

Meanwhile, in this chapter, the reasons causing regional heterogeneity concerning HQD performance have been addressed. Chapter 6 discusses the distribution characteristics of ISU, ISR, and IS. Chapter 7 examines the effects of ISU, ISR and IS on China's HQD based on regional and national perspectives. Finally, Chapter 8 focuses on concluding remarks, policy implications, and research limitations.

CHAPTER 2: LITERATURE REVIEW ON HIGH-QUALITY ECONOMIC DEVELOPMENT, INDUSTRIAL STRUCTURE AND ECONOMIC DEVELOPMENT

2.1 Introduction

This chapter reviews the existing literature discussing; the concept of HQD, the existing assessment of HQD, the notion of industrial structure, and in contrast, the research gaps based on the past literature that has set the stage for development and addresses the concepts of HQD and its key drivers will be presented.

2.2 Concepts of High-Quality Economic Development

The UN's Agenda 2030, with its 17 SDGs, has provided frameworks that are significantly distinguished from those previously concentrated on economic growth. These 17 SDGs include many potentially diverging policy goals in; society, economy, ecology, and the environment, which implies that the comprehensive consideration of economic development, people's well-being, and environmental protection has been the general trend of global inclusive development (Kroll et al., 2019). At the same time, countries worldwide have positively acted on these proposed SDGs by formulating a set of strategic plans. For example, the U.S proposed The America 2050 Strategy in 2006, providing a guiding blueprint for facilitating integrated investment in economic development, environment, and mobility (Georgeson & Maslin, 2019). At the end of 2019, the EU announced the European Green Deal and developed a package of circular economy plans, with the achievement of carbon neutrality in 2050 as its core goal, to establish a robust modern economic system with the decoupling of resource consumption and economic growth (Sanyé-Mengual et al., 2019).

The NEGM and its impact on China's HQD have been widely addressed. To establish a practical assessment system for the NEGM for China's HQD, an in-depth understanding of the characteristics and connotations of the NEGM is of fundamental importance. A common consensus that has been reached by scholars from China and Western countries concerning China's HQD is that breaking the old economic growth momentum while fostering a new one can stimulate economic growth further. The decline of the initial drivers and the lack of new drivers are the main reasons causing the sluggishness of a country's economic development during the transition period from a low- to a high-income country (Aiyar et al., 2018).

However, there remains a significant difference between China and Western countries in cultivating the NEGM due to the difference in politics, regulations, and culture (Nasreen et al., 2020). In particular, economists from Western schools advocating the cultivation of the NEGM concentrate on demand-side reform or management. For instance, Moses & Pual (2001) argued that the unification of domestic technology and production structures and the scale effect triggered by the fast expansion of the domestic market were the principal reasons why the US economy surpassed the UK. In contrast, the cultivation of the NEGM in China lies in SSSR (Hong et al., 2022). Thus, cultivating the NEGM can be considered the starting point for maintaining HQD in China.

It is worth pointing out that China's HQD also requires the continuous cultivation of the NEGM. It requires transforming and adjusting traditional economic development patterns toward sustainable ones (Lu et al., 2019; Guo et al., 2014). HQD concentrates on improving quality, enhancing efficiency, and fostering new growth drivers. In the meantime, HQD aims for; environmental protection, energy conservation, and letting nature restore itself (Lu et al., 2015; Liu & Xu, 2016). Given its rich contents, the first strand of literature has discussed the concept of HQD, mainly focusing on the following crucial aspects: improving product quality and SSSR.

First, Tian (2018) proposed that HQD is a philosophy, mode, and strategy for Chinese economic development, according to which quality improvement is the orientation, core, and target of development. Thus, it can improve economic efficiency by lowering transition costs and achieving more coordinated, stable, and sustainable development. In this regard, Jin (2018) stated that HQD is a structure, dynamic state and mode of economic development that can better satisfy people's ever-growing needs. Similarly, Zhang (2017) proposed that despite the vast accumulation of materials and technologies, the low-end locking product is challenging to meet people's ever-growing needs because the people's "actual need" constantly changes. To this end, the most crucial problem to be solved is dealing with the relationship between supply and demand to meet people's diversified demands. The same understanding can also be found in the work of Zhang et al. (2019). Therefore, the relevant authorities should enact strict quality standards and ask enterprises to improve the supply quality, providing high-quality products or services (Xu & Xue, 2019).

Second, the 19th CPC National Congress report mentioned that "China's economy has been transitioning from a rapid growth phase to a stage of HQD. Thus, China must focus on the economy, prioritise improving the quality of the supply system, and enhance its economy's strength in terms of quality. This situation indicates that structural imbalance is still a pressing issue China faces in realising HQD. To effectively address this issue, China must firmly carry out the SSSR policy through the market, releasing the right price signal and reallocating production resources. Being different from deindustrialisation (mainly represented by declines in industrial employment and output) that has taken place in industrialised countries (Koistinen, 2013; Feinstein, 1999). SSSR, with Chinese characteristics, is a government-organised and initiated reform package for the country's socialist economy theories and practices[22] (Geng et al., 2013; Zhang et al., 2018). Therefore, another understanding of HQD in a broad sense means that if a product

[22] Major tasks identified included; reducing overcapacity issues in mining, iron, and coal, cutting the housing inventory, lowering leveraged corporate and financing industries, and strengthening the weak linkage between high-quality demand and low-end supply.

or service meets international standards and the entire supply system, it should have vitality, efficiency, and quality (Wang, 2017).

Furthermore, Lin (2018) proposed that HQD satisfies people's diversified demands for better lives and synthetically embodies innovation, coordination, greenness, openness, and sharing. It is the comprehensive embodiment of five aspects: economy, politics, ecology, culture, and society. While achieving the coordinated development of the five dimensions is conducive to realising HQD (Jin, 2018). Therefore, going beyond these understandings mentioned above, the second strand of literature has explained HQD from a more integrated perspective.

First, the quality of economic growth ensures economic growth with a steady speed and considers welfare distribution, ecological environment, and governance (Bucci et al., 2019).

Second, Zhao (2018) pointed out that HQD mainly regulates regional and industrial development quality, which embodies the; synergy, integrity, inclusiveness, and openness of industrial optimisation and regional development[23]. In this regard, Zhao et al. (2019) mentioned that China's HQD could be understood from three aspects: system balance, economic development, and people's livelihood orientation. Moreover, HQD requires; building a modern economic system, improving the quality of input factors and innovation capability, and adhering to a green coordinated development road leading to a new type of industrialisation (Zhang et al., 2019).

Third, An (2018) stated that China should weaken its economic growth index while the long-term development goals should be primary. The above content shows that the relevant authority should properly handle the relationship between; input and output,

[23] Study provided by Tian et al. (2022) also highlighted that realising balanced development is beneficial to aid China realise HQD.

the government and market, fairness and efficiency, home and abroad, etc., to promote HQD. Therefore, HQD implies a healthy and sustainable development of the entire national economy (Pang et al., 2019). In essence, HQD should be a dynamic adjustment from quantity and priority to efficiency enhancement, scale expansion to structural advancement and optimisation, investment & input-driven to innovation-driven development (Bain et al., 2019; Mohanty et al., 2018).

To summarise, firstly, China has fulfilled the basic needs of over a billion people by enabling them to lead decent lives. Soon, the country will create a moderately prosperous society with a successful completion. However, the people's basic needs and living standards are increasingly broad. By achieving HQD, the industrial structure will be constantly optimised, environmental issues will be addressed, and people's living conditions will be progressively enhanced.

Secondly, intensifying the protection of property rights, better exerting the functions of the government, accelerating the reform of local and central financial systems, as well as deepening the reform of the social security system is conducive to improving innovation capability, speeding up the opening-up policy, and refining the institutional mechanism. The uncoordinated development problem, of course, will be effectively addressed in the process of HQD.

Finally, the core of realising HQD is addressed by continuously satisfying people's diversified demands. However, with the development of society and economy, the people's focus is shifting from "Is there enough" to "Is it good enough", reflecting that the quality of development is receiving more attention. Therefore, in the transformation process, people hope to maximise their utility in; politics, economy, culture, ecology, and society.

Detailed information corresponding to HQD is reported in Table 2.1 below:

Table 2.1: Summary Table for High-Quality Economic Development Concepts

Perspectives	Concepts	Literature
Micro-level	Quality of product	Xu & Xue (2019); Zhang (2017); Tian (2018); Liu (2018)
	The vitality, efficiency, and quality of the entire supply system	Wang (2017)
	The importance of overcoming backward production overcapacity	Liu (2016); Jia et al. (2016)
	The importance of implementing SSSR	Huang (2016); Zhou et al. (2017)
Middle-level	Emphasising the important role of state-owned enterprises in realising HQD in China	Hou (2018); Huang et al. (2018)
	The quality improvement of regional economic development and industrial optimisation	Zhao (2018)
	Achieving HQD lies in seeking coordination among three dimensions: system balance, economic development, and people's living standards	Zhao et al. (2019); Zhang et al. (2019)
Macro-level	To weaken economic growth and pay more attention to long-term quality improvement of China's economy	An (2018); Pang et al. (2019)
	HQD includes five aspects: innovation, coordination, greenness, openness, and sharing. The five aspects mentioned above correspond to; economy, politics, ecology, culture, and society	Liu (2018); Jin (2018)

2.3 Existing Assessment System of China's High-Quality Economic Development and its Determinants

This section reviews the critical components of HQD to understand how HQD has been assessed in the existing literature. In contrast, further discussions will focus on the potential determinants of China's HQD.

HQD is a comprehensive composite organism (Jin, 2018) that contains political, social, economic and livelihood, innovation, religion and environment, and other closely related crucial factors (Wen et al., 2021). Hence, constructing an HQD assessment system should start from a systematic viewpoint (Tian et al., 2022). Scholars have constructed different assessment systems, indicators, and standards regarding their purposes (Xu et al., 2020).

The 19th CPC National Congress report emphasised that "we should pursue SSSR as the main task, and work hard for better quality, high efficiency, and more robust economic growth drivers through reform, thereby improving TFP gradually". This situation indicated that the improvement of TFP plays a pivotal role in realising HQD. Therefore, the first strand of literature reported that TFP as a valid indicator could be directly adopted to assess China's HQD. For example, Jahanger (2020) empirically explored the impacts of foreign direct investment (FDI) on China's HQD. The study held that the quality of economic development was reflected in the efficiency of economic development, which means that the higher the full factor productivity, the higher the quality of economic development.

Wang et al. (2019) studied the effects of FDI on agricultural HQD in China's 24 selected provinces from 2004 to 2016. They innovatively brought bad output (i.e., agricultural CO_2 emissions) into the agricultural TFP interpreting framework to measure green TFP[24]. The two-step systematic generalised method of moments (SYS-GMM) estimator was adopted to model the effects of agricultural FDI on green TFP. They found that agricultural FDI positively affected green TFP. Specifically, every 1% increase in agricultural FDI led to an increase of 0.0736% in green TFP. The results also proved that agricultural FDI promoted green TFP and various sub-items[25] in the short run but inhibited green TFP in the long run. Thus, an inverted "U-shaped" relationship between agricultural FDI and green TFP was identified. Additionally, the increase in agricultural green TFP over the past ten years designated that the HQD level of the Chinese agricultural economy has exhibited an upward trend.

[24] Where the calculation of the GTFP in the work of Wang et al. (2019) was based on the SBM-ML (Slack-based Measure and Malmquist-Luenberger) index.
[25] Where the sub-items mainly referred to the technical progress index and technical efficiency index.

In conclusion, TFP regulates the contribution of intangible factors to economic growth rather than the tangible factors of production, such as land, labour and capital. While TI, rational distribution of economic factors and continuous innovation of institutions are usually the main items of the intangible factors. The differences thereof explain the huge differences in the quality of economic development among different regions and countries. Although TFP can assess the growth features of one country's economy in a certain period, this indicator cannot be regarded as a good proxy variable for measuring China's HQD. HQD is a comprehensive, efficient, equitable, and sustainable development system. Thus, a single indicator cannot accurately and comprehensively reflect HQD-rich connotations (Du et al., 2020; Shi & Li, 2019).

It is worth mentioning that the failure of TFP or the single variable interpreting China's HQD induces the feasibility of the multidimensional assessment system. Therefore, the second strand of literature reported that constructing a multidimensional assessment system was essential to quantify China's HQD. Cross-sectional and panel data sets are two typical data sets.

Huang et al. (2020) used a cross-sectional data set to construct an HQD assessment system based on five dimensions: innovative development, urban and rural coordination, environmental protection, opening up to the outside world, and people's living standards. Specifically, 49 indicators were selected to assess China's provincial HQD degrees. The modified G-1 method based on the grey correlation degree is employed to calculate the weight of each indicator and then obtain a comprehensive index. Empirical findings showed that the maximum HQD value in Beijing was 0.6653, and the national HQD value was 0.4236 in 2016, while Xinjiang ranked at the bottom with a value of 0.3290. Concerning the five subsystems, the open to outside world subsystem had the lowest value, indicating that this subsystem had the most uncoordinated development.

In contrast, the people's living standard subsystem had the largest value. Uncoordinated and uneven development was still a pressing issue. Policy implications of the study highlighted that achieving integrated development of the five subsystems was essential for China to realise HQD.

Ma et al. (2019) built a synthetic assessment system of HQD, which was used to empirically analyse China's HQD and the development levels concerning high-quality supply, high-quality demand, economic efficiency, economic stability, and opening up. The study adopted a cross-sectional data set and selected 28 proxy variables to measure the HQD levels in China's 30 provinces in 2016. The study first carried out a dimensionless process[26] and then assigned weights to each indicator by adopting the linear weighting approach. The empirical findings showed that the highest score of HQD in Beijing was 89.2, while the lowest value in Yunnan was 62.5, with a difference of 26.7. Additionally, Beijing and Shanghai played leading roles in HQD's five subsystems.

Looking at panel data, Zhan & Cui (2016) established an assessment system from 2000 to 2014 to evaluate China's HQD performance. The assessment system was constructed based on the "Five new development concepts[27]", such as innovation, coordination, green development, opening up and sharing development. Consequently, the principal component analysis (PCA) method evaluated the development performance of the above five dimensions and provincial HQD levels. The empirical findings showed that China's provincial HQD had a greater advance because of the significant improvement in the five aspects. Second, there was a tremendous difference in HQD

[26] The dimensionless process in the work of Ma et al. (2019) is classified into three methods according to the attributes of each indicator. Specifically, for the positive indicator: $x_{ij}^{*} = (X_{ij}/X_{max}) \times 100$. Where x_{ij}^{*} denotes the standardised value; X_{ij} represents the i-th indicator of the province j, while X_{max} denotes the maximum value of all DMUs (decision-making units). For the negative indicator: $x_{ij}^{*} = [1/(X_{ij}/X_{max})] \times 100$. For the moderate index: $x_{ij}^{*} = [1/|x_{ij} - A|] \times 100$. Where A represents the moderate value.
[27] See http://www.gov.cn/zhuanti/19thcpc/baogao.htm.

across provinces and regions. Third, green and sharing development are two main factors inhibiting HQD improvement in China.

Employing panel data from 31 provinces in China from 2014 to 2018, Li et al. (2021) examined the effects of green innovations and institutional constraints on HQD. The assessment system in the study included three first-class indicators (i.e., economic growth momentum, economic growth structure and economic growth outcomes) incorporating 22 third-class indicators. The spatial distribution results showed that the HQD level in the eastern region was better than in the other regions. The collaborative effect between green innovations and institutional constraints promoted HQD nationally. The corresponding collaborative effect exists in regional heterogeneity, and the positive effect was captured only in the eastern region.

Concurrently with the transformation of China's economy from a high-speed growth stage to the HQD stage, China's logistics industry as an integrated part of HQD has not yet been widely explored. Therefore, Yan et al. (2021) analysed the coupling-coordination relationship between China's HQD and the logistics industry. Sequentially, a total of 24 second-class indicators were selected to measure HQD based on the "Five new development concepts", namely, "innovation", "coordination", "green", "openness" and "sharing". The PCA method was employed to obtain an HQD comprehensive index. Besides, the Super-SBM model was used to evaluate the high-quality logistics industry development performance. The results showed that the performance of HQD and the logistics industry in China were not necessarily high quality.

The performance of various subsystems of China's HQD varied among different studies. For example, the development of the openness subsystem was not coordinated (Huang et al., 2020); green and sharing subsystems were the main factors affecting HQD, while others were opposite (Zhang & Cui, 2016). However, the major reason may lie in the selection of assessment indicators. Nonetheless, the unsustainable development of each dimension will inject uncertainties into China's HQD.

The third strand of literature regulated the heterogeneous analyses from provincial, regional and national (or world) perspectives.

Firstly, taking Guangdong Province as an example, Ye (2019) built an assessment system from six aspects: economic strength, the S&T level, government management, resource and environment, openness degree, and basic infrastructure. The entropy method and cluster analysis method were applied to calculate urban HQD. The empirical results showed S&T's vital role in promoting urban HQD in Guangdong province. Cities were classified into three categories regarding their HQD performance (i.e., cities in a quality optimisation stage, cities in a quality improvement stage and cities in a quality lagging stage). Meanwhile, the estimated results showed that HQD levels in Guangdong province were extremely uncoordinated.

Wei & Li (2018) built an assessment system to measure China's HQD and further analysed its spatial distribution characteristics by performing the entropy-weighted technique for order preference by similarity to the ideal solution (TOPSIS) method. Their assessment system included ten aspects[28] and 53 third-class indicators. The empirical findings revealed that HQD presented a regional distribution pattern of "east strong, middle ordinary and west weak". Subsequently, China's 30 provinces were categorised into three types according to their HQD performance: celebrity, mediocre, and backwards.

Du et al. (2020) investigated resource dependence's direct and indirect effects on China's HQD by adopting structural equation modelling. Specifically, the study selected

[28] Where the ten aspects are as follows: optimisation of economic structure, innovation-driven development, efficient resource allocation, the perfection of the market mechanism, stability of economic growth, regional coordination and sharing, high quality of products and services, improvement of infrastructure, construction of ecological civilisation, as well as people's receiving benefits from economic development.

39 third-class indicators to construct an evaluation system from five aspects: innovation-driven, economic coordination, green development, openness and achievement sharing. The estimated results showed that the HQD levels of Beijing, Tianjin and Shanghai were significantly higher than in other provinces over 11 years (the research period of the study was 2007-2017). Moreover, the HQD level of the central and western provinces was in a backward position compared with the eastern provinces.

Based on the new development concept, Sun et al. (2020) analysed China's provincial HQD in 2017. Empirical evidence showed that the economic development of Beijing, Shanghai, Zhejiang, Guangdong, Jiangsu, and Shandong Provinces was high quality at the provincial level. At the regional level, HQD performance in the eastern region is better than in the central and western regions. In comparison, HQD performance in the southern region was better than in the northern region. At the level of sub-indicators, China's HQD had advantages in innovation, coordination and green dimensions, but it had shortcomings in the open and sharing dimensions.

As for spatial analysis, Lu et al. (2019) built an assessment system from four aspects: high-quality economic growth, high-quality innovation and development, high-quality ecological civilisation and high-quality livelihood development. The combined weighted PCA method was used to analyse the provincial HQD levels in China from 2013 to 2017. Empirical evidence showed that regional HQD performance presented a significant spatial aggregation effect, creating a distribution pattern of "east high", "middle flow" and "west flow".

Secondly, scholars have also carried out empirical analyses from regional perspectives.

Zhou & Wu (2018) constructed an assessment system to study the inclusive green growth level, change trend, regional difference and convergence characteristics of 30 provinces and three regions in China, spanning 2000 to 2015. The empirical findings showed that the green growth level of China's provinces and three major regions exhibited an upward trend, with significant regional differences but narrowing year by year. Second, convergence analysis showed China's inclusive green economic development exhibited significant convergence characteristics in the three major regions. Specifically, the convergence speed in the western regions was faster than in the eastern and central regions, implying that the disparity of green economic development across the three major regions has gradually narrowed.

Miao & Feng (2020) selected data from 31 provinces and constructed a regional HQD assessment system with three dimensions: convergence element level, industrial level, and social level. The empirical findings showed that HQD performance among regions was extremely unbalanced, while the HQD level in various regions gradually weakened from east to west. The study further highlighted that China should benchmark the leading regions, exert regional advantages and improve the quality of innovation elements, thereby promoting HQD.

Jin (2019) proposed that the sustainable development of the Yellow River Basin played a vital role in economic and social development and ecological security in China. It is strategically significant to deal with the relationship between ecological protection and HQD in the Yellow River Basin (Ren & Zhang, 2019). To facilitate HQD of the Yellow River Basin, Xu et al. (2020) established an assessment index system for a scientific assessment of such a development by adopting nine provinces in the Yellow River Basin from 2008 to 2017. The assessment system was built on two aspects of economic and social development and ecological development, incorporating five dimensions (i.e., economic development, innovation, improvement of people's livelihood, environmental conditions and ecological conditions), and the entropy method was used in the calculation. The empirical evidence showed that HQD levels in the Yellow River Basin had formed a spatial distribution of "high on both sides and low in the central area". Still, the development disparity was decreasing year by year. In contrast, the overall HQD level of the basin has exhibited an upward trend, with small fluctuations during 2008-2010 and a significant increase from 2011.

Finally, scholars have also conducted empirical analyses from a national (or world) perspective.

Following the methodology designed by Mlachila et al. (2014), Shi & Ren (2018) calculated China's HQD index based on economic growth fundamentals and social achievements. The results illustrated that China's HQD level increased from 1992 to 2016 and experienced four whole cycles from 1992 to 2014. Furthermore, a new round of cyclical fluctuations has been observed since 2015. Moreover, China's provincial HQD fluctuation cycle has been widening gradually in recent years. The study also predicted that China's average HQD index value would rise from 0.49 in 2016 to 0.55 in 2020, and Shanghai, with the highest value, would exceed 0.85.

Based on the "Five new development concepts," Shi & Li (2019) built an assessment system incorporating 62 indicators. Their empirical results showed that the unreasonable industrial structure of the manufacturing industry had inhibited HQD improvement in China. Still, the study suggested that China needed to improve green TFP through the channel of TI.

Taking 99 countries as an example, Liu et al. (2017) established an HQD assessment system based on the "Five new development concepts" from 2001 to 2017.

The empirical findings showed that HQD performance was unbalanced across various countries. Moreover, the HQD level of developed countries was significantly better than that of developing countries. China's HQD performance was relatively optimal compared with other countries, but the level of coordinated and green development was relatively poor.

While current studies focusing on the determinants of HQD have been relatively scant. However, scholars also have shared their wisdom in conducting a set of empirical discussions.

For example, the digital economy boom has brought about new growth impetus for stimulating economic development (Li et al., 2020). This situation raised the interest of Ma & Zhu (2022) to question how we should understand the digital economy's role in HQD. Employing city-level data, Ma & Zhu (2022) empirically investigated the direct and indirect effects of the digital economy on HQD (proxied by green TFP) from 2010 to 2018. The empirical findings revealed that the digital economy could directly promote HQD and indirectly affect HQD through the industrial structure and innovation channel.

After conducting spatial analysis, Hong et al. (2022) pointed out that; TI, institutional reform, transformation and upgrading directly and indirectly affected HQD (referred to as development effectiveness in their work).

Adopting city-level panel data spanning from 2008 to 2017, Chen et al. (2021) demonstrated that industrial structure had a significant impact on Ecological Carrying Capacity (ECC), where realising ECC plays a decisive role in China's HQD Chen et al. (2021).

Taking China's Yangtze Reviver Economic Zone as an example, Wang et al. (2021) investigated the effect of environmental pollution and green finance on high-quality energy development by adopting the SDM. Three crucial indicators are measured in their study by constructing a comprehensive assessment system. At the same time, empirical findings show that environmental pollution exerted negative direct and indirect effects on high-quality energy development. In contrast, green finance has positive and spatial spillover effects on high-quality energy development. Similarly, Yang et al. (2021) also pointed out that green finance could promote HQD by improving the ecological environment, optimising the economic structure and enhancing economic efficiency.

By adopting the propensity score matching and difference-in-difference method (PSM-DID), Wang et al. (2021) explored the role of environmental regulation on the HQD of the manufacturing industry in China's 30 provinces from 2011 to 2016. The empirical findings showed that HQD performance in the manufacturing industry was relatively low, while environmental regulation could stimulate HQD in China.

By performing a threshold analysis, Liu et al. (2021) explored the effect of marine TI on HQD in China's marine economy in selected coastal regions from 2006 to 2016. The empirical results showed that marine TI could positively impact the HQD of the marine economy only after reaching a threshold value.

Adopting the PSM-DID model, Peng et al. (2022) empirically examined whether corporate outward foreign direct investment (OFDI) promoted the HQD (proxied by TFP) of firms. At the same time, the empirical results demonstrated that OFDI significantly sustained the HQD of firms.

In conclusion, constructing multidimensional assessment systems for measuring China's HQD in the existing literature has been fruitful, emphasising that HQD is a systematic project. Thus, this study must construct a multidimensional assessment system to identify HQD status and regional heterogeneity. Second, the findings in most existing studies demonstrated that China's overall HQD level exhibited an upward trend, but unbalanced and uncoordinated development across provinces and regions was still obvious. Moreover, the HQD level in Beijing has been better than in other provinces. Regionally, the HQD level of the eastern region has been higher than the central and western regions. Third, some potential determinants affecting HQD should be fully considered when exploring the effect of ISTU on HQD, such as TI, government expenditure, etc.

Detailed information corresponding to the HQD assessment strategy is reported in Table 2.2 below:

Table 2.2: Summary Table for High-Quality Economic Development Assessment Strategy

Perspectives	Methods	Assessment aspects	Literature
Single indicator	DEA, Super-SBM model	TFP or GTFP	Jahanger (2020); Wang et al. (2019); Du et al. (2020); Shi & Li (2019)
Multidimensional assessment system	Entropy method	Five aspects: innovative development, urban and rural development, environmental protection, openness, people's livelihoods	Huang et al. (2020)
	Entropy method	Five aspects: HQD supply, HQD demand, economic efficiency, economic stability, openness	Ma et al. (2019)
	Entropy method	Three aspects: economic growth momentum, economic growth structure, economic growth outcomes	Li et al. (2021)
	PCA & Super-SBM model	Five New Development Concepts: innovation, coordination, greenness, openness, sharing	Yan et al. (2021); Shi & Ren (2018); Liu et al. (2017); Zhan & Cui (2016)
	Entropy method	Economic strength, S&T, government management, resources and environment, openness, basic infrastructure	Ye (2019)
	Structural equation modelling & Entropy method	Five aspects: innovation-driven development, economic coordination, green	Du et al. (2020)

	development, openness, and achievement sharing	
PAC	Four aspects: HQD growth, HQD innovation and development, HQD ecological civilisation, HQD livelihood development	Lu (2019)
Entropy method	Four aspects: inclusive development, changing trends, regional differences, convergence characteristics	Zhou & Wu (2018)
Entropy method	Three aspects: convergence element level, industrial level, social level	Miao & Feng (2020)
Entropy method	Three aspects (Yellow River Basin): economic development, environmental conditions, people's livelihoods	Jia (2019); Xue et al. (2020); Ren & Zhang (2019)

2.4 Industrial Structure and Economic Growth

2.4.1 The Linkage Between Structural Changes and Economic Growth

Schumpter & Nichol (1934) proposed that economic growth would lose power without structural change. However, the beginning of the fundamental study of the economic structure dates back to the first half of the 20th century and is associated with the studies of Fischer (1935), Clark (1940) and Fourasti (1954). These pioneering works have laid the theoretical foundations in the economy by developing a three-sector model (because the works were hypothesised based on the three sectors), which portrayed the evolution process of the economy from agricultural and industrial economic structures to the sphere of the service-oriented industry.

In the 1950s, in parallel research of the three-sector hypothesis, special attention to structural change as a crucial enabler of economic growth was growingly intensified. The development of such a research field was preceded by the studies of Rosenstein-

Rodan (1943) and Nurkse (1953). They pointed out the need to consider the heterogeneity of industries as a condition for balanced growth.

Subsequently, theoretical treatment regarding this issue was further addressed by the Nobel prize winner Lewis (1954) and later on by the work of Ranis & Fei (1961). According to Lewis's (1954) model, the economy in most countries was built on the agricultural and industrial sectors, while the agricultural sector was characterised by low incomes, low productivity, and prominent underemployment. Conversely, the scholar defined the industrial sector as technologically developed and with a high level of investment.

The structural adjustments and transformations that take place in the progress of countries' development have been explored, among which are the works of Chenery & Watanabe (1958), Hirschman (1958), Hoffman (1958), Kuznets (1967), Harris & Todaro (1970), Chenery & Syrquin (1975, 1980) and Ishikawa (1987). These studies highlighted the patterns of structural change, the structural features of growth and the phenomenology of economic growth.

It is worth mentioning that modern scientific studies have not diminished attention to structural adjustments and economic development transformations. The scholars (Raiser et al., 2003; Thießen & Gregory, 2005; Gryshova et al., 2019) explored the effects of structural change on national economies.

Aiming to assess the effects of deindustrialisation, explore how it affects economic growth and whether there is a need for the reindustrialisation of the country. Beg et al. (2017) selected 26 deindustrialised European Union (EU) member states (including 15 developed and ten post-communist countries) spanning from 1995 to 2012 to identify the determinants of deindustrialisation. After implementing the one-step GMM estimator approach, the study rejected the null hypothesis that deindustrialisation in post-communist economies was characterised by factors significantly different from those in developed EU countries. The study also proved that a higher trade surplus and boosted production in 15 developed EU countries significantly affected deindustrialisation. However, industrial production was the main reason for slowing down the deindustrialisation process in the 10 post-communist countries.

Based on the classical three-sectoral model, Dudzevičiūtė et al. (2014) explored the characteristics of structural change in the Lithuanian economy and made a comparison in a global context. The structural change was measured based on the intensity coefficient and the absolute structural change rate. The study revealed that the Lithuanian agricultural and industrial sectors grew slowly in the last decade, while the global economy has stepped up to a service-oriented economic structure.

Most recent studies have explored the structural changes in the economy of different countries in the context of a three-sectoral model: Teigeiro & Solís (2007), Jiang (2011), Mao & Yao (2012) and Zdrazil et al.(2016). Also, an array of scholars have analysed economic structure from the perspectives of economic activities and individual sectors (see Tanuwidjaja & Thangavelu (2007); Matsuyama (2009); Matgorata & Marcin (2009) and Cho et al. (2013)).

For example, considering the crucial role of the manufacturing industry, Rohana & Masron (2010) investigated the source of growth and structural changes in the manufacturing industry in Malaysia by employing ARDL (Autoregressive Distributed Lag) and SDA (Structural Decomposition Analysis) methods. The empirical findings proved that the export-oriented strategy was increasingly a vital factor of change in the industrial growth of the Malaysian economy. Moreover, the empirical findings from the SDA model demonstrated that the reorientation of industrialisation strategies and changes in domestic demand were two crucial reasons causing a structural change in the Malaysian economy.

Adopting the shift-share analysis, the total labour productivity of the Japanese manufacturing industry was decomposed by Tanuwidjaja & Thangavelu (2007) into two components, namely structural change across the manufacturing sector and productivity growth, to evaluate the interaction between them. Subsequently, the Japanese manufacturing industry was divided into four categories according to the technological sophistication degree. The results showed that the fundamental structural change in the late 1990s was crucial for the dramatic increase in the medium-high-technology sector.

Drawing attention to the relationship between innovative capability and the industrial structure of economies, Zdrazil et al. (2016) explored whether selected groups of EU countries exhibited similar trends in industrial structure reflected in their innovative capability. The gamma-convergence method and SHA-DE (Share-Development) model were adopted to assess the countries' innovative capability and industrial structure changes. The derived empirical results were consistent with the classic theses concerning the transformation of the national economic structure, namely the stable development of the primary industries' share, the declining share of the secondary industries and the increasing share of tertiary industries.

Based on the above analysis, this study concluded that structural change in one country's economy plays an important role in sustaining economic growth. However, the causal relationship between structural change and economic growth has not yet reached a consistent consensus. The channels linking structural change and economic growth are sophisticated, and the directional causality (whether structural change causes economic growth or vice versa). Nonetheless, neoclassical growth theory (Solow, 1956; Solow,

1957) and new growth theory (Lucas, 1988; Romer, 1986; Romer, 1990a; Aghion & Howitt, 1992; Jones, 1995; Jones, 1999) have disregarded these relationships.

Scholars have recently started exploring the causal relationship between structural change and economic growth. For example, implementing a panel data Granger-causality test, Olczyk & Kordalska (2018) examined structural change[29] and economic growth by selecting eight transition countries from 1995 to 2011. The empirical findings showed that the causality relationship between the variables above existed in regional heterogeneity. One subgroup was characterised by bilateral causality (i.e., Latvia, Estonia), another subgroup exhibited a one-directional relationship (i.e., Poland), or even no causal relationship in Hungary.

Adopting the Granger-causality test, Dietrich (2012) took seven OECD countries as an example from 1996-to 2004 to test the hypothesis of economic growth causing structural change or changes in the economic structure causing aggregate growth. The empirical results showed that aggregate growth decelerated structural change in the shorter period but accelerated it with some time lags. However, the causal effects mainly depended on measuring structural change (i.e., employment or real value-added). In contrast, structural change contributed to aggregate growth, irrespective of which measurement scheme of structural change was adopted. The conclusion that the causal relationship between structural change and economic growth existed in regional heterogeneity was also identified.

Employing panel data of China's 31 provinces from 1978 to 2008, Dong et al. (2011) examined the relationship between economic fluctuations and industrial structure disproportion using the Granger causality test. Specifically, the economic growth rate and

[29] Where the changes in gross value added and employment were selected to measure structural changes.

dynamic standard deviation were adopted to measure economic fluctuation and disproportion in the degree of China's industrial structure. The results showed that economic fluctuations caused industrial structure disproportion in the short run, while there was a long-term bidirectional causal relationship between the two variables.

The classic three-sectoral model is usually adopted to analyse structural change. Still, the causal relationship between structural change and economic growth has varied in different studies. At the same time, the main differences may lie in the economic basis, geographical locations of the selected countries, or the different indicator measurement schemes. Nonetheless, scholars have provided strong empirical evidence to demonstrate the importance of structural change in stimulating economic growth (Mcmillan & Rodrik, 2011), especially for developing countries (Szirmai, 2012), and improving TFP (Naudé et al., 2015).

Detailed information corresponding to the linkage between structural changes and economic growth is reported in Table 2.3 below:

Table 2.3: Summary Table for the Linkage Between Structural Changes and Economic Growth

Effects or Casual Effects	Purposes	Literature
Linkage	Economic growth will lose power without structural change	Schumpeter & Nichol (1934)
	The three-sector model has been widely adopted to explore the effects of structural changes	Fischer (1935); Clark (1940); Fourasti (1954)
	The heterogeneity of industries is vital for achieving balanced economic growth	Lewis (1954); Ranis & Fei (1961)
	The structural changes that take place in the progress of one country's economic development are also addressed	Chenery & Watanabe (1958); Hirschman (1958); Hoffmann (1958); Kuznets (1966); Todaro (1966); Chenery & Syrquin (1975, 1979); Ishikawa (1987)
Effect	The effects of structural changes on economic growth	Raiser et al. (2003); Grysgova et al. (2019); Beg et al. (2017); Teigeiro & Solis (2007); Mao & Yao (2012); Zdrazil et al. (2016); Tanuwidjaja & Thangavelu (2007); Matsuyama (2009); Matgorata & Marcin (2009); Cho et al. (2012)

Causal effect	The casual effect between structural changes and economic growth is also addressed	Solow (1956, 1957); Lucas (1998); Romer (1986); Aghion & Howitt (1992); Jones (1995, 1999); Olczyk & Kordalska (2018); Dietrich (2012); Dong et al. (2011)

2.4.2 The Role of Industrial Structure in the Process of Economic Growth

Scholars have continued to discuss industry's role in the world's economic growth. To better understand the mechanism between industrial structure and economic growth, this study has recapped the existing literature based on two aspects: ISU and ISR. However, the conclusions regarding the effect of ISU and ISR have varied between studies.

For example, referring to Jorgenson & Timmer (2011), services accounted for approximately three-quarters of the total value-added. Moreover, they stimulate productivity growth in Japan and the U.S. Still, Rodrik (2013) found a significant convergence in labour productivity of manufacturing industries by using both sigma-convergence and gamma-convergence tests. The results indicated that countries with a higher share of the manufacturing industry would exhibit a higher economic growth rate, designating that industry itself is a driver stimulating economic growth. Also, Rocha (2018) also pointed out that the manufacturing industry had some special properties that cannot be found in other industrial sectors. This situation again stressed the importance of ISU in economic growth.

Taking Japan as an example, Murakami (2015) examined the effects of industrial structure change[30] on urbanisation[31]. The empirical findings showed that industrialisation could attract population inflows from other prefectures. Meanwhile, prefectures with a

[30] The industrial structure was classified three categories, namely standard industrialisation (improving of the non-agricultural sectors), service industrialisation and industrial upgrading (improving specialised service-oriented sector)

[31] Correspondingly, the migration in the process of urbanisation was also categorised into two types: intra-prefectural migration and inter-prefectural migration.

higher share of manufacturing attracted many migrants from other prefectures, thereby contributing to the urbanisation process. Moreover, intra-prefectural migration became active in prefectures where ISU is advanced, entering an economic stagnation stage.

The vital role of the manufacturing industry in maintaining sustainable economic development was also addressed in a note by UNCTAD (2019a) (United Nations Conference on Trade and Development). The note stressed, "economic diversification and industrial transformation, towards a greater reliance on manufacturing as a share in the total output and employment of economies, have been synonymous with development". Moreover, structural transformation is a core of economic development. Countries will fail to deliver on the 2030 Agenda for Sustainable Development without enhancing their productive capacity and a shift of factor endowments to higher productivity sectors (UNCTAD, 2019b).

While scholars have concentrated more on the impacts of ISU on various issues in most recent studies, such as eco-efficiency (Han et al., 2021; Zhou et al., 2019), problems related to CO_2 emissions (Wu et al., 2021; Zheng et al., 2021), problems related to environmental regulations (Zheng et al., 2021; Yu & Wang, 2021; Du et al., 2021), OFDI (Liao et al., 2021) and so on.

Employing a panel data model with a fixed effect, Xie et al. (2019) examined the effects of marine industrial structure changes on China's marine economic growth. The empirical results showed that ISU inhibited marine economic development while ISR could promote marine economic development. The positive effect of ISTU on marine economic development could also be detected in the work of Dong (2019).

Zhu et al. (2019) held that industrial structure adjustment played an important role in promoting China's interprovincial green eco-efficiency. Subsequently, ISU and ISR denoted China's industrial structure adjustment, while the Super-efficiency SBM model was adopted to assess China's green eco-efficiency. The empirical results demonstrated that ISU and ISR positively affected green eco-efficiency, but the magnitude of the coefficient of the former was greater than the latter. This situation implies that ISU can shift economic endowments from lower to higher productivity sectors than ISR, improving green eco-efficiency.

Similarly, using the Super-efficiency DEA model, Li & Lin (2017) investigated the effects of investment-driven economic growth patterns, ISU and ISR[32] on green TFP in 30 Chinese provinces from 1997 to 2010. The empirical findings showed that ISU negatively affected energy-adjusted TFP but positively impacted energy-CO_2-adjusted TFP. In addition, reallocating the labour force in three major industries was beneficial to enhancing green TFP. In contrast, the "structural burden" caused by manufacturing structural changes hindered green TFP.

Using panel data from 1995 to 2009, Zhou et al. (2013) explored the relationship between industrial structure transformation and CO_2 emissions in China. The results demonstrated that the first-order lag of industrial structure adjustment significantly reduced CO_2 emissions. Technical progress did not have an exhibitory effect on CO_2 emissions, but it could indirectly mitigate CO_2 emissions through the channel of industrial structure transformation.

Besides, Chen (2003) verified the long-term equilibrium relationship between China's industrial structure changes and economic growth from 1978 to 2003. Meanwhile, the study also suggested that a progressive industrial structure with secondary, tertiary

[32] Where the study adopted the shift-share analysis and structural change index to measure ISR and advancement, respectively.

and primary order was beneficial for sustaining economic growth. The same conclusion also could be found in the work of Zhou & Mei (2013).

Gan et al. (2013) developed a new method to measure China's ISR and ISU. Adopting a fixed-effect model, they examined the relationship between industrial structure and economic growth. The results proved a steady relationship between ISR and economic growth, while ISU and economic growth had an uncertain relationship. However, ISU was the main source causing China's economic fluctuations. In contrast, ISR could effectively avoid such fluctuations.

Peng et al. (2013) employed a panel VAR model to analyse the dynamic effects of industrial structure on economic growth. The empirical findings revealed that ISR had an "ironing effect" on China's economic fluctuations. Conversely, the optimisation shock of the industrial structure is the main source of economic fluctuations, contributing to approximately 18.8% of economic fluctuations. The same findings also can be detected in the work of Han et al. (2016), Zhang & Ren (2019), Che et al. (2019) and Zhang et al. (2019).

Although structural changes could positively affect energy efficiency improvement and economic growth (Timmer & Szirmai, 2000; Fan et al., 2003), the above empirical findings revealed that ISR is more beneficial for smoothing China's economic fluctuations compared with ISU.

Detailed information corresponding to the role of industrial structure in economic growth is reported in Table 2.4 below:

Table 2.4: Summary Table for Revisiting the Role of Industrial Structure in Economic Growth

Industrial structure	Effects	Literature
ISU	ISU positively affects productivity growth in Japan and the US	Jorgenson & Timmer (2011)

	There is significant convergence in labour productivity in manufacturing industries	Rodrik (2013); Rocha (2018); UNCTAD (2019a, 2019b)
	The manufacturing industry plays a pivotal role in driving economic growth	
	ISU promotes the redistribution of production factors (i.e., skilled labour), thereby accelerating urbanisation in Japan	Murakami (2015)
	Many studies focused on ISU's role based on specific subjects, such as; eco-efficiency, carbon emissions, environmental protection, OFDI, etc.	Han et al. (2021); Zhou et al. (2019); Wu et al. (2021); Zhang et al. (2021); Yu & Wang (2021); Du et al. (2021); Liao et al. (2021)
ISR	Compared with ISU, the effect of ISR on economic growth is more significant	Xie et al. (2019); Dong (2019); Zhu et al. (2019); Li & Lin (2017); Zhou et al. (2013); Gan et al. (2013); Peng et al. (2013); Che et al. (2019); Zhang et al. (2019).

2.5 Research Gaps

Several research gaps must be addressed based on the literature review.

First, the existing literature's selection of assessment indicators assessing HQD has subjectivity. Still, some works' classifications of the selected indicators have not been reasonable. For example, Du et al. (2020) constructed an assessment system based on five aspects incorporating 29 third-class indicators to measure China's HQD. Specifically, the study categorised the proportion of cultivated land area as green development. However, China's 2020 Central Economic Work Conference stressed that "we must maintain the warning line for the preservation of 18-billion-mu arable land", meaning that the purpose of arable land preservation is to ensure the food supply and meet people's life needs ultimately. Therefore, such an indicator needs to be classified as sharing development.

Second, although most studies have explored the impacts of structural change on economic growth (proxied by GDP or industry value-added, etc.), the existing economic literature has not yet explored the correlation between ISTU and China's HQD. Compared with ISU, current studies have paid less attention to ISR. Therefore, this study sheds new evidence to demonstrate the promoting effect of ISTU (i.e., ISU, ISR and IS) on China's HQD.

Third, current studies have only selected the ratio of capital to labour (Cole & Elliott, 2003; Antweiler et al., 2001; He & Wang, 2012) or the share of the manufacturing industry to the GDP (Auty et al., 1997; Cole, 2000) to evaluate the industrial structure. However, these measures only scratch the surface of the problems and do not reflect the dynamics of industrial structural evolution characteristics, thus, resulting in biased estimations. Still, no studies have focused on the assessment of IS.

2.6 Chapter Summary

First, the concept of HQD has varied in different studies because scholars have interpreted the HQD concept from different perspectives. Nonetheless, HQD is a systematic project and has become a guiding ideology in China's key area of economic construction and social change.

Second, the rich connotation of HQD entails the necessity of constructing a multidimensional assessment system to evaluate China's HQD.

Third, referring to Lin & Justin (2011), economic literature has devoted much attention to exploring TI but neglected one crucial aspect: the analysis of structural change and its corollary, ISU. It is worth mentioning that their study strongly facilitated the present research. This situation is because, on the one hand, TI is absolutely important for sustaining economic growth, but structural change as an engine also should be fully considered (see Rocha (2018)). On the other hand, their study emphasised ISU but neglected ISR (of course, this is a common issue in the current literature). Moreover, Zhou (1992) was one of the first to describe industrial structure theory systematically and then classified industrial structure into two aspects: ISU and ISR, which scholars have widely cited (Wang et al., 2019; Albala-Bertrand, 2016; Mbate, 2017) to carry out different research topics.

So far, scholars have not yet reached a consistent consensus on the role of ISU and ISR in economic growth (or TFP improvement). It is believable that vigorously upgrading industrial structure will accelerate factor endowments shift from lower to higher productivity sectors, thus, fostering economic growth. At the same time, balanced development among the three major industries is also crucial because rationalising industrial structure could balance economic resources redistribution, thus, smoothening China's economic fluctuations ("ironing effect"). Meanwhile, Gryshova et al. (2020) pointed out that countries with a progressive industrial structure (where the terminology progressive means the reasonable industrial structure) could promote sustainable economic development and improve people's living standards. Albeit with ISU and ISR, to the best of the present study's author's knowledge, no studies have focused on the role of IS on China's HQD.

According to Zhang (2015), industrial structure adjustment mainly refers to the proportional changes among three major industries, showing the dynamic process of one country's industrial structure evolution. More specifically, ISTU in this study includes two crucial components. One refers to the speed of industrial structural changes, namely upgrading the industrial structure. This indicator reveals the evolutionary process from labour-intensive to knowledge-intensive and technology-intensive industries. The other regulates the composition of industrial structure, namely the rationalisation of industrial structure. This indicator reveals the extent to which resources are allocated effectively, and it mainly reflects the synergy effect or coupling degree between industries (Liang et al., 2021).

CHAPTER 3: CONCEPTUAL FRAMEWORK FOR HIGH-QUALITY ECONOMIC DEVELOPMENT

3.1 Introduction

As discussed in Chapter 2, research gaps exist in HQD assessment and the impact of ISTU on HQD. This chapter provides the theoretical justification for assessing HQD through; innovative development, coordinative development, green development, open development and sharing development. This situation lays the foundations for constructing a multidimensional HQD assessment system.

3.2 Theoretical Framework for High-Quality Economic Development

Figure 3.1 displays the notion of HQD where various subsystems have been considered in this study, including; innovative development, coordinative development, green development, open development and sharing development. The next section discusses how the abovementioned components could be applied to assess HQD comprehensively.

Figure 3.1: Crucial Components of HQD
Source: The 19th National CPC Congress Report

3.2.1 Innovative development

Innovation has been the first driving force to facilitate China's economic development to shift into HQD (Wang & Tian, 2021). Schumpeter's classical endogenous growth theory, stemming from growth theory, describes how economic growth has been facilitated by mechanisms shaped by innovative activity, known as 'creative destruction. This situation goes beyond the mechanisms of economic growth portrayed by Solow's exogenous theory of technological progress and objectively captures the essence of economic growth. Endogenous growth theories suggest a strong causal relationship between technological progress and economic growth (Romer, 1994; Grossman and Herman, 1994; Lucas, 1998). Since the development of these theories, combined with sound econometrics, empirical studies have mushroomed to investigate the specific impacts of TI on economic development (Silva et al., 2017; Shin et al., 2019; Chege & Wang, 2020).

First, the concept of 'learning by doing' (LD), proposed by Arrow (1962), has shown that material capital and production accumulation improved labour productivity. Since then, many scholars have begun to analyse the impact of LD. For example, Rosenberg (1976) stated that LD resulted from the accumulation of operational knowledge and production capacity, which originates from repeated operations in the production process. Young (1993) first attempted to integrate LD and invention models and pointed out that independent invention as new technology was brought about by R&D activities. In contrast, LD was a process whereby technical progress was created as a fortunate by-product in the goods production process caused by the learning experience.

More specifically, the accumulation of knowledge results from mechanisation to a great extent because each new machine can optimise the production environment so that learning and innovation receive continuous stimuli. In adopting a new device or equipment, new forms of production organisation and/or the search for new ideas change the internal structure of its components. Hence, a higher level of mechanisation and an increase in the stock of knowledge are two vital forces during the capital formation process. Therefore, the AK model states the output is a linear function of capital. Thus, as capital increases, the output level will also increase linearly. Therefore, technical progress can generally be considered as the corresponding experience accumulation.

As an endogenous element of technical progress, LD has also aroused broad interest concerning its effect on other related economic factors. For example, taking paired type production and single type production, Kellogg (2011) explored the impact of LD on production efficiency and proved that the experience accumulation of the Producer-Driller Pair exhibited a greater promoting effect on productivity than the experience accumulation of drilling alone or production. Managi et al. (2004) examined the relative importance of LD, technical innovation and technological diffusion and stressed that the effects of TI and LD on TFP were greater than technical innovation. Taking LD as a primary source of technical progress, Usman & Batabyal (2014) investigated the effect of LD on the balanced growth path of the regional economy from two main perspectives: material capital and innovation capital.

Second, industrial development has undergone four major technological revolutions, represented by the adjustment of industrial production patterns since the 1860s. Specifically, the first industrial technology revolution (ITR) accelerated the development of the mechanised textile industry. This development gradually affected the mechanisation of the mining, transportation, and metallurgical industries. Subsequently, in the second ITR, the re-articulation of relevant industrial structures, especially heavy industry, was boosted by developments in electrical technology, which opened up the new electricity era. The popularisation of computers further promoted the third information technology revolution and improved the innovative capability of other high-tech industrial sectors centred on biotechnology. The wide implementation of Internet technology has promoted the future ISTU through the intelligence channel. Artificial intelligence, information technology and electrical technology change the production structures and patterns. This result has been mainly observed in adopting new technologies to cultivate new production models and develop high-end products that can enhance labour productivity and expand production scale.

Third, looking at global practices, the global economy is in a new era of digital economic transformation; it represents the rapid revolution of the emerging industries that rely on high-tech digital technology, which has dramatically expanded globally. Being different from the conventional economy, data as a new crucial engine of the digital economy (Cong et al., 2021) has spawned new economic forms, bringing considerable changes in modes of governance and production. It is characterised by "green" development, such as lower resource consumption, lower marginal costs (Murthy et al., 2021), and less environmental deterioration, consistent with the ideology of new development (Abukhader, 2008).

Unsurprisingly, exceptional development and availability of digital technologies could help reduce environmental issues, thus creating a strong new endogenous impetus (Lange et al., 2020) for stimulating HQD in China. More specifically, the representative characteristics of the digital economy, such as platformisation, permeability and sharing, can effectively empower traditional industries represented by high energy consumption and high pollution emissions to enhance resource utilisation efficiency and facilitate deep integration with low-carbon and sustainable development (Nambisan et al., 2017).

With the evolution of the current industrial sector from inter-industry to intra-industry to intra-production specialisation, industrial competition remarkably lies in the value chain (Yu & Zhang, 2015). However, the low-end locking status has determined

China's fate as a major resource consumer. At the same time, the conventional economic development model has limited China's integration in the GVC (Global Value Chain). As depicted in Figure 3.2, the share of domestic value-added exports and China benefited 70% from its exports, which is substantially below the US (89%), Russia (91%), India (90%), Japan (82%), Australia (87%), and Brazil (87%). The features of the Chinese economy are a high share of trade in exports with weak distinctiveness in the global division of labour and low value-added products or services.

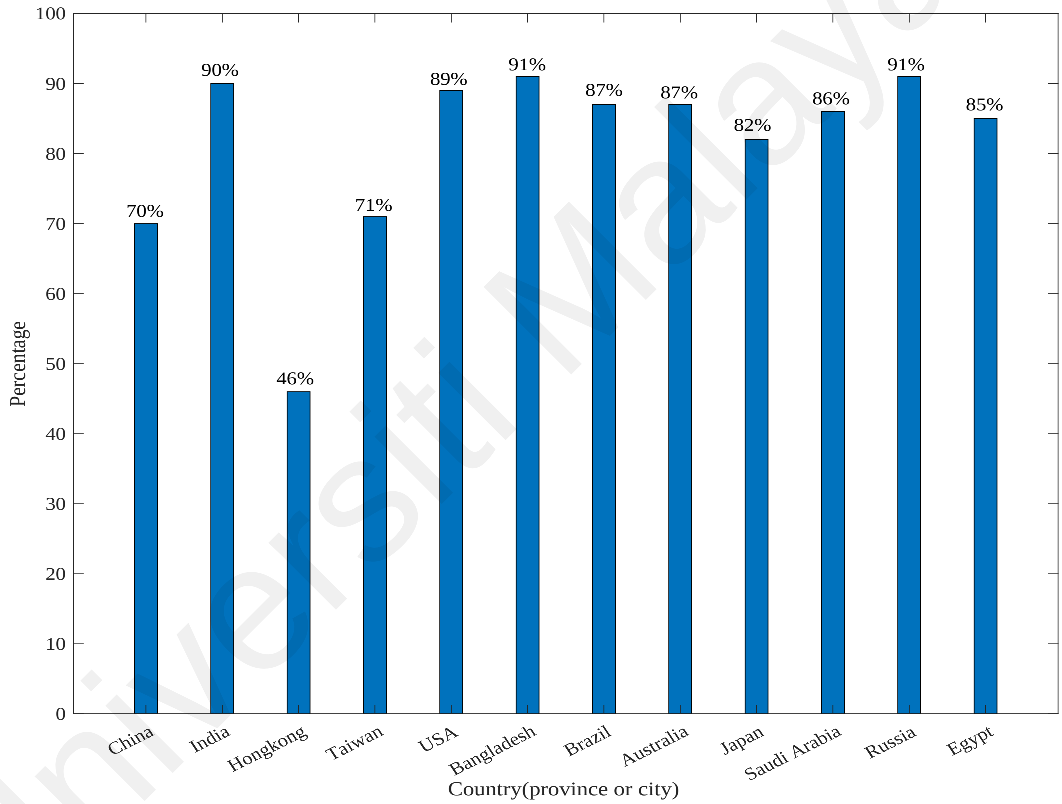

Figure 3.2: Share of Domestic Value-Added Exports
Source: United Nations on Trade and Development Database (2020)

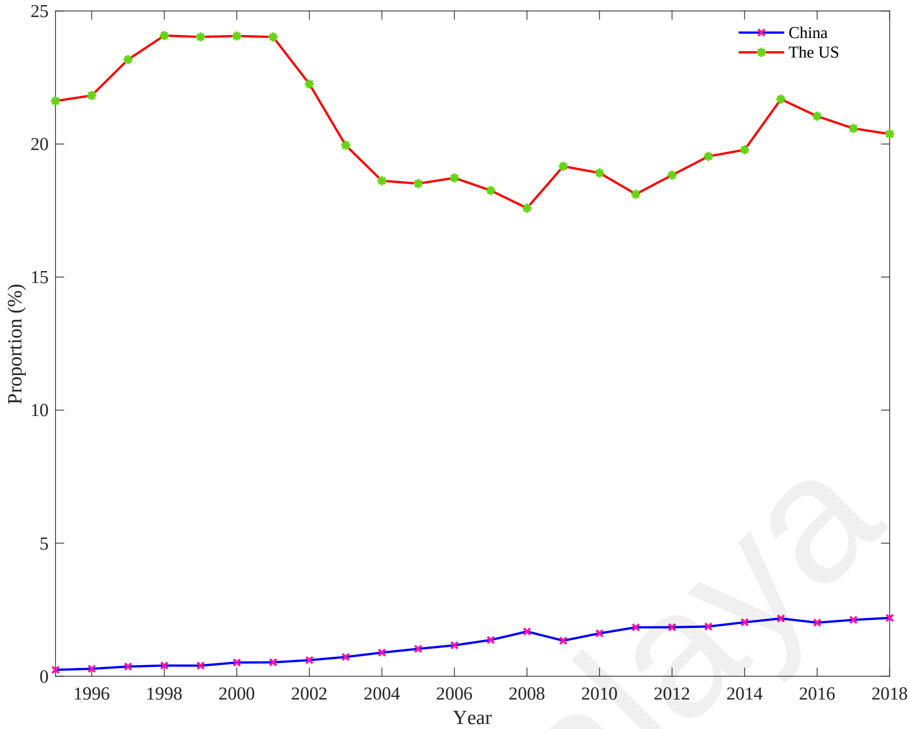

Figure 3.3: Share of Trade in Value-Added Exports in the US and China
Source: United Nations Trade and Development Database (2020)

Although Figure 3.3 shows the share of trade in value-added exports in China presents an upward trend from 1995 to 2018, the value-added exports in China have lower domestic content than in the US. Therefore, this study concluded that China's performance at the low end of the value chain was epitomised by its extensive development model. To effectively deal with this issue, China can imitate the development patterns of developed countries by introducing advanced technology. This outcome is because the cost of imitation that relies on imported technology is much lower than that of developing new technologies. To this end, China can take advantage of this gap to carry out rapid technological changes. The faster the technological change, the higher the return on capital accumulation rate will be, and the swifter the industrial structure will change. Therefore, China's economic growth will grow faster than in other developed countries. Imitating the advanced technology from developed countries can accelerate economic growth in developing and underdeveloped countries in a shorter period. However, the core for improving economic quality, especially in the crucial transition period, should be cultivating China's independent innovation capability

Nonetheless, referring to Tang et al. (2014), technical progress results from TI or technology introduction and is reflected through the promotion of the TFP. This study constructed a "output-oriented boundary and efficiency curve" and a "input-oriented boundary and efficiency curve" to illustrate the essential role of technical progress in the TFP improvement[33] process.

Figure 3.4 displays the output-oriented boundary and efficiency curves. This study assumed that the TFC (technology frontier curve) was fixed in the same period because its performance depended on the country's technological development level from the output perspective. The TFC in period t was better than in period s, implying that the output in period t was greater than in period s given the same factor inputs. For example, assuming the factor input is X_t. The output at point B will be better than that at point C. As for the same TFC, for example, the ideal output in period $s(F_s)$ is b given the input X_s, which the TFC determines in a certain period. Unfortunately, the actual output of an economy fails to reach point b but reaches point c, which is caused by the efficiency problem. The closer to point b, the higher the efficiency (the analysis in period t is the same).

[33] The most important reasons for this study to illustrate the pivotal role of technical progress from the perspective of TFP improvement were twofold: First, as discussed in Chapter 2, TFP has widely adopted to assess China's HQD performance. Second, albite with whether the estimation is correct or not, Saleem et al. (2019) it affects economic growth through TFP.

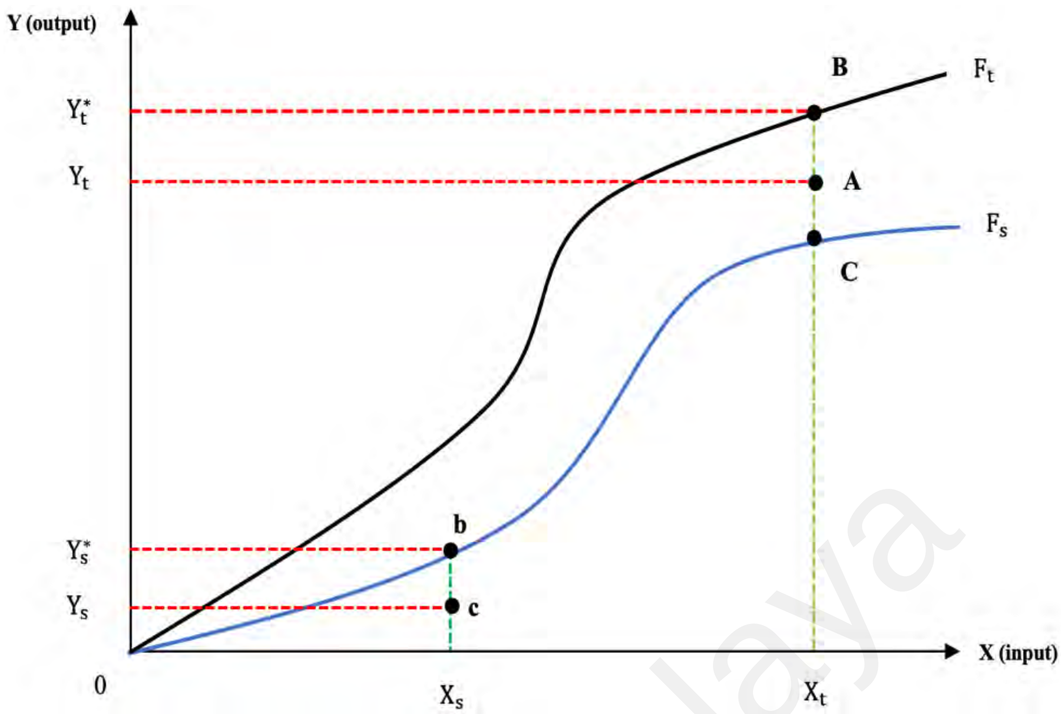

Figure 3.4: Output-Oriented Boundary and Efficiency Curve
Source: Computed by the Author

Figure 3.5 displays the input-oriented boundary curve. Similarly, the TFC is also fixed in the same period from the input perspective. Under the same input, the output in period t (F_2) is higher than that of period s (F_1). For instance, assuming that the factor input is X_t^*, the output at point C is better than that at point B. As for the same TFC, for example, for F_1, the output of point B is higher than that at point c, assuming that the input increases from X_s^* to X_t^*. However, if the factor input is increased from X_s^* to X_s, the output will be constant, that is, $output_a = output_c$. Due to the limitation of technical progress, excessive input will cause overcapacity and inefficient supply issues.

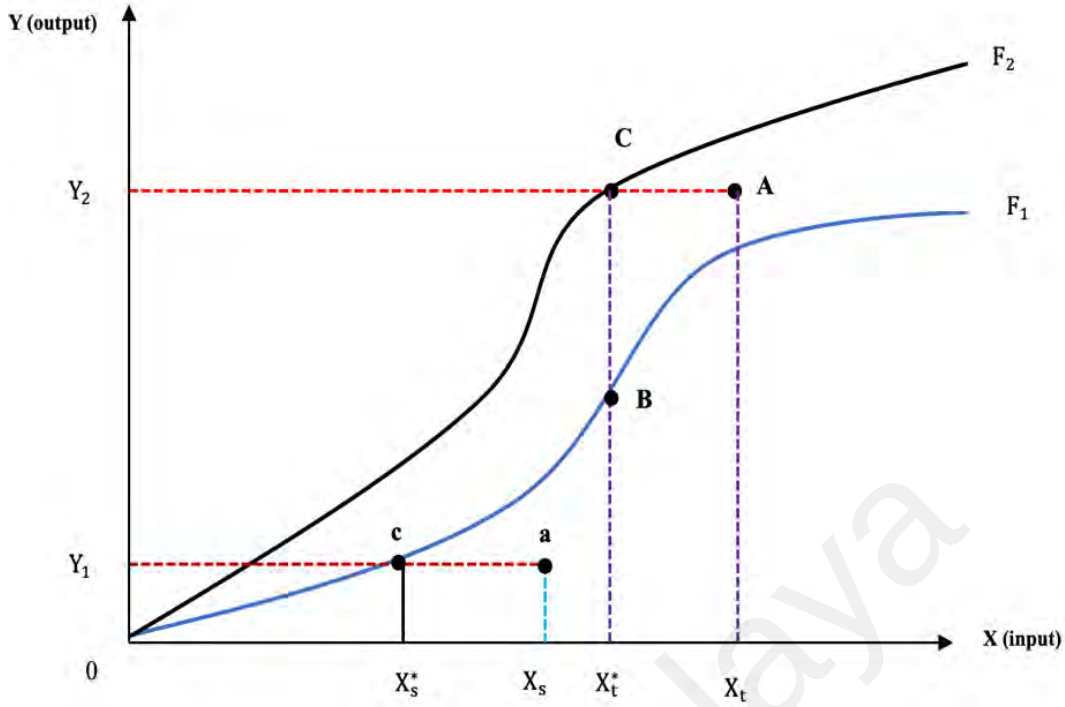

Figure 3.5: Input-Oriented Boundary and Efficiency Curve
Source: Computed by the Author

Based on the above analysis, it is believable that the limitation of technological progress could inhibit economic efficiency improvement despite excessive factor inputs. Subsequently, two implicit impacts can be derived. First, the overcapacity issue will be raised because of the restriction of technological capacity. Consequently, economic resources cannot be effectively channelled into industrial sectors with higher productivity, thereby curbing TFP improvement. Second, enterprises that are good at taking the lead in strengthening technological capability will provide high-end products to better meet people's high-quality demands in both domestic and international markets. Thus, their competitiveness will be strengthened, and their profits will be maximised, refining the survival of the fittest mechanism.

With the advent of the "Industry 4.0" era characterised by intelligent manufacturing, the development of industrial manufacturing and economic growth have increasingly become inseparable from technological progress (Song et al., 2022). TI's role in the ISTU process is quite important (see, for example, Wu & Liu, 2021; Zameer et al., 2020; Zheng et al., 2021). Conclusively, the core of innovative development in the process of ISTU is to; solve the problems existing in the production field, adjust the unreasonable industrial structure, improve the quality of products (services), and realise the transformation from labour & investment-driven development to innovation-driven development, which is mainly reflected in the traditional industrial sectors and heavy industries. The traditional industrial sectors will achieve transformation and optimisation by learning and accumulating professional knowledge and cooperating with universities and research institutions. In the long run, ISTU will force relevant industrial sectors to adopt advanced technology and encourage them to conduct R&D activities, which will help resolve overcapacity and ineffective supply issues, thereby contributing to HQD ultimately.

3.2.2 Coordinative Development

This study addressed coordinative development in realising HQD from an urban-rural income disparity (URID) perspective. The crucial reasons were twofold. First, distinct from other developing countries, the Chinese urban-rural dual structure has been institutionalised through laws and regulations and has become a rural-urban dual structure system. Second, as mentioned by scholars, increasing income disparity could dampen long-term economic growth or even trigger political upheaval and social instability (see, for example, Alesina & Perotti (1996); Lee et al. (2019)). Moreover, excessive URID will aggravate social inequality and curb the HQD of China's economy (Zhao et al., 2022). Thus, seeking balanced development between urban and rural regions and mitigating URID should play a crucial role in China's HQD. While three crucial theories could be useful to help explain URID in China.

First, Kuznets' (1995) theory of development stages mentioned income distribution in urbanisation. The underlying assumption behind this theory was that urban incomes are relatively higher and less equally distributed than rural ones. More specifically, the shift of urban demographics increases income disparity in the earlier economic development stage as many people seek job opportunities with higher incomes. Beyond the turning point, income disparity decreases as more people earn higher urban incomes (Acemoglu & Robinson, 2002). Thus, an inverted "U-shaped" trend is identified. The URID will increase, reach a peak, and then decrease during urbanisation and economic development. It is worth mentioning that the Kuznets Curve portrays the urbanisation-income disparity nexus. Still, it does not consider other related socioeconomic factors that could facilitate urbanisation. Besides, the relationship discussed above is also mixed in the context of China's economic development (see, for example, Wang et al. (2019), Li et al. (2014) and Su et al. (2015)). The assumption of unlimited labour supply is hard to satisfy in China because a labour shortage still exists in some rural regions. Thus, the roads of urbanisation narrowing URID in China may differ from those in developed economies.

Second, the dual economic structure model proposed by Lewis (1954), focusing on the key economic determinants that influence urban-rural income, has been the foundation of regional economic theory. Based on the model, productivity difference has been the fundamental reason causing URID. At the same time, an increase in rural productivity has a dual influence on URID. One regulates that the substantial improvement of rural productivity and primary outputs will raise the income levels of rural residents. Another regulates that the rural labour surplus caused by rural labour productivity improvement will force farmers to pursue off-farm job opportunities in higher-income urban regions (Wang et al., 2019a). Both these impacts are expected to narrow URID. In the meantime, increasing urban productivity could bring two contrary effects. On the one hand, the dramatic enhancement of urban productivity means higher urban wages and widening income disparity. On the other hand, the wage differentials between urban and rural regions will attract surplus labour from rural regions, reducing income disparity.

Lewis's two-sector dualism model illustrates the process of urban development and industrialisation as the shift of surplus labour in the rural labour force from traditional agricultural sectors characterised by low labour productivity levels to urban industrial sectors, with relatively high labour productivity.

However, such a classical dualism model is no longer suitable for China. Referring to NBSC (2016)[34], China's labour force increased by 373 million between 1978 and 2019, while the growth of the rural working population exhibited an inverted "U-shaped" trend, which increased from around 306 million in 1978 to approximately 490 million in 1998 and then dropped to less than 400 million in 2012. Figure 3.6 displays the distribution of China's labour employment from 1998 to 2019. It can be seen that labour participation in agricultural sectors dropped dramatically, from 76.3% in 1978 to around 42.9% in 2019, while the working participants in non-agricultural sectors displayed an upward trend. Urban employment exhibited steady growth from 23.7% in 1978 to slightly more than 57% in 2019.

Moreover, approximately 80 to 150 million workers cannot be effectively employed (Kwan et al., 2013). Thus, the Chinese rural economy can be regarded as a surplus worker economy. However, the arable land in China comprises just 134.89 hectares (NBSC 2019)[35]. It is, therefore, hard to provide enough farm job opportunities for those surplus workers. Subsequently, the high man-land proportion has spurred workers to look for alternative jobs in urban areas. Chinese policies and institutional

[34] See http://www.stats.gov.cn/.
[35] See http://www.stats.gov.cn/.

constraints have distorted the country's labour market. Consequently, progress towards free labour mobility and a developed labour market has been sluggish.

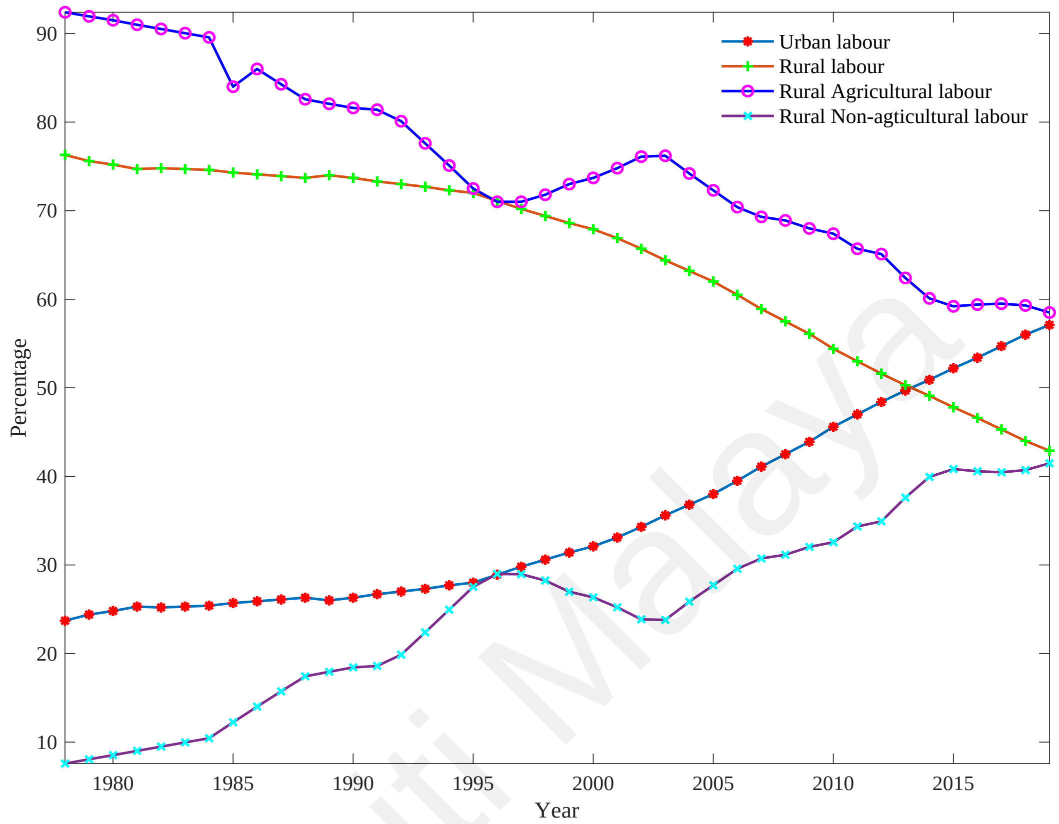

Figure 3.6: China's Distribution of Labour Employment, 1978-2019
Source: National Bureau of Statistics of China (1979-2020)

In this regard, a novel three-sector model considering the labour from non-agricultural sectors proposed by Kwan et al. (2018) based on the classical two-sector dualism model can be seen as a good extension for addressing the importance of the structural change of labour employment in the process of TFP enhancement. Their theoretical analysis showed that aggregate TFP could be decomposed into three crucial components. One was the sum of the weighted TFP from each sector. The second was the change in the share of labour employment between rural and urban non-agricultural sectors. And the last was the structural change adjusted by the propensity to transfer (i.e., labour moves from rural agricultural to urban non-agricultural sectors). The last part could capture the growth dividend associated with marginal labour productivity and wage differentials across three sectors.

Based on the theoretical results, it can be inferred that China's dramatic industrial revolution could absorb labour surplus from rural to urban areas because of the expected wage differentials across various industrial sectors. The redistribution of the labour force could facilitate the urbanisation process. At the same time, the urbanisation process at a reasonable speed is a crucial driver for combating China's URID (Yao & Jiang, 2021).

Third, the last important theory related to this study is the urban-bias theory formulated by Lipton (1997) and later formalised by Bates (1981) and Lipton (1993). The core of this theory is that urban-biased strategies and policies promulgated by the governments in pursuit of urbanisation and economic growth lead to inefficiency in; resource allocation, fiscal expenditure, social welfare, education, and human capital, which is the driving force in URID. Although Krugman (1991) emphasised that geographic space was the main reason for economic agglomeration rather than the urban-biased theory, the theory suits China given its top-down urbanisation process and state-driven economic development.

The urban-biased theory points out that rural areas in most developing economies suffer inequality and discrimination in resource allocation because of institutional obstacles. In China, recent decades have also witnessed bias toward urban areas regarding fiscal expenditure and asset investment, as depicted in Figure 3.7. At the same time, such unreasonable allocations are arguably one of the crucial reasons for the widening development disparity between urban and rural regions.

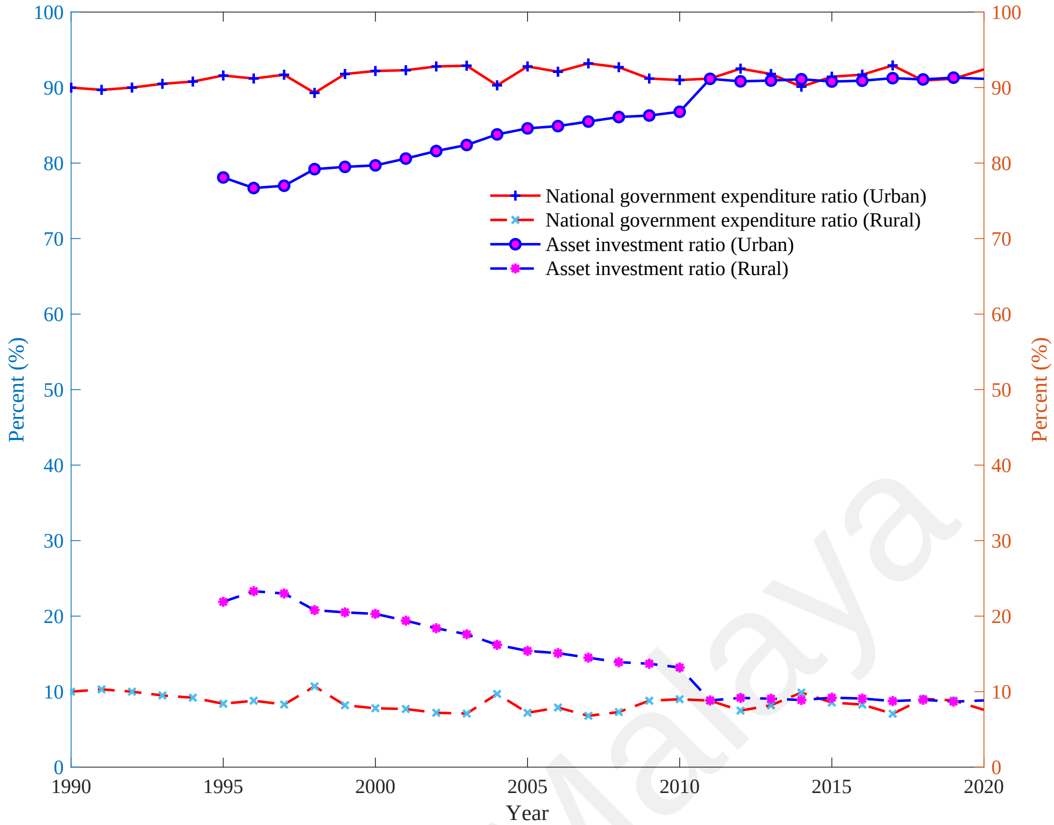

Figure 3.7: Indices Revealing Differences in Resource Allocation Between Rural and Urban Areas
Source: China Statistical Yearbook (1991-2021)

Theoretically, with the development of China's economy, the developed regions will exert positive effects on less-developed regions, generating the so-called "spillover effect". Therefore, development disparity across various provinces and regions will be eliminated. With the arrival of Lewis's turning point, the dual urban-rural economy will be gradually transformed into a unitary economy.

The "flying geese paradigm" can be regarded as an effective notion used to depict the catch-up process of China's central and western regions. The relocation of excess industrial chains from the eastern region to the west and central regions is conducive to accelerating industrial transformation and optimisation, changing the initial production layout between regions. Technological progress makes the division of labour more refined, which generates emerging industries. Emerging industries use advanced technologies to; enhance labour productivity, expand production and increase job opportunities. Industrial changes also lead to the redistribution of human capital and other resources among regions. As a result, the quality of economic development in less developed regions will gradually improve, facilitating the catch-up process.

3.2.3 Green Development

It is undeniable that rapid economic development has led to environmental damage that severely affects human health. Governments and policymakers have concentrated increasing attention on enacting effective policies and regulations to sustain economic development and protect the environment. China has made remarkable achievements since 1978. For example, the speed of China's urbanisation has grown monotonically, increasing from 17.9% in 1978 to 63.89% in 2020 (NBSC, 2019)[36]. However, deterioration of environmental quality and increased pollutant emissions are negative side-effects of Chinese rapid economic growth (Luo et al., 2013). Air pollution (Yan et al., 2020), water scarcity (Lv et al., 2020), climate change (Tang et al., 2021) and biodiversity loss (Tan et al., 2017) are all related environmental issues. As one of the largest developing countries, China is also one of the world's largest energy consumers and CO_2 emitters. More specifically, China's total energy production increased from 627.7 million tce (tons of coal equivalents) in 1978 to 4.1 billion tce, with an annual growth rate of 6.05%. Total energy consumption increased from 571.4 million tce to 4.98 billion tce in China, with an annual growth rate of 6.97% in the same period. The Chinese central government faces major environmental deterioration and energy shortage challenges with ever-growing energy demand and consumption. However, huge energy consumption and increased pollutant emissions inevitably challenge China's sustainable economic development (Li et al., 2021). Therefore, China must identify the most effective measures to solve its environmental issues.

[36] See http://www.stats.gov.cn/.

The nexus between environmental deterioration and economic growth should be dated back to Kuznets' hypothesis. Kuznets' hypothesis proposed by Kuznets (1955) discusses the relationship between economic growth and income inequality. Specifically, income inequality will reach a maximum during earlier economic development stages. Further economic growth will decrease income inequality (see detailed information in Section 3.2.2). Kuznets' theory has been widely discussed in environmental economics. The works of Grossman & Krueger (1991) and Shafik & Bandyopadhya (1972) were the first studies to testify to the hypothesis on economic growth and emissions. Fortunately, their empirical findings were consistent with Kuznets' conclusions.

Figure 3.8 shows the EKC (Environmental Kuznets Curve) graphically. Specifically, environmental degradation increases with economic growth up to a threshold value beyond which environmental degradation tends to be improved with higher economic growth. Therefore, an "inverted-U" shaped relationship between the abovementioned variables was identified. Moreover, the EKC shows a long-term relationship between economic growth and environmental degradation.

Several influential factors are responsible for forming the EKC. Grossman & Krueger (1991) stated that economic growth affects the environment through three crucial effects: scale, composition, and technical effects. Specifically, increasing outputs require more economic factor inputs. Also, more outputs indicate more pollution emissions and waste as by-products, thereby degrading the environment. Therefore, economic growth exhibits a scale effect that negatively affects the environment (scale effect). However, economic growth also plays a positive role in environmental quality improvement. Economic structure tends to be rearticulated and changed, gradually increasing cleaner economic activities that generate less pollution (composition effect). Environmental deterioration tends to increase with economic structure changes from agricultural to industrial or rural to urban areas[37].

In contrast, the industrial structure moves towards capital-intensive and information-intensive services and industries, resulting in a gradual decline in environmental degradation (technical effect). It is hypothesised that the transition to increasing environmental quality starts after economic growth beyond the turning point plotted in Figure 3.8. Such a process could be considered a good depiction of the essence of economic development from an agrarian economy (pre-industrial stage) to a service-oriented economy (post-industrial stage) through a polluting industrial economy (industrial stage) (Arrow et al., 1995).

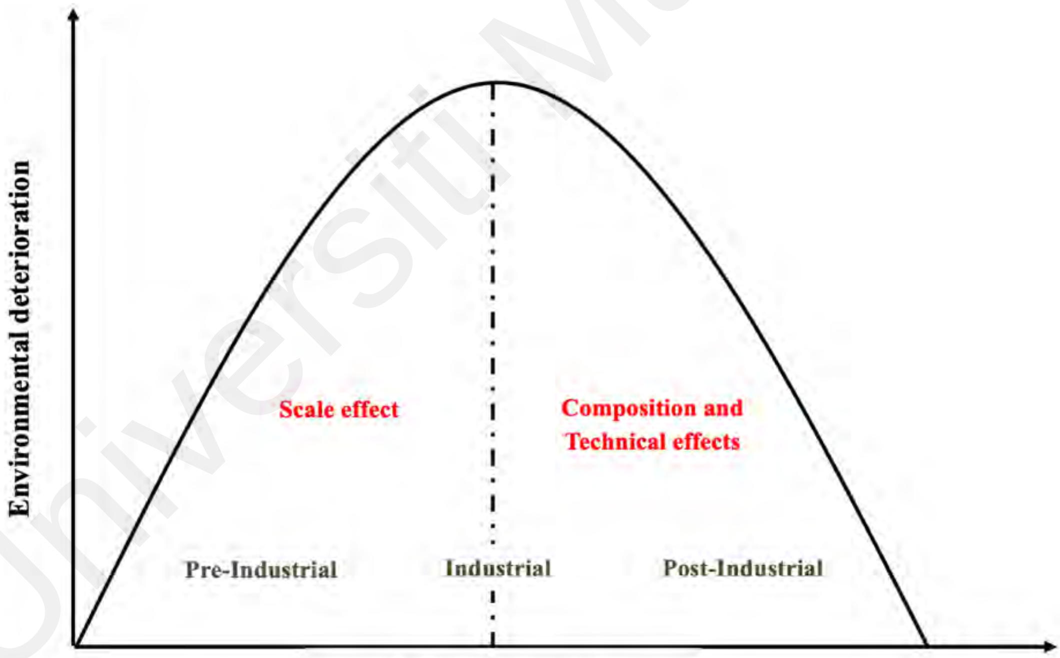

Figure 3.8: Environmental Kuznets Curve
Source: Computed by the Author

While it should be noted that government policies also play an important role in structural changes and technological advancement because they can influence the above

[37] It is feasible to stress that a fast urbanisation process is responsible for environmental deterioration. According to Mahmood et al. (2020), industrialisation and urbanisation were pertinent for economic well-being in Saudi Arabia, while their negative effects on environmental deterioration should not be neglected. Similarly, taking Pakistan as a research case, Ali et al. (2019) found that urbanisation contributed to CO_2 emissions.

processes, thereby adjusting the relationship between industrial emissions and economic growth.

Over time, as income grows, pollutants will accumulate, and people will begin to be aware of the importance of environmental protection. Therefore, other forces underlying the EKC are (1) the proportion of environmental protection expenditure in the public government budget at different development levels and (2) the people's demands for environmental amenities at different income levels. In the earlier stages of development, when poverty is widespread, tax expropriation is insufficient, and people's awareness of environmental protection is low. Therefore, few funds are used for environmental protection. In other words, environmental amenity can be regarded as an income elastic "commodity" that does not contribute to the consumer's budget before reaching high-income levels. More simply, a clean environment is a 'luxury commodity'. As development takes off, countries will move to the status of NIE (newly industrialised economy), and environmental quality will approach its lowest value because of the lagging effects of the past accumulation of industrial emissions and waste. As a higher income level is consolidated economically, people will be threatened ecologically by the negative impacts of resource depletion on people's living standards. Subsequently, social, political and economic pressures are built up, spurring relevant departments to enact environmental policies and regulations and increase public expenditure for environmental protection. The role of income elasticity and environmental quality demand is usually invoked in the studies as a major reason to discuss reducing emission levels (Beckerman, 1992; Hilton & Levinson, 1998)

Based on the above discussion, this study verified the EKC hypothesis by running the regression scatter diagram between economic growth (proxied by per capita GDP) and pollutant emissions (proxied by per capita CO_2 emissions) from 1960 to 2018.

According to Figure 3.9, the EKC hypothesis was identified only in the U.S in the selected countries. At the same time, there is a positive relationship between per capita GDP and per capita CO_2 emissions in China and Malaysia. Namely, as economic growth increased, per capita CO_2 emissions grew monotonically.

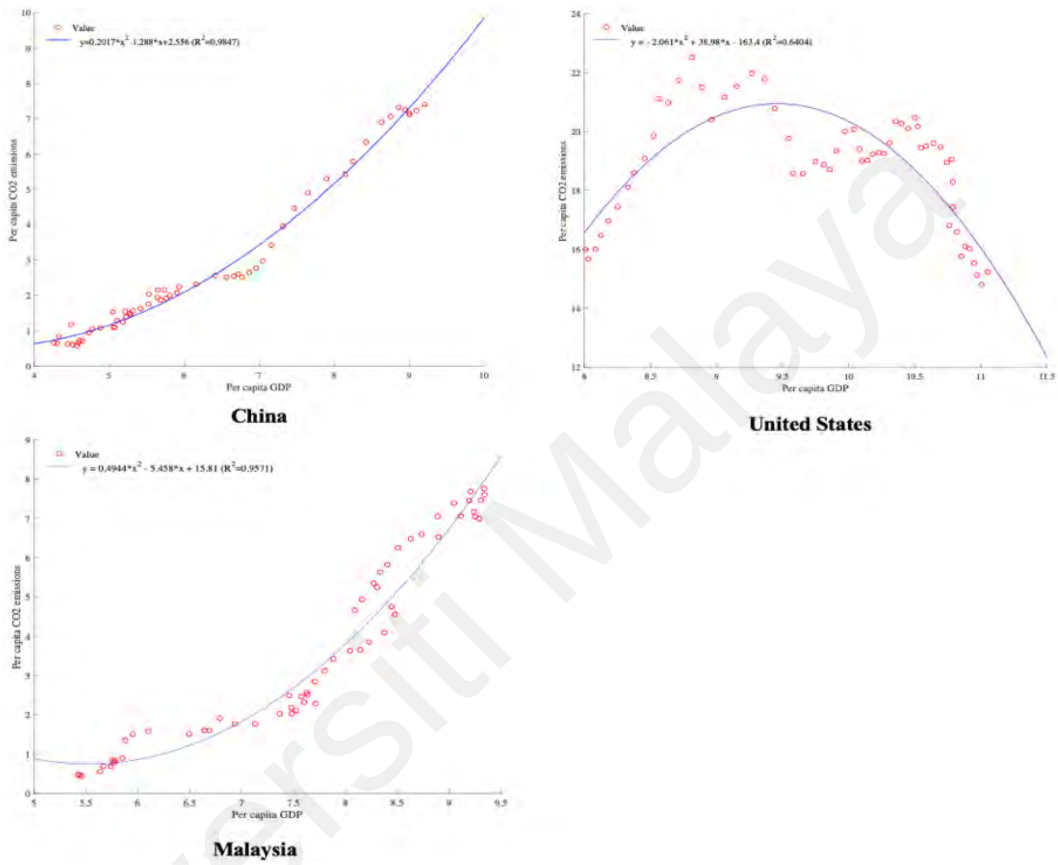

Figure 3.9: The Correlation Between Per Capita GDP and Per Capita CO_2 Emissions
Source: World Banks Database (2020)

The industrial structure plays a crucial role in reallocating factor endowments and improving energy utilisation among different industrial sectors (Chebbi, 2010). As Minihan & Wu (2012) pointed out, an appropriately designed industrial structure helps improve the utilisation efficiency of economic resources and reduces the adverse effects of economic activities on the environment. The industrial structure regulates the share of different industries in a country's economy. Although the classification standards vary between countries, the industrial structure could generally be regarded as three strata: primary, secondary and tertiary industries (Gallouj & Savona, 2009). According to the

"Industrial Classification for National Economic Activities" and the "Rules on Division of Three Strata of Industries" formalised by the NBSC (2020)[38], the primary industries regulate agriculture, forestry, fishery and animal husbandry industries (excluding services in support of agriculture, forestry, fishery and animal husbandry industries). The secondary industries include mining, quarrying, manufacturing, production and supply of electricity, heat, gas, and water. In contrast, tertiary industries include services and the circulation industry (i.e., information, transportation, the financial industries).

As discussed in Chapter 2, ISTU includes two crucial aspects: ISU and ISR. These two crucial components play different roles in environmental quality improvement. On the one hand, the emerging industrial sectors with higher-level ISU can fully use various resources by adopting technologies, maximising economic utility and decreasing waste pollution simultaneously. On the other hand, development economics emphasises the free and full flow of economic resources at multiple levels (i.e., industries and enterprises) (Hsieh & Klenow, 2007). While if resource allocation derivates from optimal levels, the speed of industrial evolution will be relatively low, and the country's industrial development will remain at a low level. Take so-called "zombie enterprises" as an example. First, "zombie enterprises" have resources that should be channelled into industrial sectors with higher productivity levels. As a result, economic resources cannot be allocated efficiently following the laws of economic operation, leading to resource misallocation. Second, the overcapacity issue could be triggered by "zombie enterprises", which are restricted by innovative capability and external financial support. Nevertheless, seeking balanced development among industries and continuously upgrading the industrial structure could help reduce pollutant emissions and facilitate energy conservation, which would benefit China's HQD.

[38] See http://www.stats.gov.cn/tjsj/.

3.2.4 Open Development

Openness brings new progress, while self-seclusion is left behind. The 19th CPC National Congress report proposed that "China will strongly develop a new pattern of all-round opening-up". At the same time, China's President Xi also pointed out that "China's door of opening-up will not close and will only become more and more open". The core of shaping a new pattern of all-around opening-up is to change (or adjust) the way of open development – that is, to cultivate a high-quality open economy. China's foreign trade, an important part of the open economy, is vital. It is an essential manifestation of stepping into the international division system, which the GVC guides. Thanks to its dramatic development, China's foreign trade has been rated the best globally. However, China's foreign trade has shifted from high-speed growth to a medium-to-high development stage because of domestic and international market challenges, especially "anti-globalisation" imposed by the world's advanced economies. This study lists three stylised facts describing situations for China to adopt the SSSR[39] in its foreign trade.

It should be noted that China's foreign trade in the former round of open development could be characterised as "low-end embedded". "Low-end embedded" entails the stylised fact that China's exports have remained concentrated in labour-intensive products. Therefore, the value-added ratio has been relatively low. Second, the structural problem has been the main reason for China's sluggish growth in foreign trade. From a global perspective, China's sluggish growth in global trade is not a unique but universal phenomenon. Short- and long-term factors have significantly impacted the slowdown of China's foreign trade development, i.e., macroscopic (or cyclical) and

[39] Although the supply-side structural reform of foreign trade was derived from the western supply school that has a sound theoretical foundation, the neoclassical theory (Say's Law) cannot be completely applied to China's foreign trade development practice. The supply school advocates stimulating input via policies, i.e., tax reductions to stabilise growth. In contrast, China's supply-side structural reform aims to adjust structure, characterised by the production layout, production efficiency, industrial nature, and international market demands, thus gradually realising application and practice in foreign trade. That is to say, China's current supply-side structural reform in the field of foreign trade is by no means directly repeating and following existing western theories. Powerful reforms should be implemented by China to gradually eliminate the improper configuration of production factors, expand effective supply, and improve the quality of products and services.

structural problems. Finally, the "re-industrialisation" strategy adopted by some countries worldwide has not followed or repeated the conventional industrial development pattern. Still, it has sought to find a new niche in the global division of labour system and become a leader in the next round of global trade development. This situation has been a great impetus for China to actively adjust and transform the structure of its foreign trade system based on the perspective of SSSR. Therefore, this study conducted discussions based on the following aspects: the connotations and measures of SSSR in foreign trade.

Firstly, the connotations of China's SSSR in foreign trade.

SSSR's connotation needs to be grasped to successfully promote the SSSR of foreign trade. As the name implies, it is the adoption and application of SSSR in foreign trade. Intuitively, it tries to answer what the country will supply to the domestic and international markets and how to achieve effective supply.

China has seized opportunities in the former round of open development brought by economic globalisation. It has also achieved tremendous development of foreign trade by vigorously integrating into the GVC. At the same time, China has become the largest trading and exporting country globally, as shown in Figure 3.10. Overall, China's total imports and exports have increased since 1990. The total volume of imports and export reached RMB 315.63 billion in 2019.

The index proxied by the proportion of imports and exports to the RGDP exhibited an upward trend since 1990, with a maximum value of 2.91% in 2007. But this index suddenly dropped to 2.19% in 2009 because of the global financial crisis, thus, forming a "V-shaped" trend. However, after China entered a new normal, this index showed a significant downward trend.

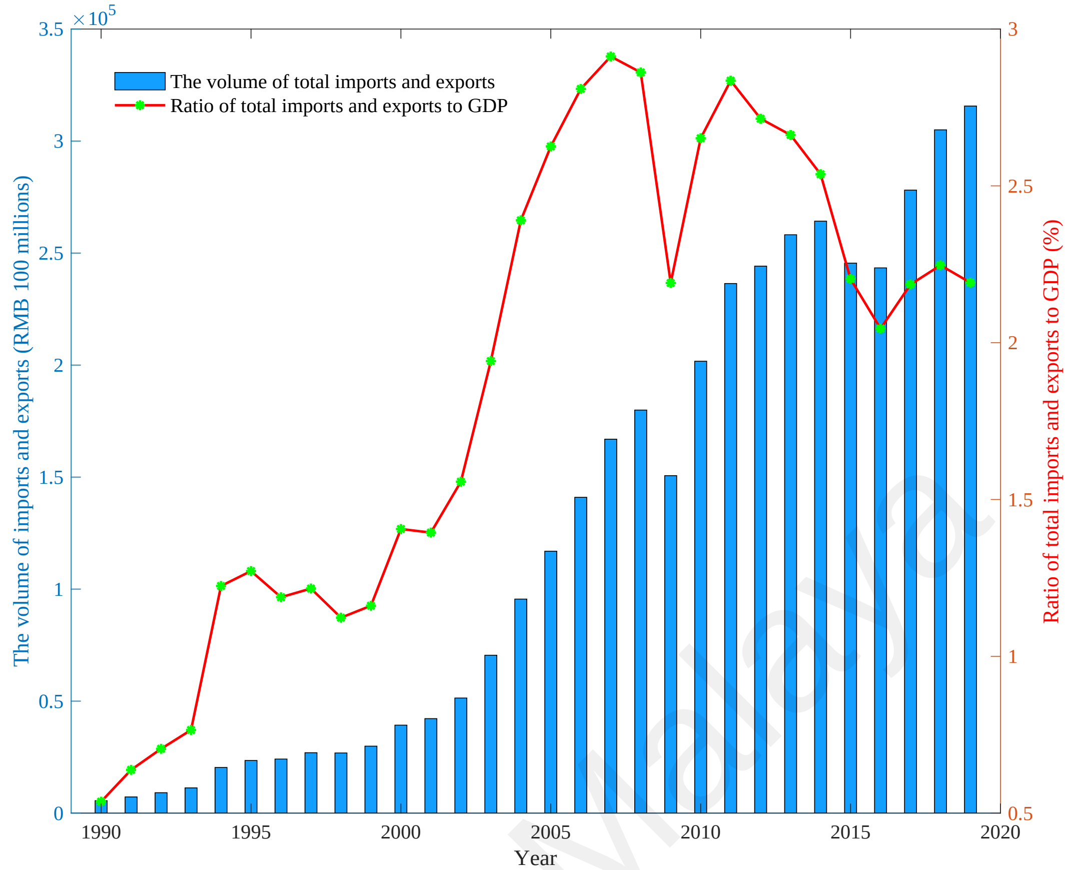

Figure 3.10: Total Volume of Imports and Exports and its Ratio to RGDP
Source: National Bureau of Statistics of China (1991-2020)

This study believes China benefited from the previous phase of global economic prosperity. Still, the dramatic growth of China's foreign trade should be attributed to the full use of its comparative advantages. However, China is still at the middle-and-low end of the GVC, and extensive development characteristics still characterise the industries. The extensive development model has given China the "world's factory" title. It is prone to cause serious overcapacity problems in the global adjustment and transformation period in which short-term and long-term factors coexist. Correspondingly, overcapacity problems will cause foreign-oriented enterprises with low profits to experience potential risks from rising debts and falling profitability. The lack of robust growth is the core of the current foreign trade development dilemma, thus inevitably curbing long-term foreign trade sustainable development in China. Based on the above analysis, the connotation of SSSR in foreign trade is to develop a new and inclusive development model through reforms and then transform labour and resource-driven development into technology-driven development. Therefore, reducing insufficient supply and increasing high-end and high-quality supply is one of the most crucial meanings of this concept.

Based on the supply-side perspective, it is worth mentioning that the SSSR of foreign trade can be implemented in both production and logistic sectors because it can change the supply pattern by deepening reforms, that is, the renovation of the structure on the supply side. The key to survival for an export-oriented enterprise largely lies in what is provided and how the products on offer cater to and satisfy people's needs in the international market. Referring to the Heterogeneous Corporate trade theory, compared with domestic enterprises, export-oriented enterprises have stronger financial capabilities and higher survival capabilities because of the high sunken costs of entering international markets. This situation indicates that it is hard for small and medium-sized enterprises to enter international markets because of capital, finance, and technological capability limitations. This outcome was also supported by the work of Fernandes et al. (2016). Specifically, large and medium-sized enterprises with a small market share usually have the greatest trade volume.

In contrast, the rankings of small and medium-sized enterprises are relatively low. Based on the perspective of the demand side, the needs of the consumers in the international market are increasingly diversified and personalised. However, diversified and personalised consumers' needs can be easily met due to the rapid development of information and communication technology (ICT). This situation applies especially with the popularisation of the "Internet +", which has helped small and medium-sized enterprises. Undoubtedly, these two factors play an important role in foreign trade development. Still, implementing these two factors in China's foreign trade development largely depends on the supply-side structural adjustment of foreign trade. Therefore, the other connotation of SSSR of foreign trade is to promote the diversification of China's foreign trade supply model while consolidating the traditional import and export model.

Secondly, the measures of implementing SSSR in China's foreign trade.

Accelerating the adjustment and transformation of foreign trade is one of the primary goals of implementing the SSSR in Chinese foreign trade. This study proposes the following points to help carry out SSSR in China's foreign trade.

More specifically, the measures are summarised as follows:

1. Advancing and adjusting the industrial structure. China's manufacturing industry developed rapidly in its earlier stages by vigorously accepting technological diffusions and transfers. However, it should be noted that the high-end manufacturing industry in China is far behind other developed countries in terms of technological capability and quality standards. One of the noteworthy directions and connotations of "restructuring the economy" (rearticulating structure and transforming motives) is advancing and rationalising the industrial structure. This outcome is because industrial sectors could be regarded as the cornerstone of foreign trade development. Given this, China needs to improve the levels of high-end manufacturing industries, putting quality improvement in the primary position. This situation involves adjusting and transforming the internal industrial structure within China's manufacturing industry. The service-oriented industry is becoming dominant in the new round of economic globalisation. Therefore, to accelerate ISTU, China should also promote the development of the service-oriented industry, especially modern productive, service-oriented industrial sectors. This situation comprises the adjustment and transformation of the inter-industrial structure.
2. Promoting the diversification of supply models. China has satisfied consumers' needs

in the international market by exporting and meeting the demands of the consumer country market with FDI. However, neither export nor FDI is characterised by "large volume". However, the rapid development of techniques (i.e., applied information technologies) has completely disrupted such a traditional "volume-scale" supply model. The reason lies in the diversification and individualisation of consumers. The above statement does not mean that a large-volume supply is no longer important. Still, it indicates that the supply model in the future must be characterised by; large volume, diversification, and decentralisation. Although large-scale plays a crucial role in ensuring low costs (because of the scale effect), China needs to find and seize new growth points to satisfy better the demands of "personalisation and diversification" based on consumer needs. Therefore, China can provide more high-end products or even lead the trend of the consumer's needs in the international market based on the perspective of the supply side.

3. Strengthening technological capability. Lacking core technologies is the main restriction in China's most industrial sectors because of the shortage of R&D funds and the limited technical support, resulting in a serious lack of brands and intellectual property. Nonetheless, enhancing innovative capability is crucial to aid "zombie enterprises" to realise self-adjustment. This result will consequently reallocate economic resources and overcome overcapacity.

It is worth mentioning that China's economic development strategy has been adjusted along with the times. It has experienced "building a long-term mechanism to expand domestic demand", "implementing the SSSR", "strengthening the domestic market" and "smoothening national economic circulation". It has also formed a new development concept of dual circulation strategy under the new situation proposed in China's 14th Five-Year Plan. The new development pattern of the dual circulation strategy starts from the interaction between supply and demand. It goes beyond a simple relationship between the two, running through and extending to all aspects of; production, distribution, circulation, and consumption. In this sense, it has an inherent relationship with SSSR yet has further expansion and more importance theoretical and practical significance.

With the continuous improvement of people's living standards, people's demands will change accordingly. Subsequently, the new requirements will follow, which will, in turn, stimulate industries to adjust and optimise their production modes and promotion strategies, thus providing high-end products and services. Enterprises actively responding to market demand changes will seize new opportunities to maximise profits. However, in recent years, "anti-globalisation", protectionism, and unilateralism sentiments have mounted, negatively impacting China's foreign trade. At the 2020 APEC CEO Dialogues, China's President Xi mentioned that "China had committed herself to open up and development while promoting the formation of a more all-inclusive world. " Yet, China has not stalled in the pursuit of opening up. It has taken many policy steps to open the country still wider. It mainly contains the following: The foreign investment law and its supporting rules and regulations have been fully implemented. A master plan has been developed to develop the Hainan Free Trade Port. Reform and opening-up in Shenzhen and Pudong's new economic zone have advanced. The above initiatives will help China integrate deeply with global economic development and develop a new, more open economy.

3.2.5 Sharing Development

Measures and targets to improve people's well-being have been unveiled in China's latest government work report and draft development blueprint, revealing the country's pursuit of common prosperity[40]. Over the past decade, China's phenomenal economic adjustment and transformation have featured a considerable improvement in people's well-being, guided by a people-centred philosophy that has aimed to ensure that development benefits all.

At the annual sessions of the top legislature and the top political advisory body, deputies deliberated the 2021 government work report and the draft outline of the 14th Five-Year Plan for national social and economic development and the long-range objectives through 2035. The draft aims to, for example, improve the well-being of the Chinese people by; boosting employment, actively responding to an ageing population, and raising the average life expectancy by one year in the next five years.

This study has discussed sharing development in realising China's HQD based on two crucial aspects. One addresses the sharing economy (SE) with China's practice. The second focuses on shared prosperity based on the poverty reduction perspective.

First, the terminology "sharing economy" was mentioned in China's 13th Five-Year Plan. Such economic activities mainly focus on; accommodation, transportation, life services, skills, and knowledge. Currently, SE has dramatically developed, and it has become a significant development trend in the global economy since the 2000s (Frenken, 2017).

With ICT's widespread application and advancement, SE in China has also stepped into a new development stage. According to the Stage Information Center (2020)[41], approximately 800 million people participated in the sharing business, with 78 million service providers employing about 6 million in 2019. This situation designates that more than one-half of Chinese people have participated in sharing economic

[40] Report on the work of the government: http://www.gov.cn/premier/2022-03/12/content_5678750.htm.
[41] See http://www.sic.gov.cn/News/568/10429.htm.

development in different capacities. Additionally, as shown in Figure 3.11, the market size of China's SE has increased steadily, spanning from 2016 to 2019. In contrast, its annual growth rate reached 95.7% in 2016, though it slowed down since then, and from 2018 on, once popular businesses, such as P2P (peer-to-peer) lending and bike-sharing, have undergone setbacks.

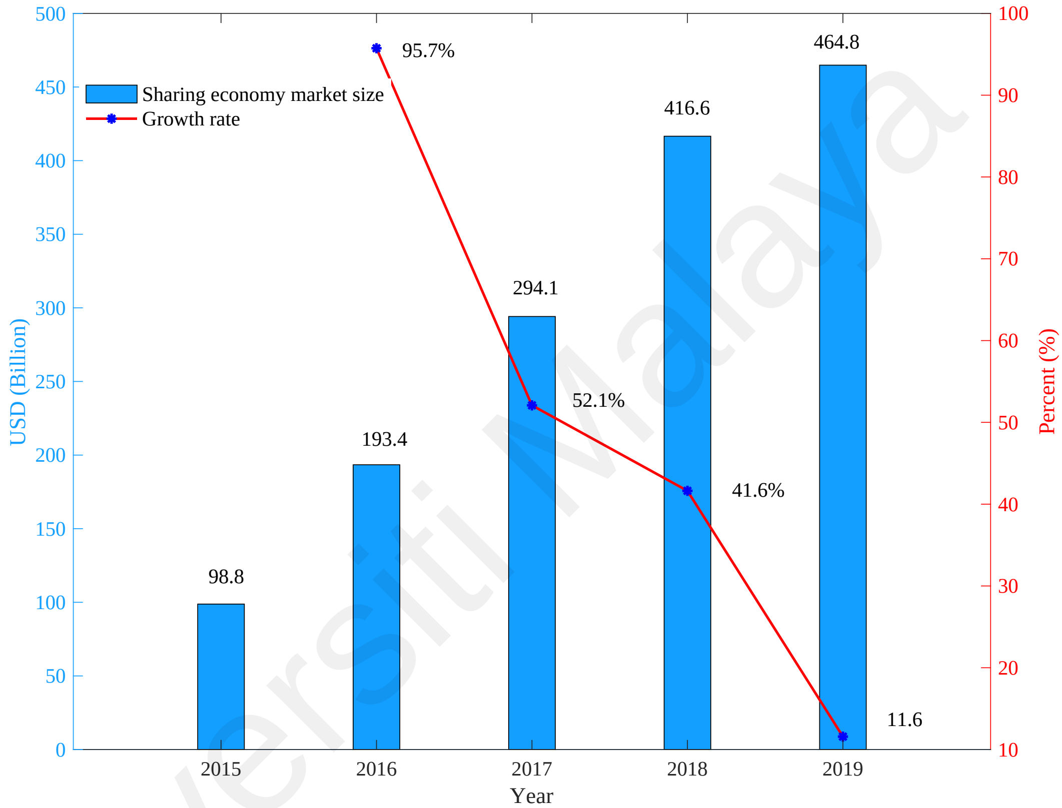

Figure 3.11: The Market Size of China's Sharing Economy, 2015-2019
Source: State Information Center (2016-2020)

SE has been considered a socioeconomic development pattern capable of decreasing the environmental burden and facilitating social collaboration and bonding (Andreoni, 2020). It could exert social, economic and environmental effects on sustainable development (Hossain, 2020). More specifically, (1) Social effects: SE could enhance the participants' feelings of trust and thus promote social connections (Nadeem & Al-Imamy, 2020). Hence, it has the potential to construct a participatory community and society (Benkler, 2017). (2) Economic effects: SE is an economic development model which could help empower individuals, produce economic revenue and create more job opportunities (Muñoz & Cohen, 2017). (3) Environmental effects: SE can effectively optimise utilising various underutilised resources. Thus, it is a green and sustainable development model of consumption that will minimise hyper-consumption (Acquier et al., 2017). Albeit with the distinct advantages mentioned above, the most important benefit of SE is that it can make associated services and goods accessible to more people with the potential of improving their welfare (UNCTAD[42], 2018). Thus, it makes sense to facilitate the sustainable development of SE and give full play to the role of SE in China's HQD process.

Second, shared prosperity concentrates on the poorest 40% (the bottom 40) of the population in a given economy and is defined as the annualised growth rate of their average per capita consumption or income (World Bank, 2020). Boosting shared prosperity and eliminating poverty is one of the twin goals of the World Bank (2015). Moreover, the group (World Bank, 2015) further stressed that shared prosperity is "unbounded," which indicates that shared prosperity includes numerous targets while combating poverty is one of the specific targets.

Why is poverty reduction important for contributing to sharing development in China? The reason is that poverty can be regarded as one of the greatest challenges in the world and contains the most severe form of human deprivation (Mora-Rivera & García-Mora, 2021). Poverty is a stubborn and highly sophisticated issue involving economics, politics, sociology and even geography. Thus, combating poverty is a global challenge, and many demand a poverty-free world (Yang & Liu, 2021). To this end, special attention has been raised on how to mitigate poverty, i.e., the role of governance (Asadullah &

[42] See https://unctad.org/meeting/development-dimensions-sharing-economy-learnings-china.

Savoia, 2018); the role of the internet (Mora-Rivera & García-Mora, 2021); the role of eco-compensation (Le & Leshan, 2020); intergovernmental transfers (Lü, 2015), etc.

Thanks to the great efforts made by the Chinese central government over the past 40 years, China has successfully lifted approximately 700 million people out of poverty, and it was the first developing country to realise the Millennium Development Goal for poverty eradication (Liu et al., 2019). The Chinese central government has prioritised many policies targeting improving residents' welfare in rural areas. However, China's poverty remains a critical issue, with about 17 million people living in poverty, and the poverty incidence index was 1.7% in 2018 (NBSC, 2019)[43].

While the rapid development of ICT, especially the prevalence of computer utilisation in modern society, has been considered crucial in reducing transaction costs, offering access to markets, and significantly increasing people's income levels, especially in developing countries (Mushtaq & Bruneau, 2019; Galperin & Viecens, 2017). Undoubtedly, the Internet is now widely used in all spheres of society. It is a useful instrument that facilitates commercial and social integrated development by offering efficient access to a wide range of opportunities, which provides more job opportunities and improves residents' income. Therefore, these mechanisms aid in achieving poverty alleviation (Alderete, 2019).

Dramatic ICT development has also accelerated rural e-commerce (RE) development. RE could be regarded as a direct approach for rural residents to take advantage of ICT and earn higher profits. Some studies have demonstrated that RE has played a pivotal role in developing commerce and modern agriculture. For example, taking Kenya as a research case, Ogutu et al. (2014) found that the ICT-oriented market

[43] See http://www.stats.gov.cn/.

information service project positively contributed to labour productivity, fertiliser, etc. Adopting a PSM method, Zeng et al. (2018) found that RE operation positively affected farmers' income increase, mainly by enhancing profitability and sales growth. Moreover, some scholars also proclaimed that e-commerce could promote commodity circulation, thus increasing the agricultural value chain (Song & Yang, 2019; Jalali et al., 2011; Parker et al., 2016).

China's RE has undergone profound changes. Specifically, China's No.1 Central Document released in 2014 introduced policies for sustaining RE development. Subsequently, China's No. 1 Central Document released in 2019 stated that China would strongly carry out its "Digital Rural Strategy". According to the statistics (Ministry of Commerce of China), China's central government has funded 28 provinces incorporating 1,231 counties to enrol in the National RE Comprehensive Demonstration Project by the end of 2019. Among those funded counties, 189 are severely impoverished counties, and 975 are poverty-stricken national ones. According to Figure 3.12, the overall rural network online retail sales from 2014 to 2019 exhibited a significant upward trend. It reached RMB 1.7 billion in 2019, with a year-on-year increase of approximately 19.1% and 2.6 per cent points higher than the growth rate of the national ORS, accounting for approximately 16.1 of national online retail sales[44].

[44] Ministry of Commerce of China: http://dzsws.mofcom.gov.cn/article/ztxx/ndbg/202007/20200702979478.shtml.

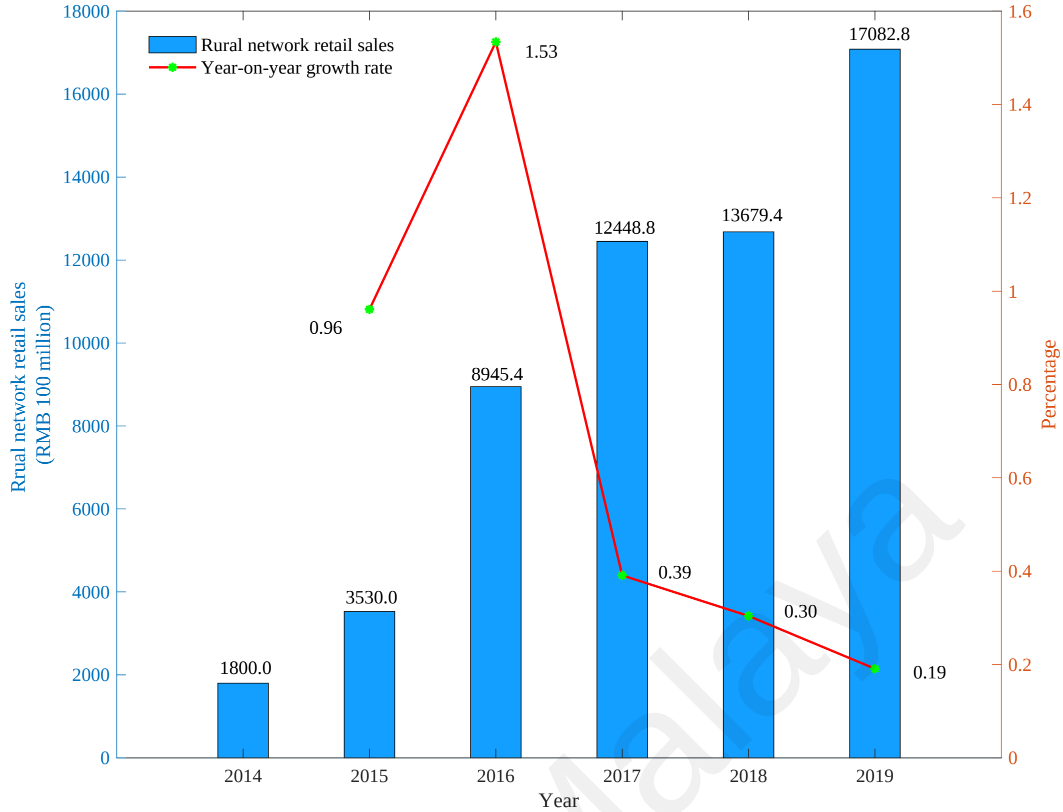

Figure 3.12: China's Rural Online Retail Sales
Source: Ministry of Commerce of China (2015-2020)

Based on the above discussion, RE's development has undeniably become one of China's most vibrant emerging industries. The continuous refinement of RE helps increase residents' income and reduce poverty.

The ideology of people-oriented development is a fundamental requirement in China, given that the essence of development lies in eradicating poverty and further enhancing national welfare (Long et al., 2011). In this regard, the fruits of development should benefit all and meet people's aspirations for a better life (Plummer et al., 2018). Thus, with the premise that people-oriented development can be empirically described, sharing development should reflect the coordination between spiritual life and material demands (Haseeb et al., 2020). The former mainly contains public services and a range of basic social security, such as medical care. And the latter mainly refers to the spread of culture and information. Therefore, sharing development will be significantly facilitated in realising China's HQD.

3.3 Framework Assessing High-Quality Economic Development

First, Figure 3.13 summarises the crucial information of the whole theoretical justification that has formed the framework for assessing China's HQD. Based on the theoretical justification, this study holds that China's HQD is a systematic project that addresses social, economic, and ecological gains and embodies sustainable growth coordination among the economy, society and the people. Undoubtedly, achieving HQD is conducive to realising sufficient and coordinated development. Specifically, sufficient development manifests development with high efficiency of economic factors' utilisation, sufficient innovation capability, the balanced development of social undertakings, the welfare of people's living standards, and a favourably ecological environment. Coordinated development reflects the balance of urban-rural and regional development (URID, employment, education, etc.).

Second, the well-being of the people is the fundamental goal of China's economic development (sharing development). Technological progress (innovative development) improves the country's TFP and enhances resource utilisation efficiency, thus solving overcapacity and environmental problems (green development). The development disparities among different regions and provinces will be gradually eliminated (coordinative development). Besides, strongly implementing the reform and opening-up policy is conducive to the qualitative improvement of China's economy (open development).

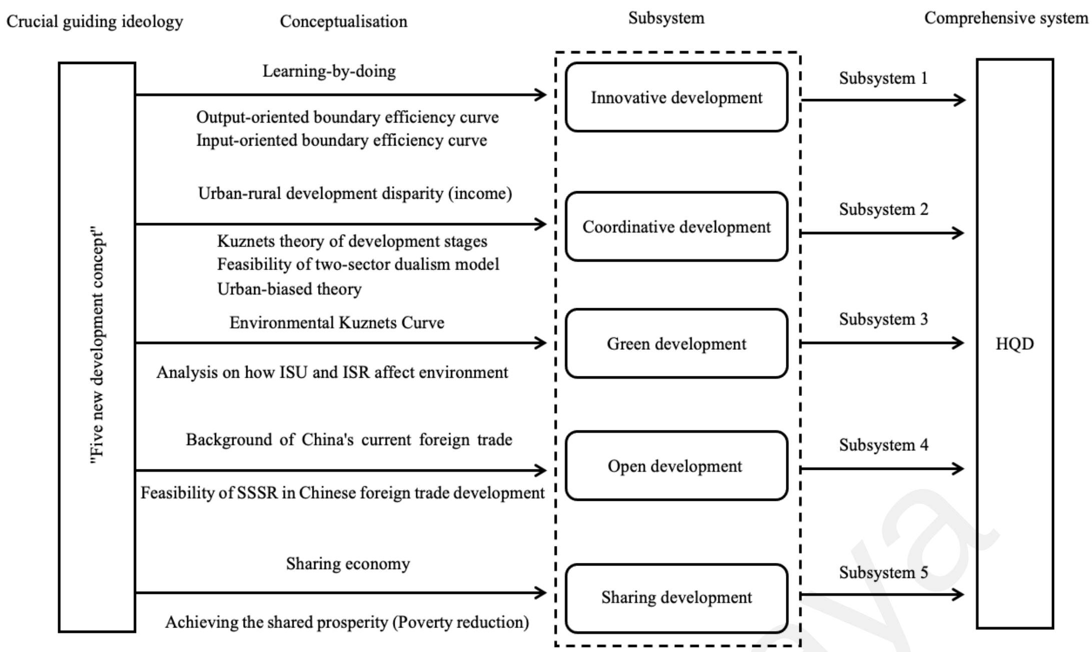

Figure 3.13: Summary of Conceptual Framework
Source: Computed by the Author

3.4 Chapter Summary

This chapter has formed a theoretical basis for constructing the HQD assessment system. HQD considers a multidimensional approach considering five important dimensions: innovative, coordinative, green, open, and sharing development. The chapter has also highlighted China's progress in each of the subsystems. The theoretical justification has provided the avenue to frame the assessment of the HQD framework used in this study. The next chapter discusses the methodology and measurements in assessing the HQD subsystems.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

This chapter develops the research methodology, including assessing China's HQD based on the theoretical justification discussed in Chapter 3, the methodology for analysing development levels and investigating distribution characteristics of ISU, ISR and IS, and the methodology used for modelling the ISTU's effect on China's HQD. Also, this chapter presents the research framework relevant to this study and the data sources.

4.2 Methodology of HQD Assessment System Construction

This section describes the indicators and subsystems applied to assess China's HQD. It explains the methodological approach used to measure and construct the HQD assessment system. This study took the 19th CPC National Congress report as a cut-off point to briefly illustrate the selection of the assessment indicators based on the "Five new development concepts".

This study constructed an HQD assessment system based on five subsystems incorporating 26 indicators to assess 30 provinces' HQD levels in China from 2005 to 2019. Figure 4.1 displays the notion of the HQD assessment system in which China's HQD was measured in this study.

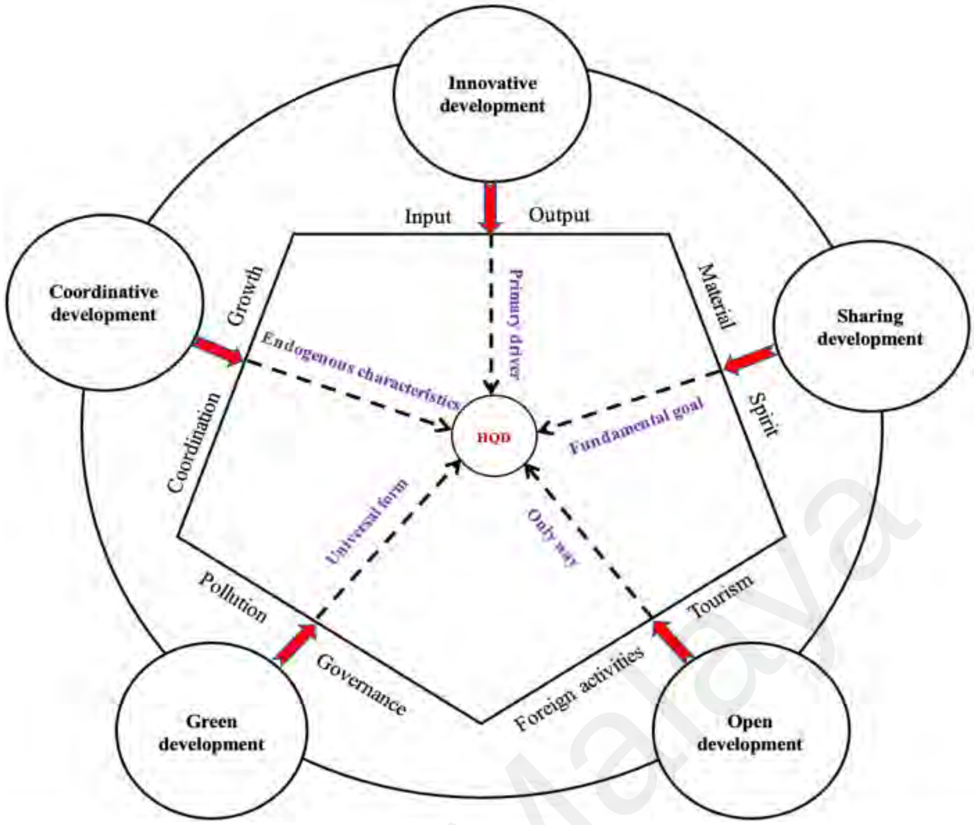

Figure 4.1: The Notion of the HQD Assessment System
Source: Computed by the Author

4.2.1 Selection of Assessment Indicators

First, the 19th CPC National Congress report proposed that "innovation should be the primary driver behind development and the strategic underpinning for establishing a modernised economic system". TI plays a crucial role in human social development and is an important enabler for green TFP (Jiang et al., 2021). The Chinese central government has implemented a series of powerful initiatives (i.e., the "Innovation-driven development strategy") to transfer its current economic development model towards a sustainable one. The role of TI in economic development has been evident. On the one hand, sufficient R&D investment can encourage industrial sectors, especially the old-industrial bases, to conduct R&D activities.

Consequently, old-industrial bases can simultaneously reduce pollution emissions and improve input-output efficiency, thus contributing to HQD. On the other hand, sufficient technology innovation resources are also beneficial to improving research institutions' research capabilities and developing world-class universities. As for assessment indicators measuring TI, the number of innovation patents (Zhang et al., 2018), R&D input intensity (Zhang et al., 2021), and green technology patents (Wu et al., 2022) have been widely adopted. While considering data availability, this study selected the assessment indicators measuring innovative development based on R&D and S&T perspectives. The detailed definition of the selected variables is shown in Table 4.1.

Table 4.1: Innovative Development (ID) [45] for the HQD Assessment System

Code	Basic indicator	Definition
A11	R&D input intensity	Expenditure for R&D/GDP
A12	R&D personnel input intensity	The full-time equivalent of R&D personnel/total population
A13	S&T input intensity	Expenditure for science and technology/total fiscal expenditure
A14	S&T output and results	Number of patent grants/total population×10,000
A15	Transaction value in the products and technical market	Transaction value in the technical market/GDP

Second, the 19th CPC National Congress report proposed that "China will vigorously implement a coordinated regional development strategy". Following theoretical justification, this study selected assessment indicators measuring coordinative development, mainly focusing on urban-rural coordination. The Chinese dual economic character remains a pressing issue facing China, and income inequality between urban and rural areas remains obvious (Wang et al., 2019). Therefore, the income disparity index was adopted to capture income inequality between urban and rural areas (Ran et al., 2020). Referring to Wu et al. (2016), China's industrialisation and urbanisation have been distinguished by its rapidly increasing urban population and economic growth rates. The

[45] According to the classification of the National Bureau of Statistics of China (2020), the items under the basic statistics on scientific and technological activities are classified into three parts: Statistics on R&D input, Statistics on S&T outputs and results, Statistics on the exports and imports of high-tech products and the technical market. Considering data availability for each indicator in different provinces, five indicators were selected from three aspects mentioned above.

rates have sped up dramatically since 1978. Thus, the industrialisation rate and urbanisation rate were selected.

Further, the two-yuan contrast coefficient and binary contrast index[46] (Shi & Li, 2019) were also used. Existing studies have widely adopted these indicators to measure urban-rural coordination (Du et al., 2020; Zhan & Cui, 2016). Apart from the abovementioned indicators, this study also introduced economic growth as another assessment indicator. This situation is because quantity expansion remains crucial for quality improvement. While realising HQD should seek a balance between quantity and quality in economic development. A detailed definition of the selected variables is shown in Table 4.2.

Table 4.2: Coordinative Development (CD) for the HQD Assessment System

Code	Basic indicator	Definition
B21	Industrialisation rate	(Number of employed persons in the secondary and tertiary industries)/total employed persons
B22	Two-yuan contrast coefficient	Two-yuan contrast coefficient = Comparative labour productivity of agricultural industries/ Comparative labour productivity of non-agricultural industries
B23	Binary contrast index	Binary contrast index = |The share of non-agricultural output – the share of agricultural output|
B24	Urbanisation rate	Urban population/total population
B25	GDP growth rate	Reporting period GDP/base period GDP
B26	URID	Per capita disposable income of urban residents/per capita disposable income of rural residents

Third, the 19th CPC National Congress report proposed that "China will speed up reform of the system for developing an ecological civilisation and build a beautiful China". On the one hand, China needs to establish a market-oriented system for green TI and develop more energy-intensive and environmentally-friendly industrial sectors. On the

[46] It is worth noticing that these two selected indicators can not only reveal the relationship between agricultural sectors and non-agricultural sectors, but also reflect the relationship between agricultural sectors and non-agricultural sectors within agricultural sectors.

other hand, sufficient fiscal expenditure for environmental protection is needed, thus, creating liveable and sustainable living standards. Hence, government expenditure for environmental protection was first adopted to measure fiscal input intensity for environmental protection. At the same time, the harmless disposal rate (Chen et al., 2021) was used to measure environmental governance at the interprovincial level. Referring to Jiang et al. (2021), the Chinese forestry coverage rate has increased from approximately 8% in 1949 to 23% in 2021. Thus, such an indicator was used to measure the interprovincial biodiversity degree.

Most importantly, China remains one of the largest energy consumers in the world (Wang et al., 2021). At the same time, China also stands in the first position in coal consumption (Sarwar et al., 2019). Still, the ratio of coal consumption to GDP has been broadly adopted by scholars to measure China's consumption structure (Li & Ma, 2021; Zhang et al., 2021). Although China's interprovincial CO_2 emissions can be obtained manually, it is worth mentioning that different measurements exert differences, which may cause a biased estimation of the HQD score. The detailed definitions of the selected variables are shown in Table 4.3.

Table 4.3: Green Development (GD) for the HQD Assessment System

Code	Basic indicator	Definition
C31	Environmental protection	Expenditure for energy conservation and environmental protection/total fiscal expenditure
C32	Harmless disposal rate of municipal waste	Municipal waste disposed of/municipal waste generated
C33	Energy consumption structure	Coal consumption/GDP
C34	Forestry coverage rate	Area of afforested land/area of the total land

Fourth, the 19th CPC National Congress report proposed that "China will make new ground in pursuing opening-up on all fronts". Ahn (2011) described international trade as exchanging services and goods among countries. Indeed, international trade has led to more globalised and integrated markets, leading to increased trade flows between developing and developed countries (Elias et al., 2018). Also, Suresh & Tiwari (2018) demonstrated international trade through its positive effect on economic growth. At the same time, China's international trade has developed dramatically in recent years. Specifically, total foreign trade reached approximately 38 billion US dollars in 2016[47] (Wang et al., 2017). China's total foreign trade amounted to about 25 trillion US dollars two years after China launched the Belt and Road Initiative (Du & Lu, 2018). Thus, foreign trade development, the number of contracts, and foreign cooperation were selected as assessment indicators[48].

Tourism has long been recognised to affect economic activity (Dwyer et al., 2004). Tourism is expected to increase overall economic activities, and this increase in economic activities is normally considered desirable. This situation is because the speedy growth of tourism triggers; increases in government revenues and household income through multiplier effects, enhancements in the balance of payments, and growth in the number of tourism-oriented policies (Chou, 2013). Likewise, empirical findings (Fahimi et al., 2018) have proved the wisdom of tourism-induced economic growth. Thus, the related indicator dependence on foreign tourism was also adopted. The detailed definitions of the selected variables are shown in Table 4.4.

Table 4.4: Open Development (OD) for the HQD Assessment System

Code	Basic indicator	Definition
D41	Number of contracts	Total number of contracts (economic cooperation with foreign countries or regions)
D42	Foreign trade	Total volume of imports & exports/GDP
D43	Dependence on foreign tourism	International tourism income/GDP
D44	Foreign cooperation	Contracted value of contracted projects/GDP

[47] Still, China's total foreign trade has amounted to about 46.6 billion US dollars in 2020 (see http://www.stats.gov.cn/tjsj/).

[48] Among which, overseas contracted projects refer to activities contracting overseas construction projects by Chinese enterprises or any units (see http://www.stats.gov.cn/tjsj/).

Fifth, the 19th CPC National Congress report proposed to "gradually improve people's well-being and strengthen social governance. China will prioritise developing education, improving the quality of employment, strengthening the social security system, and carrying out the Healthy China initiative, etc.". This study selected seven related indicators, including; culture, education, health care, social security development, and the social unrest rate, to measure the performance of the sharing development considering data availability (Du et al., 2020). The detailed definitions of all the selected variables are shown in Table 4.5.

Table 4.5: Sharing Development (SD) for the HQD Assessment System

Code	Basic indicator	Definition
E51	Number of museums and libraries per 10,000 people	(Number of public museums and libraries)/total population×10,000
E52	Health technical personnel in health care institutions per 10,000 persons	Number of health technical personnel/total population
E53	Public services	Expenditure for; culture, tourism, sport and media/total fiscal expenditure
E54	Social unrest rate	Consumer Price Index + unemployment rate
E55	Illiteracy rate	Total illiterate population/total population aged 15 and over
E56	Social security and employment	Expenditure for social security and employment/total fiscal expenditure
E57	Number of buses per 10,000 people	Number of buses/total population

4.2.2 Feasibility Checking of the High-Quality Economic Development Assessment System

Using a PCA method, this study then checked the feasibility of the above-selected assessment indicators. First, common variance is the amount of variance shared among a bundle of items. Highly correlated items contribute more to the variance. Communality (also called h-squared) is a common variance distributed in [0,1]. Values closer to 1 mean that extracted components explain more of the variance of an individual item. According to Table 4.6, the value of each component was higher than 0.5, with a total value of 20.07. The proportion of the variance explained by all indicators was 20.07÷26=0.7720. This result implied that the model could explain about 77.20% of the variance in all factors. Figure 4.2 further summarises the key information concerning the feasibility checking results.

Table 4.6: Results for Communalities

Factor	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5
Initial	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Extraction	0.879	0.847	0.818	0.828	0.890	0.845	0.527	0.770	0.831	0.770
Factor	B6	C1	C2	C3	C4	D1	D2	D3	D4	E1
Initial	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Extraction	0.778	0.766	0.790	0.774	0.774	0.627	0.824	0.799	0.755	0.783
Factor	E2	E3	E4	E5	E6	E7			Sum	20.07
Initial	1.000	1.000	1.000	1.000	1.000	1.000			Average	0.772
Extraction	0.823	0.713	0.746	0.767	0.663	0.684			h-squared	0.743

Notes: Abbreviations A∗, B∗, C∗, D∗, and E∗ represent ID, CD, GD, OD and SD, respectively.

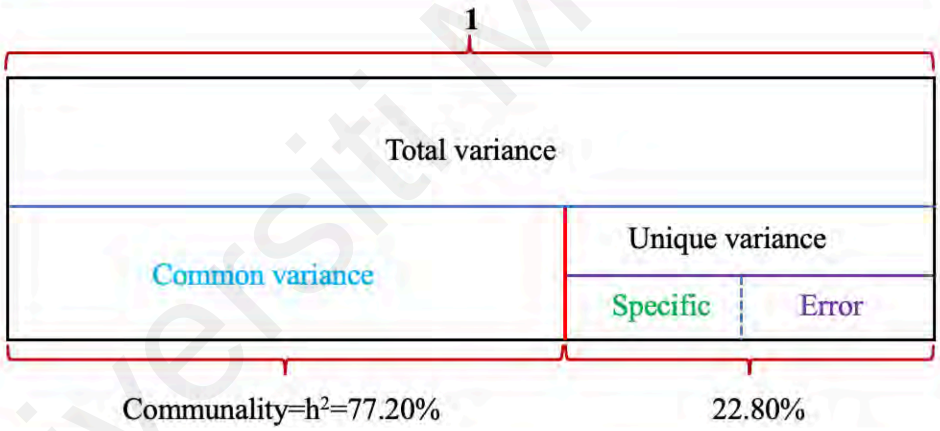

Figure 4.2: Communality for the HQD Assessment System
Source: Computed by the Author

Second, the KMO test (Kaiser-Meyer-Olkin test measuring sampling adequacy) and Bartlett's test of sphericity were adopted to verify the suitability of the data for structure detection.

(1). The KMO test is a statistical index used to detect the appropriateness of factor analysis. A high value (close to 1) means that factor analysis is reasonable. If the value is less than 0.5, factor analysis is not appropriate.

(2). Bartlett's test of sphericity examines the hypothesis that the correlation matrix is an identity matrix, which implies that the selected indicators are uncorrelated and, therefore, unsuitable for structure detection.

(3). According to Table 4.7, the KMO test value was 0.793, greater than 0.5. At the same time, Bartlett's test was significant at the 1% level, which strongly rejected the null hypothesis. This situation meant that the constructed assessment system measuring China's HQD was applicable.

Table 4.7: KMO Test and Bartlett's Test

KMO test		0.793
Bartlett's test of sphericity	Approx. Chi-squared	10246.385
	df	300
	Sig.	0.000

4.2.3 Data Standardisation and Weighting Determination

Since the attribute of measures varied within the key subsystems, this study involved standardising the data. Simple data standardisation with weights was adopted in this study. Referring to Li et al. (2012), the extreme value processing method eliminated the difference in; magnitude, dimension and sign between the selected indicators. This method ensured that all final values were distributed in [0,1] and reflected each indicator's overall degree of all DMUs (Ghorbel & Trabelsi, 2014).

Specifically, the expressions are as follows:

$$x_{ij}^{+} = \frac{x_{ij} - \min\{x_{1j}, \dots, x_{nj}\}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad (4-1)$$

$$x_{ij}^{-} = \frac{\max\{x_{1j}, \dots, x_{nj}\} - x_{ij}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad (4-2)$$

Where x_{ij} expresses the value of the j-th indicator in region i ($i = 1, \ldots, n;\ j = 1, \ldots, m$); $\max\{x_{1j}, \ldots, x_{nj}\}$ and $\min\{x_{1j}, \ldots, x_{nj}\}$ denote the maximum and minimum values of the indicator x_{ij}, respectively, while x_{ij}^{+} and x_{ij}^{-} represent the positive and negative assessment indicators, respectively.

This study assigned weights beyond simple standardisation methodology, given that not all subsystems and indicators have equal importance. Thus, this study's combined objective weighting determination methods consisted of the entropy method and the coefficient of variation[49].

More specifically, the detailed steps for performing the entropy method were as follows:

Step 1. Calculating the proportion p_{ij} of the indicator j for province i:

$$p_{ij} = x_{ij} \Big/ \sum_{i=1}^{n} x_{ij} \qquad (4-3)$$

Step 2. Calculating the entropy e_j of the indicator j:

$$e_j = -k \sum_{i=1}^{n} p_{ij}\,;\, k = 1/\ln(n) \qquad (4-4)$$

In particular, if $p_{ij} = 0$, then $\lim\limits_{p_{ij} \to 0} p\ln(p_{ij}) = 0$.

Step 3. Calculating the weight w_i of indicator j:

$$w_{1j} = (1 - e_j) \sum_{j=1}^{m} (1 - e_j) \qquad (4-5)$$

---

[49] The variation of coefficient represents the proportion of standard deviation to the average (mean).

The detailed steps for performing the coefficient of variation were as follows (Fan et al., 2019):

Step 1. Calculating the mean of indicator j:

$$\overline{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij} \qquad (4-6)$$

Step 2. Calculating the standard deviation of indicator j:

$$S_j = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{ij} - \overline{x}_j\right)^2} \qquad (4-7)$$

Step 3. Calculating the variation coefficient of indicator j:

$$\begin{cases} \varphi_j = S_j/\overline{x}_j \\ w_{2j} = \varphi_j/\sum_{j=1}^{m} \varphi_j \end{cases} \qquad (4-8)$$

Therefore, a comprehensive weight of each indicator was then determined by calculating the average w_{1j} and w_{2j}, which is denoted as w_j. Finally, following the same steps, this study obtained a comprehensive index for China's HQD using $z_{ijq} = \sum_{i=1,j=1}^{m,n} x_{ij}^{+}\left(\text{or } x_{ij}^{-}\right) * w_j$ $(q = 1, \ldots, 5)$, denoted as HQEI.

It should be noted that the estimated index weights mainly reflected the data difference information. Hence, this study adopted the normalised sample data's standard deviation (Std.) to express its distribution difference. The comprehensive weights and Std. are depicted in Figure 4.3.

As depicted in Figure 4.3, the following conclusions were drawn.

- The ID (A1) indicators differed greatly. Thus, the weight was larger, while the CD (B2) indicators performed less differently. Thus, the weight was relatively small. This situation was because one of their indicators was distributed differently. For example, in CD (B2), URID's (B26) was 0.078, while the weight of the urbanisation rate (B24) was 0.272. For data difference, the Std. of URID was 0.128, whereas the urbanisation rate was 0.185.

- The weights of the bottom indicators in GD (C3) and OP (D4) had a certain difference. This outcome was because these two subsystems included intensively performed indicators in the data distribution. For example, in the GD (C3) subsystem, the weight of environmental protection (C31) and the harmless disposal rate of municipal waste (C32) were 0.361 and 0.316, respectively. However, the energy consumption structure (C33) weight was 0.047. As for the data difference, the Std. of environmental protection, the harmless disposal rate of municipal waste and energy consumption structure were 0.140, 0.338 and 0.128, respectively. Due to the data distribution, the Std. of the energy consumption structure was more concentrated than the Std. value presented, and, thus, its weight was relatively smaller.
- For the SD (D5) subsystem, the indicators performed less differently. For example, the weights of; public service (E53), social unrest rate (E54), illiteracy rate (E55) and social security and employment (E56) were 0.086, 0.054, 0.074 and 0.074, respectively. For the data difference, the Std. of; public service, social unrest rate, illiteracy rate, and social security and employment were 0.156, 0.154, 0.176, 0.180 and 0.147, respectively. For similar data distribution, there were no evident differences between their weights.

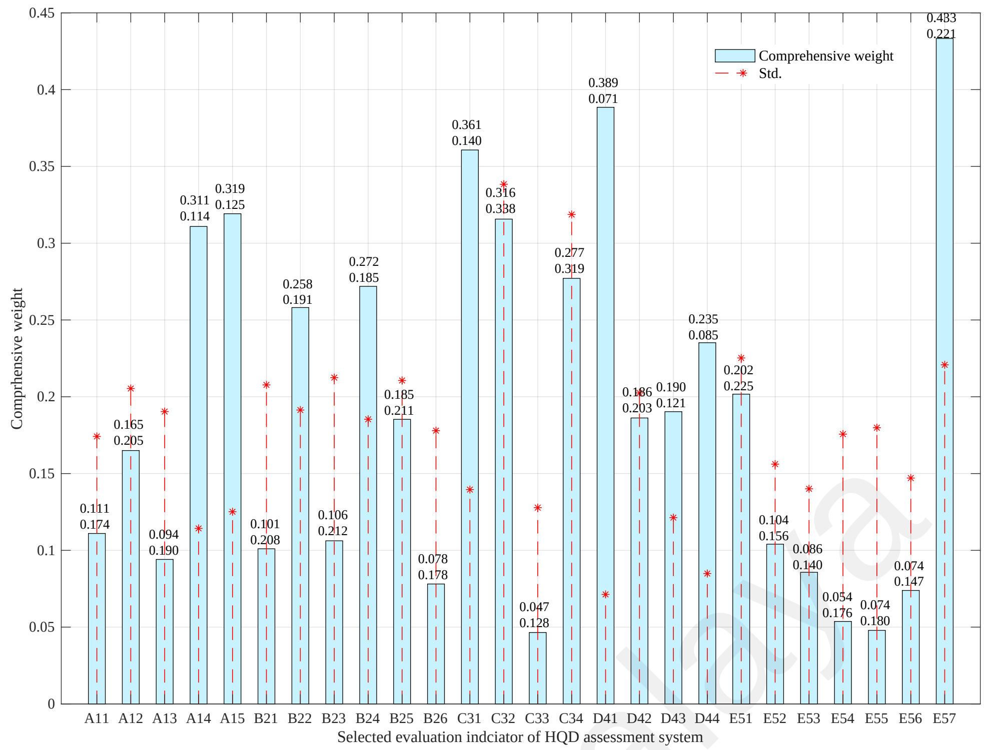

Figure 4.3: Comprehensive Weight of Each Assessment Indicator
Source: Computed by the Author

Figure 4.4 presents the weights of HQD's subsystems. The ID subsystem had the most significant value of 0.4133, highlighting that innovation development played a decisive role in realising HQD. OD's weight was 0.3115, suggesting that strongly implementing the reform and opening-up policy was conducive to improving HQD. However, compared with other subsystems, the performance of GD in China was not high quality, with a value of 0.0771. At the same time, CD ranked at the bottom with a value of 0.0581, designating that unbalanced and uncoordinated development remains a bottleneck faced by China to realise HQD. The weight of SD was 0.1402, which was higher than that of the CD subsystem.

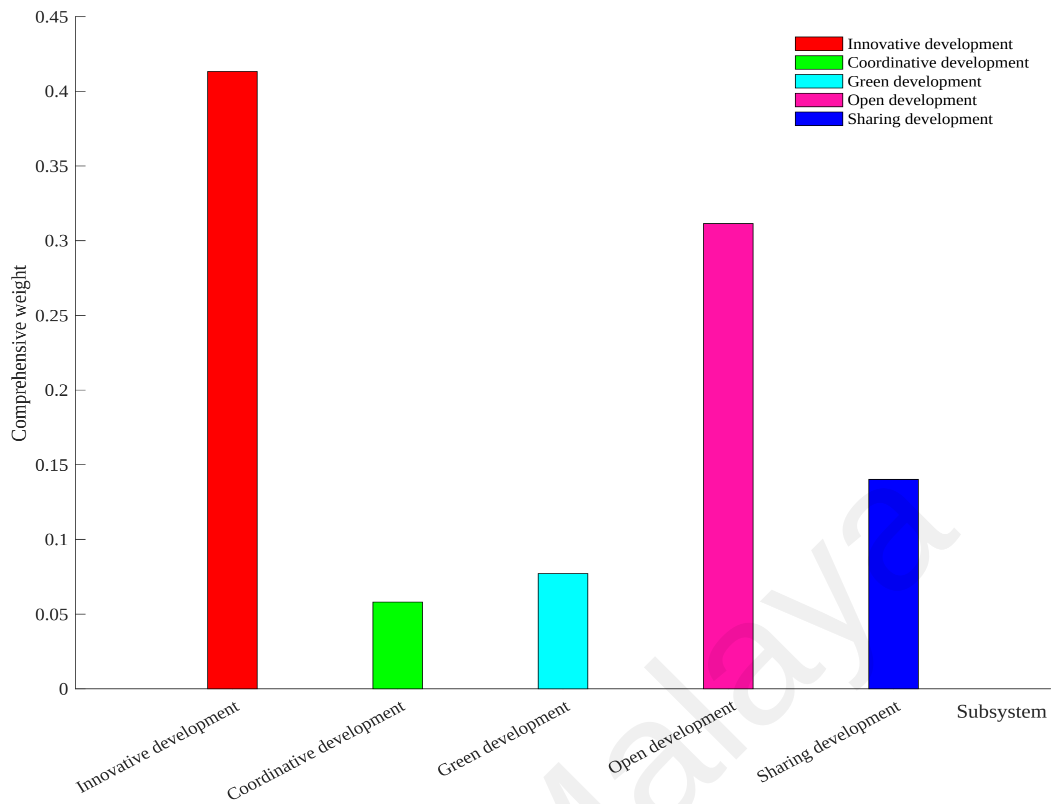

Figure 4.4: Comprehensive Weight of Each Subsystem[50]
Source: Computed by the Author

4.2.4 Empirical Method for High-Quality Economic Development Based on Relative Scores

Mathematically, the word "increment" means a small positive or negative change in the value of one or more of a set of variables. At its most basic level, the growth rate is applied to measure the annual change in a variable. An economy's growth, for instance, is calculated as the annual rate of change in the increase or decrease of a country's GDP. This growth rate is employed to measure an economy's expansion or recession. If the income within a country decline for two consecutive quarters, it is regarded as a recession. Hence, the increment level of each indicator can be expressed as follows:

[50] Note that the weight of each subsystem merely refers to an indicator of how much emphasis should be put on a particular variable. The final comprehensive weight of each subsystem is consistent with the "Five New Development Concepts". More specifically, first, the Chinese central government puts more emphasis on TI and focuses on cultivating independent innovative capabilities. Therefore, ID has the largest comprehensive weight compared with other subsystems. Second, the implementation of the reform and opening-up policy has been 46 years. China treats this policy as a long-term guiding ideology to promote open development. Third, people-oriented development is a fundamental requirement in China because the purpose of development lies in reducing poverty and improving people's welfare simultaneously. Fourth, to effectively address the environemntal issues caused by the traditional economic development model, China has introduced a series of powerful environemntal regulations to enhance environemntal quality. Lastly, however, regional disparities should be further addressed (i.e., China's urban-rural dual structure).

$$\mu_{ij}(t) = \Delta x_{ij}(t)/x_{ij}(t) = \left[x_{ij}(t) - x_{ij}(t-1)\right]/x_{ij}(t) \qquad (4-9)$$

Further, the increment level matrix of each DMU is expressed as follows:

$$\mu_i = \begin{bmatrix} \mu_{i1}(2) & \mu_{i2}(2) & \cdots & \mu_{im}(2) \\ \mu_{i1}(3) & \mu_{i2}(3) & & \mu_{im}(3) \\ \vdots & & \ddots & \vdots \\ \mu_{i1}(T) & \mu_{i2}(T) & \cdots & \mu_{im}(T) \end{bmatrix} \qquad (4-10)$$

The increment level matrix of all DMUs can be specified as follows:

$$\mu = (\mu_1, \mu_2, \dots, \mu_N)^T \qquad (4-11)$$

Similarly, Eq. (4-1) was used to treat the initial scoring judgement matrix. Then the combined weighting determination procedure, including the entropy method and coefficient of variation, was performed to determine the weight of each index. The higher the value, the faster the indicator grows.

4.2.5 Empirical Method for High-Quality Economic Development Based on Fluctuating Scores

Fluctuation means the variation coefficient of the selected indicator in period T, which can reflect the fluctuating degree over time. In other words, the variation coefficient is used to measure the dispersion of data points in a time series around the mean. Therefore, this indicator helped to measure the volatility of China's HQD during the research period. By combining Eqs. (4-6) - (4-7), the HQD fluctuating score is expressed as follows:

$$\varphi_{ij} = S_{ij}/\bar{x}_{ij} \qquad (4-12)$$

Similarly, this study carried out a dimensionless process based on the initial judgement scoring matrix using Eq. (4-2). Then the combined weighting determination procedure, including the entropy method and coefficient of variation, was implemented to determine the weight of each index. The higher the fluctuating score, the more stable the provincial HQD will be.

4.2.6 Cluster Analysis

Cluster analysis as a statistical analysis instrument focuses on classification issues and is also a pivotal data mining algorithm. It usually measures the ranges and points in multidimensional space (Shahrivari & Jalili, 2016). The K-means complex algorithm searches for complex centres and those in unlabeled data. When using this approach, the requested number of K-centers will be picked. At the same time, distance will be used as one of the indexes, thus making it possible to assess the similarity.

The previous section discussed China's HQD level based on; absolute, relative and fluctuating scores. To better reveal the overall level of HQD, a K-means cluster analysis from the reduced-dimension perspective was conducted, which needed to re-assign the temporal weights to each score mentioned above.

Temporal values were assigned to each period: the most recent time received the highest value while the most remote time received the lowest ("stressing present over the past"). That is to say, the closer the information was to the present, the more important the information was.

Specifically, the temporal value at point k ($1 \leq k \leq N$) is expressed as follows:

$$\omega_k = k/\sum k, k = 1,2,3, \ldots, N \quad (4-13)$$

Therefore, the HQD level based on the absolute score is expressed as follows:

$$\left(\frac{1}{\sum A_i} + \frac{2}{\sum A_i} + \cdots + \frac{15}{\sum A_i}\right) = \left(\frac{1}{1+\ldots+15} + \frac{2}{1+\ldots+15} + \cdots + \frac{15}{1+2+\ldots+15}\right) (4-14)$$

Similarly, the HQD level based on the relative score is expressed as follows:

$$\left(\frac{1}{\sum A_i} + \frac{2}{\sum A_i} + \cdots + \frac{14}{\sum A_i}\right) = \left(\frac{1}{1+\ldots+14} + \frac{2}{1+\ldots+14} + \cdots + \frac{14}{1+2+\ldots+14}\right) (4-15)$$

It is worth mentioning that the fluctuating score of the HQD level was obtained based on the variation coefficient, which was not time-series data. Thus, it was not necessary to reassign the weight.

4.2.7 Spatial Investigation for High-Quality Economic Development

According to the First Law of Geography proposed by Tobler (1970), "everything is related to everything else, but near things are more related than distant things. " Therefore, this section analysed China's HQD performance from a spatial perspective.

Spatial Weight Matrix Construction. In addition to geographical factors, the correlations between different regions are also affected by their economic development level and the scale of investment (Lin et al., 2006). A symmetric spatial weight matrix is not suitable for modelling regional associations. For instance, the effect of Guangdong Province on Sichuan is significantly greater than that of Sichuan Province on Guangdong. This situation is because Guangdong is a more economically developed province. An asymmetric spatial weight matrix should be designed to reveal the imbalance in the mutual relationship between different regions. Based on the geographical weight of the economic development level of each area, this study weighted the ratio of the average per capita RGDP. Thus, the economic-geographical spatial weight matrix represented by the product of the geographical distance weight matrix and the diagonal matrix of the proportion of per capita RGDP was employed in this study. More specifically, the expression of the economic-geographical spatial weight matrix is expressed as follows:

$$\begin{cases} W = w \times \mathrm{diag}\left(\frac{\bar{x}_1}{\bar{x}}, \frac{\bar{x}_2}{\bar{x}}, \cdots, \frac{\bar{x}_n}{\bar{x}}\right) \\ \bar{x}_i = \frac{1}{t_1 - t_0 + 1}\sum_{t=t_0}^{t_1} x_{it}\,; \bar{x} = \frac{1}{n(t_1 - t_0 + 1)}\sum_{t=t_0}^{t_1}\sum_{i=1}^{n} x_{it} \end{cases} \quad (4-16)$$

Where, w denotes the geographic spatial weight matrix, which was constructed based on the geographic distance between provinces i and j. $\bar{x}_i = \frac{1}{t_1 - t_0 + 1}\sum_{t=t_0}^{t_1} x_{it}$ refers to the average level of economic development in region i. $\bar{x} = \frac{1}{n(t_1 - t_0 + 1)}\sum_{t=t_0}^{t_1}\sum_{i=1}^{n} x_{it}$ denotes the average level of economic development of all regions, while x represents the per capita RGDP. t and n are the numbers of periods and regions, respectively. The designed economic-geographical spatial weight matrix should be standardised to ensure the sum of the elements in each matrix row is one.

Spatial Autocorrelation Test. It should be noted that the existence of spatial autocorrelation in China's HQD was the prerequisite for spatial analysis. Therefore, it was necessary to determine whether HQEI exhibited significant spatial autocorrelations by adopting the Moran statistical index. More specifically, the range of the Moran I was $[-1, 1]$. If the estimated values were distributed in $[-1,0]$, it would indicate that there was a negative autocorrelation between geographical units. If the estimated values were distributed in $[0, 1]$, it would indicate a positive autocorrelation between geographical units. In contrast, if the estimated value were equal to 0 or even insignificant, there was no spatial autocorrelation.

The specific form used for calculating Moran I is expressed as follows:

$$\begin{cases} \text{Moran's I} = \dfrac{\sum_{i=1}^{n}\sum_{j\neq i}^{n} W_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sigma^2 \sum_{i=1}^{n}\sum_{j\neq i}^{n} W_{ij}} \\ \qquad = \dfrac{\sum_{i=1}^{n}\sum_{j\neq i}^{n} W_{ij}\left(x_i - \frac{1}{n}\sum_{i=1}^{n} x_i\right)\left(x_j - \frac{1}{n}\sum_{j=1}^{n} x_j\right)}{\frac{1}{n}\sum_{i=1}^{n}\left(x_i - \frac{1}{n}\sum_{i=1}^{n} x_i\right)^2 \sum_{j\neq i}^{n} W_{ij}} \\ Z = \dfrac{I - E(I)}{\sqrt{Var(I)}} = \dfrac{\sum_{j\neq i}^{n}(x_j - \bar{x})}{S_i\sqrt{w_i(n-1-W_i)/(n-2)}}; \quad j \neq i \end{cases} \qquad (4-17)$$

Where, x_i and x_j represent HQEI in regions i and j, respectively. σ^2 represents the variance of x; W_{ij} is the $N \times N$ economic-geographical spatial weight matrix; S_i regulates the standard deviation of the research samples, while Z represents a statistical value to examine the significance of spatial autocorrelation.

Still, the Moran scatterplot describes the heterogeneity of HQD, which revealed the correlation between observed regional variables and their spatial lag terms. The Moran scatterplot divided China's HQD of each province into four quadrants, namely, 'high-high (H-H) type', 'low-high (L-H) type', 'low-low (L-L) type' and 'high-low (H-L) type'. The first quadrant (upper right quadrant) shows H-H type spatial agglomeration features, suggesting that these provinces and their adjacent provinces all have high HQD levels. The third quadrant (lower left quadrant) displays L-L type spatial agglomeration features, describing both neighbours' low properties. The second (upper left quadrant) and fourth quadrants (low right quadrant) present the spatial clustering features of L-H and H-L types. In addition, when provinces are of H-H or L-L types, they exhibited positive spatial autocorrelation. In contrast, if provinces were of L-H or H-L types, it implied that they exhibited negative spatial autocorrelation.

4.2.8 Geo-detector for Capturing Regional Heterogeneity

This section discusses the methodological approach concerning the Geographical Detector method, which could help capture regional heterogeneity in HQD performance.

Spatial autocorrelation and spatial heterogeneity are typical characteristics of spatial studies (Tobler, 1970; Goodchild & Haining, 2004). Spatial autocorrelation means that spatial entities' properties at closer geographical locations are more similar or dissimilar than those at distant locations (Tobler, 1970). Statistically, heterogeneity is a terminology that describes the differences of some quantities of interest (often used as a variance) within a certain number of a population (Everitt, 2002, p.178). According to

Anselin (2010), spatial heterogeneity means unbalanced distribution of events and traits, or more simply, the spatial variation of properties.

This study adopted the Geographical Detector method proposed by Wang et al. (2010) to detect the subregional heterogeneity of factors concerning HQD performance. The factor-detector under the Geo-detector can test the power determinant X of a dependent variable Y in terms of the consistency between their spatial distributions. Therefore, with the implementation of the q-statistics, the differences in HQD across different regions could be identified. As depicted in Figure 4.5, Y stands for the HQEI, $h(Y)$ means a partition of HQEI. $h(X)$ represents a partition of a component of X, while X should be stratified. Additionally, according to Wang et al. (2010), the q-statistic measures the association between X and Y, both linearly and nonlinearly.

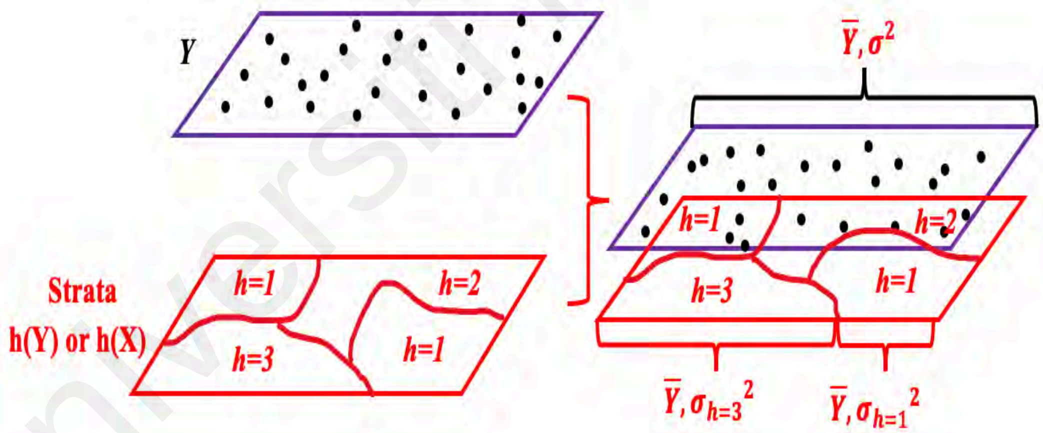

Figure 4.5: Principal of the Geo-detector Method
Source: Computed by the Author

Specifically, the q-statistic used for capturing heterogeneity can be expressed as follows:

$$\begin{cases} q - \text{statistic} = 1 - \dfrac{\sum_{h=1}^{L}\sum_{i=1}^{N_h}\left(Y_{hi} - \overline{Y}_h\right)^2}{\sum_{i=1}^{N}\left(Y_i - \overline{Y}\right)^2} = 1 - \dfrac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2} = 1 - \dfrac{SSW}{SST} \\ SSW = \sum_{h=1}^{L}\sum_{i}^{N_h}\left(Y_{hi} - \overline{Y}_h\right)^2 = \sum_{h=1}^{L} N_h \sigma_h^2 \\ SST = \sum_{i}^{N}\left(Y_i - \overline{Y}\right)^2 = N\sigma^2 \end{cases} \quad (4-18)$$

A research area is composed of N units and is stratified into $h = 1,2, \ldots, L$ stratum, while the stratum is made up of N_h units; Y_{hi} and $\overline{Y}_h$ regulate the value of unit i in the population and stratum h, accordingly. Specifically, the stratum mean and stratum variance were $\overline{Y}_h = (1/N_h)\sum_{i=1}^{N_h} Y_{hi}$ and $\sigma_h^2 = (1/N_h)\sum_i^{N_h}\left(Y_{hi} - \overline{Y}_h\right)^2$, respectively. Similarly, the sample mean and sample variance were $\overline{Y} = (1/N)\sum_{i=1}^{N} Y_i$ and $\sigma^2 = (1/N)\sum_i^{N}\left(Y_i - \overline{Y}\right)^2$, respectively. SSW and SST represent the total sum of squares and within the sum of squares, respectively. It is worth mentioning that the model was constructed assuming $\sigma^2 \neq 0$ and the interval of the $q - \text{statistic}$ was $[0,1]$. Specifically, if the $q - \text{statistic} = 0$, it suggested that the influencing factors did not drive the spatial distribution of HQD, and the larger the value of the $q - \text{statistic}$, the greater the influence of the influencing factors on HQD. Correspondingly, Table 4.8 describes the classification of impact degrees.

Table 4.8: Classifications of Influential Degree

Estimated coefficient	$0.8 \leq q \leq 1$	$0.7 \leq q < 0.8$	$0.6 \leq q < 0.7$
Impact classification	Extreme impact	Great impact	Large impact
Estimated coefficient	$0.5 \leq q < 0.6$	$0.3 \leq q < 0.5$	$0 \leq q < 0.3$
Impact classification	General impact	Smaller impact	Weak impact

4.3 Methodology on Industrial Structure Transformation and Upgrading

This section describes the detailed methodology regarding the measurement schemes measuring China's interprovincial ISU, ISR and IS. Also, the detailed empirical procedure concerning the Cloud model is presented, which was adopted to analyse the distribution characteristics of the above three variables from regional and national perspectives.

4.3.1 Industrial Structure Upgrading

In general, the measurement schemes of the ISU in the existing literature have mainly been classified into four types, which are given as follows:

1. **ISU measurement scheme I**

Cheng et al. (2018) studied the effects of industrial structure and technical processes on China's carbon dioxide emission intensity using the dynamic spatial panel model. In such a process, the study used the proportion of the added value of the tertiary industry in GDP to denote China's industrial structure upgrading level.

2. **ISU measurement scheme II**

However, the information technology revolution has significantly affected the industrial structure in major industrialised countries after the 1970s, resulting in a trend toward "economic services" (Zheng et al., 2021). Therefore, with the advancement of the industrialisation process, the traditional sector has gradually transferred to the third category, i.e., service-oriented economy and high-tech manufacturing (Li & Lin, 2017). Still, the ratio of the added value of the tertiary industry to GDP cannot reflect the dynamic characteristics of industrial changes (Zheng et al., 2021). Therefore, Zheng et al. (2021) adopted the percentage of the output of the tertiary industry to that of the secondary industry's output to reflect the dynamic process of industrial structure advancement. They quantitively analysed the spillover effect of ecological compensation on China's ISU. Based on different research purposes, (Hu et al., 2019; Chen & Wei, 2016) also used the same measurement scheme to measure China's ISU degrees.

3. **ISU measurement scheme III**

In the parallel research of industrial structure optimisation, (Liu et al., 2008; Song et al., 2021) used the following measurement scheme to reveal the dynamic changes in ISU, which is specified as follows:

$$\mathrm{ISU}_{\mathrm{i,t}} = \sum_{\mathrm{j}=1}^{3} \not{f}_{\mathrm{j}} \times \mathrm{j} = \not{f}_1 \cdot 1 + \not{f}_2 \cdot 2 + \not{f}_3 \cdot 3 \qquad (4-19)$$

Where $\not{f}_{\mathrm{j}}$ is the ratio of a total output value of industry j in region i in regional GDP, where $1 \leq \mathrm{ISU}_{\mathrm{i,t}} \leq 3$, this index reflects the sequential evolution process of the industrial structure from the primary industry to the tertiary industry through the secondary industry. Therefore, the higher the index's value to 3, the higher the advanced degree of industrial structure.

4. ISU measurement scheme IV

According to the discussion mentioned in Chapter 2, ISU results from continuous industrial structure advances. The ratio of primary industries has gradually declined, and the ratio of secondary and tertiary industries has gradually increased. Therefore, the ratio of the high-tech industry is substantially increased, implying that the industry will change from labour-intensive and resource-intensive to capital-intensive and technology-intensive industries. Fu (2010) proposed a new measurement scheme and then used the new indicator to empirically analyse the relationship between ISU and China's economic growth by adopting the Granger causality test.

Specifically, the detailed steps for calculating China's ISU degree are as follows:

Step 1. Regional GDP classification.

According to China's National Bureau of Statistics[51] classification method, the regional GDP was divided into three parts

Step 2. Spatial vector determination.

[51] See http://www.stats.gov.cn/

The added value of each industry (primary, secondary and tertiary industry) in the GDP is regarded as a component in the spatial vector, thus, forming a group of three-dimensional vectors, which can be expressed as follows:

$$X_i = (x_{i,1}, x_{i,2}, x_{i,3}) \qquad (4-20)$$

Where X_i is the industrial structure matrix of region i; $x_{i,1}$, $x_{i,2}$ and $x_{i,3}$ denote the ratio of the added value of the primary industry to the GDP, the ratio of the secondary industry's added value to the GDP, and the ratio of the added value of the tertiary industry to the GDP, respectively.

Step 3. Angle's calculation.

Calculate the angles between X_i and X_1, X_2, X_3, respectively, which are included as angles θ_1, θ_2, and θ_3. X_1, X_2, X_3 regulate the vectors of industrial evolution from the low to the high level. X_1, X_2, X_3 are given as follows: $X_1 = (1,0,0), X_2 = (0,1,0), X_3 = (0,0,1)$. Specifically, the included angle is defined as follows using the arccosine mathematical function:

$$\theta_j = \arccos\left(\frac{\sum_{i=1}^{3}(x_{i,j} \cdot x_{i,0})}{\sum_{i=1}^{3}(x_{i,j}^2)^{1/2} \cdot \sum_{i=1}^{3}(x_{i,0}^2)^{1/2}}\right); j = 1,2,3 \qquad (4-21)$$

Step 4. ISU degree calculation. The equation for calculating China's ISU degree is as follows:

$$ISU_{i,t} = \sum_{k=1}^{3}\sum_{j=1}^{3}\theta_j \qquad (4-22)$$

After reviewing the relevant literature, this study adopted ISU measurement scheme IV to measure China's interprovincial ISU levels. This method can effectively reflect the dynamic process of industrial structure optimisation and adjustment (Fu, 2010)

4.3.2 Industrial Structure Rationalisation

Similarly, the measurement schemes for ISR in the existing literature have been mainly classified into three types, which are shown as follows:

1. ISR measurement scheme I

Gan et al. (2013) proposed a method for calculating ISR by modifying the Theil Index and then used the new indicator to explore the impacts of industrial structure changes on China's economic growth and fluctuations.

Specifically, the formula for ISR is expressed as follows:

$$\mathrm{ISR}_{i,t} = \sum_{i=1}^{3} \left(\frac{Y_i}{Y}\right) \left| \ln \left(\frac{Y_i}{L_i} \Big/ \frac{Y}{L}\right) \right| \qquad (4-23)$$

Where Y_i is the output value of industry i; Y is the total output value; L_i is the employed labour of industry i; L is the total employed labour, and n $(n = 1,2,3)$ is the number of industries. Following classical assumptions, each industrial sector has the same productivity level when the economy is in its final equilibrium state. By definition, Y/L represents labour productivity. Therefore, when the economy approaches equilibrium, $Y_i/L_i = Y/L$, thus, the Theil Index $(\mathrm{ISR}_{i,t})$ is equal to 0. It should be noted that $\mathrm{ISR}_{i,t}$ is a reverse index. The larger the $\mathrm{ISR}_{i,t}$ the higher the level of deviation of the equilibrium industrial structure and the more unreasonable the industrial structure will be.

2. ISR measurement scheme II

Adopting the Spatial Lag Model, Zhao et al. (2020) empirically analysed the impacts of ISU and ISR on China's urban ecological efficiency by using the global reference super slack-based model. They adopted the deviation degree to measure China's overall ISR measurement degree. The formula is specified as follows:

$$\mathrm{Dev}_{i,t} = \sum_{i=1}^{3} \left| \frac{Y_i/Y}{L_i/L} - 1 \right| = \sum_{i=1}^{3} \left| \frac{Y_i/Y}{L_i/L} - 1 \right| \quad (4-24)$$

Where Y_i is the output value of industry i; L_i is the employed labour of the industry i; $i(= 1,2,3)$ represents the primary, secondary and tertiary industries, respectively. The smaller the $\mathrm{Dev}_{i,t}$ value, the more reasonable the industrial structure.

3. ISR measurement scheme III

Researching the impact of vertical fiscal imbalance on the upgrading of the industrial structure, Lin & Zhou (2021) adopted the adjusted deviation degree to measure China's RIS level based on the ISR measurement scheme I, which was modified by assigning the weight of industrial proportion. The relevant formula is expressed as follows:

$$\mathrm{Dev}_{i,t} = \sum_{i=1}^{3} y_{n,i,t} \left| lp_{n,i,t}/lp_{n,t} - 1 \right| \quad (4-25)$$

Where $y_{n,i.t}$ is the percentage of the output value of industry i in the GDP for the year t; $lp_{n,i,t}$ is the labour productivity of industry i. Similarly, the smaller the value, the more reasonable the industrial structure.

4. ISR measurement scheme IV

This study proposed that rationalisation of the industrial structure indicated that production factors were rationally allocated according to specific demand structures to realise coordinated and synergistic development among different industries with the constraints of productivity levels and resource endowments. Based on Eq. (4-25), the reciprocal form was adopted by this study to measure China's ISR level. The formula is given as follows:

$$\mathrm{Adj\_dev}_{it} = \sum_{i=1}^{n} (Y_i/Y)|\,(Y_i/L_i)/(Y/L) - 1|\,;\, \mathrm{ISR}_{it} = \frac{1}{\mathrm{Adj\_dev}_{it}} \qquad (4-26)$$

In the above formula, Y_i is the total output value of industry i; L_i is the labour input of industry i. When the economy is in equilibrium, $Y_i/L_i = Y/L$, $\mathrm{Adj\_dev}_{it} = 0$. Thus, the higher the value of $\mathrm{Adj\_dev}_{it}$ the smaller the value of ISR_{it} and the lower the level of rationalisation of industrial structure.

4.3.3 Industrial Structure Transformation and Upgrading Composite System

Since no suitable estimation method has been used to assess IS, this study obeyed the following procedures to calculate interprovincial IS in China from 2005 to 2019.

Step 1. Carry out a dimensionless process by adopting Eq. (4-1).

Step 2. After processing step 1, the weight of ISU and ISR were calculated using the entropy method and coefficient variation, respectively.

Step 3. A comprehensive weight w_j for each indicator was then determined by calculating the average weight estimated in step 2.

Step 4. A comprehensive index IS was determined by $m_{ijq} = \sum_{i=1,j=1}^{m,n} x_{ij}^{+} * w_j$ $(q = 1,2)$.

4.3.4 Cloud Model

The proposed Cloud map was used to overcome shortcomings in; the fuzzy set, rough set, probability statistics, evidence theory, etc., when dealing with uncertain information from different perspectives (Li et al., 1998). The Cloud model, a new cognition model for uncertainty based on the probability theory and fuzzy set theory, provides a way to realise bidirectional cognitive transformations between qualitative concept and quantitative data through the forward cloud transformation algorithm (FCT) and backward cloud transformation algorithm (BCT).

More specifically, the Cloud model is characterised by three digital features: expected value (E_x), entropy (E_n), and hyper entropy (H_e). The Cloud map can plot a synthetical map through the above three digital characteristics to reveal a comprehensive degree of the evaluation object. Correspondingly, the relevant expressions used for computing E_x, E_n, H_e, and μ (membership) are specified as follows:

$$E_x = \frac{\sum_{i=1}^{u} x_i}{u} \quad (4-27)$$

$$E_n = \sqrt{\frac{\pi}{2}} * \frac{\sum_{i=1}^{u} |x_i - E_x|}{u} \quad (4-28)$$

$$H_e = \sqrt{|S^2 - E_n^2|} \quad (4-29)$$

$$\mu = e^{-[(x_i)^2 - E_x/2(E_n)^2]} \quad (4-30)$$

Where u is the number of membership clouds of x_i; x is corresponding indicators; and S^2 is the variance of the sample. The mapping from all to the interval $u \in U[0,1]$, is a single point to a multipoint transition, generating a membership cloud rather than a curve. According to Liu et al. (2007), entropy reflects the uncertainty of a qualitative concept, in which the higher the entropy value, the higher the fuzziness and randomness. Correspondingly, it is hard to quantify the concept. Hyper entropy is a measure of uncertainty. That is, the higher the value of H_e, the higher the dispersion of membership clouds.

Implementing the Cloud model asks that the evaluation indicator be stratified. Therefore, ISU, ISR, and IS levels were classified into four categories regarding their development degrees: Excellent, Good, Normal, and Bad. The relevant evaluation standards are shown in Table 4.9, and the flowchart for implementing the Cloud model is presented in Figure 4.6.

Table 4.9: Digital Features of the Evaluation Standards

Standard level	Interval	Digital features	Decision
Level I	$(0.75,1.00]$	$(0.875, 0.106, 0.001)$	Excellent
Level II	$(0.50,0.75]$	$(0.625, 0.106, 0.001)$	Good
Level III	$(0.25,0.50]$	$(0.375, 0.106, 0.001)$	Normal
Level IV	$(0.00,0.25]$	$(0.125, 0.106, 0.001)$	Bad

However, the different magnitude of the evaluation indicator did allow this study to perform the Cloud model by following the evaluation standards directly. In this regard, this study found the leading economy or the so-called frontier and then adopted the following formula to deal with the indicator:

$$\rho_i = x_i/x_i^f;\ x_i^f = \max(x_i) \qquad (4-31)$$

Where x_i is the ISU, ISR, or IS levels in province i; x_i^f is the frontier or leading economy, regarded as a maximum value in the DMU for the same indicator. The above process entails that, on the one hand, the leading economy is not necessarily always the same one (i.e., $\rho_i = 1$). On the other hand, the above process can be regarded as a standardisation process to ensure that the values of all indicators are distributed in $[0, 1]$.

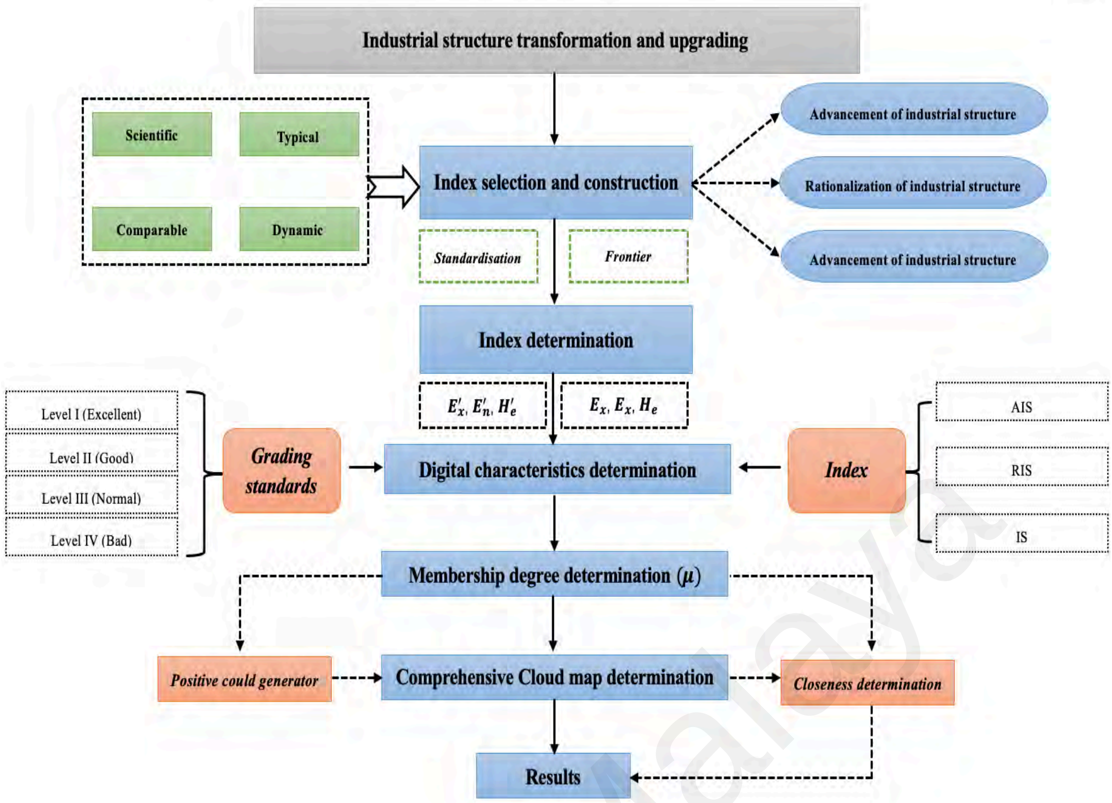

Figure 4.6: Flowchart of the Cloud Map
Source: Computed by the Author

4.4 Methodology on Modelling the Effect of Industrial Structure Transformation and Upgrading on China's High-Quality Economic Development

This section illustrates the detailed methodology, including selecting control variables and spatial regression model specification. The designed spatial benchmark regression can be adopted to model the effect of ISTU (i.e., ISU, ISR and IS) on China's HQD from national and regional perspectives.

4.4.1 Selection of Control Variables

This study reviewed the existing literature and then selected the following factors as control variables to "clean" the possible influence that may affect HQD, i.e., government expenditure, foreign direct investment, marketisation index, innovation, capital per capita, and economic policy uncertainty. The relevant discussions and corresponding definitions are as follows:

1. Government expenditure (GE)

The composition of GE varies significantly across different countries and has experienced significant change over time globally (Chen et al., 2019). The relationship between GE and economic growth has received much attention in practical and theoretical economic growth studies. However, there has been no consensus on the relationship between GE and economic growth. Some studies have found a positive relationship (i.e., Lahirushan & Gunasekara, 2015; Selvanathan et al., 2021). In contrast, other studies have found a negative relationship (i.e., Landau, 1983; Grier & Tullock, 1989; Barro, 1990; Devarajan et al., 1996), while others proclaimed that there was no significant relationship between GE and economic growth (i.e., Ansari et al., 1997).

Two opposing views exist regarding the relationship between GE and economic growth: Wanger's law and the Keynesian hypothesis. According to Wanger's law, economic growth improves GE, particularly in; infrastructure construction, social transfers and public services, and other economic services (i.e. Srinivasan, 2013). On the contrary, GE has been used to moderate economic activities in the short term as an exogenous policy tool. Particularly, Keynes (1936) proclaimed that fiscal policy through government spending could be the main driver of economic growth and should be regarded as a powerful weapon that can be adopted to fight economic stagnation (Fazzari, 1994).

Referring to the Keynesian economic theory, the continuous improvement of GE will increase total output (assuming that investment and consumption are constant). Furthermore, the Keynesian-type fiscal policy was considered highly effective during economic recessions, i.e., the 1930s (the great depression); 2007-2008 (the great recession). Increased GE, government rebates, and various stimulus tools have been common approaches to address the recessionary gap (Feldstein, 2009). Thus, GE, an instrument to increase government funds to certain sectors, has been a pivotal determinant of economic growth. This situation is because, on the one hand, GE may improve a greater level of productive investment. On the other hand, GE may moderate conflicting interests between society and the private sector, thus driving economic growth. Therefore, GE is expected to contribute to China's HQD.

2. Foreign direct investment (FDI)

The hypothesis of FDI-led economic growth indicates that FDI associated with other crucial factors, such as; capital, exports, human capital and technology transfers, has had crucial effects on stimulating economic growth (Lim & Maison, 2000). These factors might be introduced and nurtured to promote economic growth through the channel of FDI. Some studies (Shakar & Aslam, 2015; Borensztein et al., 1998) have pointed out that FDI inflows could improve a country's economic performance through spillover efficiency and technology transfers. Shakar & Aslam (2015) stated that spillover efficiency occurs when domestic enterprises absorb the intangible and tangible assets of MNCs (multinational corporations) embodied in FDI. Furthermore, as FDI generates forward and backward linkages, when MNCs provide technical assistance to domestic enterprises, domestic producers' technological levels and productivity are expected to increase (Borensztein et al., 1998). Theoretically, FDI benefits investors (expanded markets, reduced costs) and receivers (human capital transfers, technology transfers, and employment generation).

Consequently, providing incentives to increase and attract FDI represents an excellent strategy for achieving higher production levels in emerging and developing countries (Alvarado et al., 2017; Yao, 2006). In contrast, FDI may adversely affect economic growth because of the intervening mechanisms of decapitalisation and dependence (Iamsiraroj, 2016). Nonetheless, scholars have demonstrated that FDI positively affects economic development (Osei & Kim, 2020; Sunde, 2017; Reza et al., 2018).

3. Marketisation index (MI)

Marketisation can be considered the fundamental driving force for developing China's urban economy, significantly contributing to its cities' economic growth (Li et al., 2020). Independent of the Marxist economic theory, the institutional economics theory, or the neoclassical economic growth paradigm demonstrating the positive role of marketisation in the economic growth process, has laid a solid theoretical foundation. Specifically, marketisation could improve TFP (Tian, 2001) and clarify production factories' property rights and income distribution (Chang et al., 2018). Investors might, thus, be incentivised to invest more production factors into production. This outcome will lower transaction costs and reduce information asymmetries, increasing factor inputs and expanding the market (Bennett et al., 2007).

In conclusion, an effective market system can help balance input and output structures, particularly energy efficiency, thus, gradually improving TFP. Overall, a sound and complete market-oriented economic system optimises economic resource reallocation and accelerates the economy's sustainable development. This outcome is because an efficient marketisation mechanism can drive high-energy consuming and high-polluting firms and industrial sectors out of the market, resulting in lower energy consumption and industrial pollutant emissions. Thus, improving and refining the marketisation mechanism promotes China's HQD.

4. Technological innovation (TI)

TI is a crucial driver of human progress and economic growth (Broughel & Thierer, 2019). Still, it also has been a powerful and indispensable element of a country's economic development (Leckel et al., 2020). Existing studies have provided fruitful findings to show the crucial role of TI in economic growth. For example, adopting 65 countries spanning from 1965 to 2005, Bravo-Ortega & García Marín (2011) pointed out that an increase of 10% in R&D would increase productivity by approximately 1.6% in the long run. Xiao (2019) pointed out that TI could be nurtured to form an economic growth pole and stimulate regional economic growth. Still, the interactive promotion of institutional innovation and TI can create new technology and knowledge. Taking Turkey as an example, Adak (2015) also found the positive effect of TI on economic growth. At the same time, this promoting effect of TI on economic growth was not only from a single area but from the cross-border diffusion effects of technological knowledge (Torres-Preciado et al., 2014). In addition, the empirical results in Chapter 4 also show that the innovative development subsystem had the largest weight compared with the other subsystems, indicating that China has increasingly attached greater importance to innovative development. This situation once again highlights the importance of TI in HQD.

5. Education input (EI)

Economic theory (such as Human Capital Theory; New Economic Growth Theory) has traditionally defined education as a crucial determinant of economic growth, nationally and regionally (Romer, 1990b; Batabyal & Nijkamp, 2013). Attention has recently concentrated on higher education among various levels of education. Higher education has been considered the most successful in providing professional knowledge and skills to compete in the new global economy and respond to TI (Faggian & McCann, 2009). In most countries, universities are under increasing public pressure to contribute to local development (Al-Tabbaa & Ankrah, 2016). Higher education is expected to be the critical factor that contributes most to economic growth (Sianesi & Van Reenen, 2003). Given this, China's government needs to provide sufficient funds to construct and develop universities.

On the one hand, it is conducive to improving the university's research capability by attracting more professional talents. On the other hand, increasing the number of universities in a certain region is conducive to accelerating economic growth (Agasisti & Bertoletti, 2020). To this end, it can be inferred that education plays a crucial role in regional economic development.

6. Per capita capital stock (CP)

Since the reform and opening-up policy, China has maintained a high capital accumulation rate due to high saving rates and huge foreign capital inflows. The amount of capital available in the economy annually is typically greater than the amount added in the year. This situation is because physical capital lasts for a long period. Therefore, the amount of capital available to firms today helps determine how much they can currently produce and consequently affects GDP growth. As labour becomes more efficient, this increased efficiency nationwide leads to economic growth, thus gradually improving the quality of economic development.

However, China's interprovincial capital stock data cannot be directly obtained from the database. Consequently, the perpetual inventory method (Wu et al., 2014) was adopted by this study to calculate the aggregate value of interprovincial capital. The calculation expression is denoted as follows:

$$\mathrm{K}_{\mathrm{it}} = \mathrm{I}_{\mathrm{it}} + (1 - \delta)\mathrm{K}_{\mathrm{it}-1} \qquad (4-32)$$

Where for province i and year t, I_{it} represents total social fixed asset investments, which is deflated to the constant price in 2005; δ is the deprecation rate of capital, and $\mathrm{K}_{\mathrm{t}-1}$ is the capital stock accumulated in the previous period.

There are three key steps when computing the interprovincial capital stock: initial capital determination (K_0), the depreciation rate of capital (δ), investment deflation index(P).

Initial capital stock determination (K_0). This study used the econometric method to determine the capital stock in 2005. Since the initial capital is the sum of previous investments, therefore, the following equation could be used to express the relationship between initial capital stock (K_{i0}) and investment (I_{it}):

$$K_{i0} = \int_{-\infty}^{0} \Delta K_{it} = \Delta K_{i0} e^{\theta} \theta \qquad (4-33)$$

In the above formula, $\Delta K_{it} = \Delta K_{i0} e^{\theta(t+1)}$, where θ is the investment growth rate. However, there is no depreciation rate in Eq. (4-33), which may overestimate initial capital stock.

Rearrange Eq. (4-33):

$$K_i(0) = \int_{-\infty}^{0} I_i(t)dt = I_i(0)/\theta \qquad (4-34)$$

Where $I_i(t) = I_i(0)e^{\theta t}$, the following equation can be obtained by taking the natural logarithm of both sides of the formula:

$$\ln I_i(t) = \ln I_i(0) + \theta t \qquad (4-35)$$

Now, the regression model can be derived by adding the error term into Eq. (4-35):

$$\ln I_i(t) = \ln I_i(0) + \theta t + \mu_{it} \qquad (4-36)$$

Where $I_i(t)$ is the total fixed social investment of each province, which can be regarded as a time series variable; $I_i(0)$ is the capital stock of each province in 2005, and μ_{it} is the error term. The investment growth rate is not stationary because of external shocks, i.e., technological changes and structural transformation. Therefore, the error term obeys the following dynamic equations:

$$\begin{cases} \mu_{it} = \rho\mu_{it-1} + \varepsilon_{it} & \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \\ \mu_{it} = \rho_1\mu_{it-1} + \rho_2\mu_{it-2} & \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \end{cases} \quad (4-37)$$

Therefore, the initial capital stock in 2005 can be measured using Eq. (4-36), and the capital stock can also be derived from the previous period (i.e., 2004) by adopting Eq. (4-37).

Depreciation rate of capital determination (δ). The capital depreciation rate in the existing literature has been regarded as a constant. For example, Zhang et al. (2004) re-estimated China's provincial capital stock from 1952 to 2000 by taking $\delta = 9.6\%$. Lei (2009) calculated $\delta = 9.732\%$ by adopting geometric efficiency profiles, which was consistent with Zhang et al. (2004). Xie et al. (2018) set $\delta = 10.96\%$ by following Shan (2008) and then empirically explored the incentive role of urban construction land in China's regional economic growth process. Dong et al. (2011) adopted $\delta = 5\%$ when analysing the determinants of China's industrial structure disproportion.

However, contrasting with the existing literature, Chen (2014) adopted the maximum likelihood method based on the production function to estimate China's capital depreciation rate and $\delta = 5.6456\%$. However, this method needed to add dummy variables into the model (i.e., economic structure changes) when estimating δ. This research set $\delta = 5.12\%$ (which was the average value of the values mentioned above: $9.6\% + 9.732\% + 10.96\% + 5\% + 5.6456\%/5$) to calculate capital stock.

Deflation index selection (P). The price indices for investment in fixed assets are relative figures reflecting the trend and degree of changes in prices of investment goods and projects in assets during a given period. This study used the price index for investment in fixed assets to deflate the aggregate data of total social investment in fixed assets.

7. Economic policy uncertainty (EPU)

EPU refers to a situation whereby "the economic subject cannot accurately predict whether, when and how a government will react to the current economic policy" (Gulen & Ion, 2016). In other words, from a micro perspective, EPU affects the environment in which enterprises operate. As a result, overall policy-related risks would indirectly or directly affect corporate outcomes and policies, i.e., corporate tax burden (Dang et al., 2019); voluntary disclosures (Nagar et al., 2019); and the investment level. EPU is the economic risk associated with undefined future government policies from a macro perspective. This outcome shows that governments hold a "wait-and-see" view of developing their economies. Therefore, economic policies give rise to uncertainties that have far-reaching impacts on macroeconomic operation, thus, causing uneven economic development. Notably, EPU harms China's HQD.

4.4.2 Specification of the Spatial Econometric Models

The common approach in most spatial studies has been to start with a non-spatial linear model, i.e., Ordinary Least Squares (OLS); Fixed-effect model; or the Generalised method of moments (GMM). At the same time, this study determined whether the so-called benchmark model needed to be extended with spatial factors and geographical elements. The Moran I statistic has been the most preferred approach for testing the feasibility of performing a spatial regression model. In particular, if Moran's I is statistically significant, extending the traditional econometric model by incorporating spatial elements is deemed reasonable.

More specifically, the general expression of the Spatial Durbin Model (SDM) is expressed as follows:

$$Y = \beta \iota_n + \rho \mathbf{WY} + \alpha \mathbf{X} + \theta \mathbf{WX} + \varepsilon_{it} \qquad (4-38)$$

Where α is the response parameter; ε_{it} is the error term; ρ and θ represent the regressive parameters; **W** is the spatial weight matrix; **X** is the influencing factors; **WX** is the lagging term of influencing factors. If $\theta = 0$, the SDM will be simplified to the SLM (Spatial Lag Model). If $\rho = 0$, the SDM will be simplified to the SLX (Spatial Lag of X Model). If $\theta + \rho\alpha = 0$, the SDM will be simplified to the SEM (Spatial Error Model). The corresponding relationships between spatial dependence models are shown in Figure 4.7.

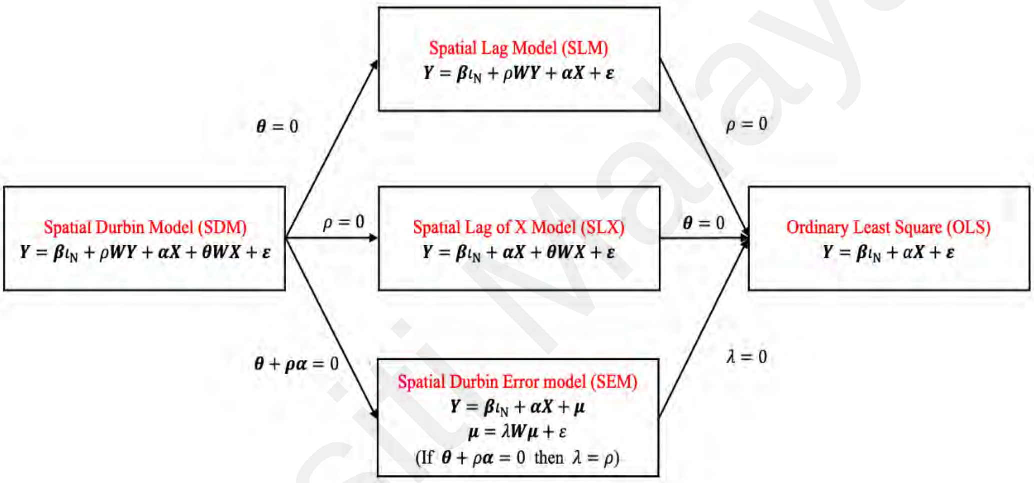

Figure 4.7: The Relationships Between Spatial Dependence Models
Source: Computed by the Author

Since there were three core independent variables, this study aimed to model the effects of ISU, ISR and IS on HQD, respectively. Therefore, three panel data models with spatial elements were constructed to examine the corresponding effects, and the models were as follows:

1. The ISU model with spatial effect is given as follows:

$$\begin{gathered} \mathrm{HQEI}_{it} = \alpha_{11}\mathrm{ISU}_{it} + \alpha_{12}\mathrm{GE}_{it} + \alpha_{13}\mathrm{FDI}_{it} + \alpha_{14}\mathrm{MI}_{it} + \alpha_{15}\mathrm{EI}_{it} + \\ \alpha_{16}\mathrm{TI}_{it} + \alpha_{17}\mathrm{CP}_{it} + \alpha_{18}\mathrm{RP}_{it} + \alpha_{19}\mathrm{EPU}_{it} + \rho_1\mathrm{WHQEI}_{it} + \\ \theta_{11}\mathrm{WISU}_{it} + \theta_{12}\mathrm{WGE}_{it} + \theta_{13}\mathrm{WFDI}_{it} + +\theta_{14}\mathrm{WMI}_{it} + \theta_{15}\mathrm{WEI}_{it} + \\ \theta_{16}\mathrm{WTI}_{it} + \theta_{17}\mathrm{WCP}_{it} + \theta_{18}\mathrm{WRP}_{it} + \theta_{19}\mathrm{WEPU}_{it} + \\ +\lambda_t + \mu_i + \varepsilon_{1it} \end{gathered} \qquad (4-39)$$

2. The ISR model with spatial effect is given as follows:

$$
\begin{aligned}
\mathrm{HQEI}_{it} = \alpha_{21}\mathrm{ISR}_{it} + \alpha_{22}\mathrm{GE}_{it} + \alpha_{23}\mathrm{FDI}_{it} + \alpha_{24}\mathrm{MI}_{it} + \alpha_{25}\mathrm{EI}_{it} + \\
\alpha_{26}\mathrm{TI}_{it} + \alpha_{27}\mathrm{CP}_{it} + +\alpha_{28}\mathrm{RP}_{it} + \alpha_{29}\mathrm{EPU}_{it} + \rho_{2}\mathrm{WHQEI}_{it} + \\
\theta_{21}\mathrm{WRIS}_{it} + \theta_{22}\mathrm{WGE}_{it} + \theta_{23}\mathrm{WFDI}_{it} + +\theta_{24}\mathrm{WMI}_{it} + \theta_{25}\mathrm{WEI}_{it} + \\
\theta_{26}\mathrm{WTI}_{it} + \theta_{27}\mathrm{WCP}_{it} + \theta_{28}\mathrm{WRP}_{it} + \theta_{29}\mathrm{WEPU}_{it} \\
\lambda_{t} + \mu_{i} + \varepsilon_{2it}
\end{aligned}
\qquad (4-40)
$$

3. The IS model with spatial effect is given as follows:

$$
\begin{aligned}
\mathrm{HQEI}_{it} = \alpha_{31}\mathrm{IS}_{it} + \alpha_{32}\mathrm{GE}_{it} + \alpha_{33}\mathrm{FDI}_{it} + \alpha_{34}\mathrm{MI}_{it} + \alpha_{35}\mathrm{EI}_{it} + \\
\alpha_{36}\mathrm{TI} + \alpha_{37}\mathrm{CP}_{it} + +\alpha_{38}\mathrm{RP}_{it} + \alpha_{39}\mathrm{EPU}_{it} + \rho_{3}\mathrm{WHQEI}_{it} + \\
\theta_{31}\mathrm{WIS}_{it} + \theta_{32}\mathrm{WGE}_{it} + \theta_{33}\mathrm{WFDI}_{it} + +\theta_{34}\mathrm{WMI} + \theta_{35}\mathrm{WEI}_{it} \\
\theta_{36}\mathrm{WTI}_{it} + \theta_{37}\mathrm{WCP}_{it} + \theta_{38}\mathrm{WRP}_{it} + \theta_{39}\mathrm{WEPU}_{it} + \\
\lambda_{t} + \mu_{i} + \varepsilon_{3it}
\end{aligned}
\qquad (4-41)
$$

Where HQEI denotes the comprehensive index of HQD; W represents the designed spatial weight matrix; α_{1i} $(i = 1,2,\ldots,9)$ is the set of response parameters; $\rho_i(i = 1,2,3)$ and $\theta_i(1,2,\ldots,9)$ represent the spatial autoregressive coefficients; λ_t and μ_i represent time and individual fixed effects, respectively.; ε_{1it}, ε_{2it}, and ε_{3it} are the error terms; ISU, ISR, and IS represent the three core independent variables, while GE, FDI, MI, EI, TI, CP, RP, and EPU are the selected control variables.

4.4.3 Spatial Spillover Effect Decomposition

For spatial studies, the regression coefficients of the model contain a large amount of information about the relationships among spatial units because spatial studies focus on exploring the sophisticated spatial dependence among spatial units. Changes in independent variables associated with a spatial unit will affect it, producing the so-called direct effect, which a conventional regression model usually describes. At the same time, it also produces indirect effects on other spatial units, generating the so-called indirect effect. As Behrens & Thisse (2007) stated, the capability to study the indirect effect is a vital manifestation of the role of spatial models.

In spatial studies, the regression coefficients of independent variables cannot directly reflect their influential degree on the dependent variable. This situation arises because the total effect is the sum of direct and indirect effects. The regression coefficients cannot directly be adopted to analyse the marginal effect of independent variables, assuming that the model has spatial lag terms. Furthermore, linear regression coefficients can be interpreted simply as the partial derivation of the dependent variable concerning the independent variable. This situation arises from linearity and the assumed independence of observation in the model: $y = \sum_{r=1}^{k} \alpha_r x_r$. $\partial y_i / \partial x_{ir} = \alpha$ is the simple form that the partial derivative of y_i concerning x_{ir} for all i, r and $\partial y_i / \partial x_{jr} = 0$, for $j \neq i$ and all variables r. The spatial spillover effect can be decomposed into direct and indirect effects through cross-sectional data by adopting the partial derivatives method (LeSage & Pace, 2009). Furthermore, Elhorst (2013) extended the above method to the panel data.

Eq. (4-38) can be expressed as follows:

$$\begin{cases} (I_n - \rho W)Y = \beta I_n + \alpha X + \theta W X + \varepsilon \\ Y = \sum_{r=1}^{k} S_r(W) X_r + V(W) I_n \beta + V(w)\varepsilon \\ S_r(W) = V(W)(I_n \alpha_r + W\theta_r) \\ V(W) = (I_n - \rho W)^{-1} = I_n + \rho W + \rho^2 W^2 + \rho^3 W^3 + \cdots \end{cases} \quad (4-42)$$

Eq. (4-42) can be re-written as follows:

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \sum_{r=1}^{k} \begin{bmatrix} S_r(W)_{11} & S_r(W)_{12} & \cdots & S_r(W)_{1n} \\ S_r(W)_{21} & S_r(W)_{22} & \cdots & S_r(W)_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ S_r(W)_{n1} & S_r(W)_{n2} & \cdots & S_r(W)_{kn} \end{bmatrix} \begin{bmatrix} X_{1r} \\ X_{2r} \\ \vdots \\ X_{kr} \end{bmatrix} + V(W) I_n \kappa + V(W)\varepsilon$$

$$Y_i = \sum_{r=1}^{k} [S_r(W)_{i1} X_{1r} + S_r(W)_{i2} X_{2r} + \cdots + S_r(W)_{ik} X_{kr}] + V(W) I_n \kappa + V(W)\varepsilon \quad (4-43)$$

$$\begin{cases} \dfrac{\partial Y_i}{\partial X_{jr}} = S_r(W)_{ij} \\ \dfrac{\partial Y_i}{\partial X_{ir}} = S_r(W)_{ii} \end{cases}$$

Where $S_r(W)_{ij}$ and $S_r(W)_{ii}$ are the indirect and direct effects, respectively, and the total spatial spillover effect is their sum.

4.5 Research Framework and Data Sources

This section presents the overall research framework that formed the basis for this study and then describes the detailed data sources employed in this study.

4.5.1 Research Framework

Figure 4.8 displays the research framework that depicts how each research question was addressed. The detailed explanations are as follows:

1. RQ1 investigated China's HQD from temporal-spatial perspectives. Three scores assessed China's HQD: absolute, relative, and fluctuating from the temporal aspect. China's HQD was discussed from a spatial perspective by adopting spatial statistical techniques, such as Moran's Index and Moran's scatterplot. Importantly, the spatial analysis was conducted based on HQD's absolute score. The crucial reasons were twofold: (1) HQD's relative score showed the annual changes of HQD. Therefore, it was unnecessary to conduct a spatial analysis adopting this score. At the same time, the results of Moran's I showed that the relative score did not exhibit spatial autocorrelation. (2) It was unnecessary to carry out a spatial autocorrelation test using fluctuating scores because it did not belong to the time-series data set. Additionally, the Geo-detector method was adopted to identify regional heterogeneity concerning China's HQD (see Path I in Figure 4.8).
2. RQ2 explored the development status of ISU, ISR and IS. Also, their distribution features were explored from regional and national perspectives by performing the Cloud model (see Path II in Figure 4.8).
3. RQ3 identified whether ISTU promoted or inhibited HQD. Subsequently, the SDM was implemented to examine the effects of ISU, ISR, and IS on China's HQE, respectively, from regional and national perspectives (see Path III in Figure 4.8).

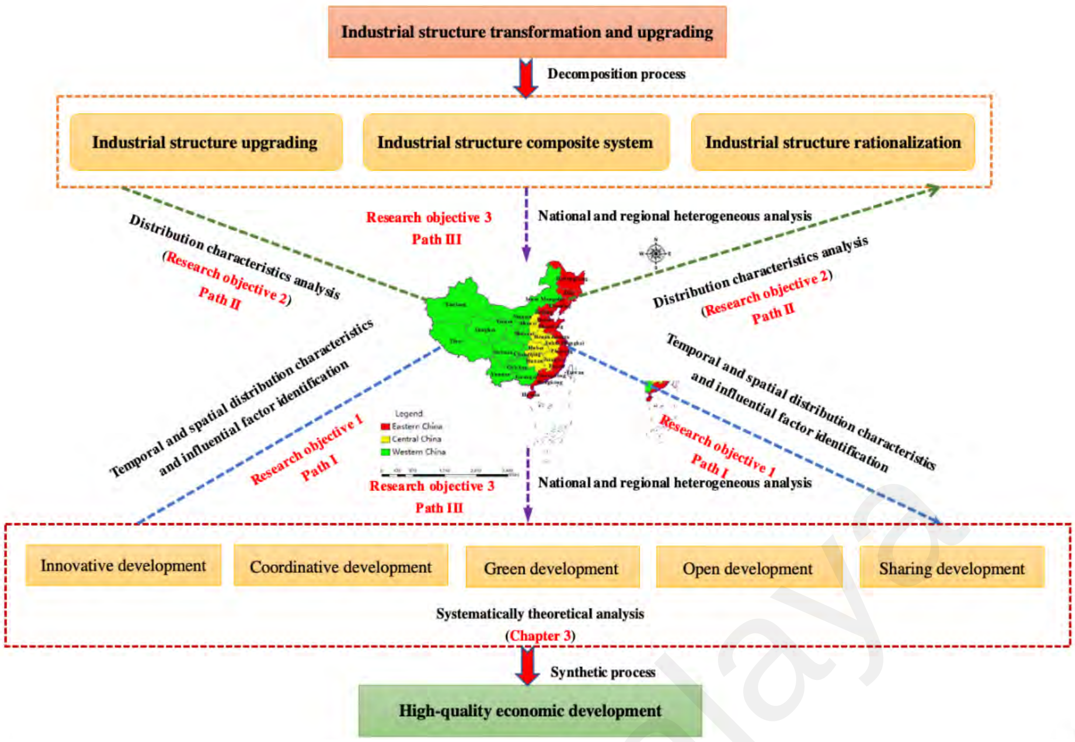

Figure 4.8: Theoretical Framework
Source: Computed by the Author

Table 4.10 displays the detailed empirical procedure that reported the techniques employed by this study to solve each research question.

Table 4.10: The Detailed Procedure for Empirical Analysis

Step	Content	Method	Objective
Step#1	HQD assessment system construction and its calculation strategy	The combined weighting determination procedure (entropy method and variation coefficient)	/
Step#2	HQD performance analysis	Temporal perspective: relative score, absolute score and fluctuating score (Cluster analysis) Spatial perspective: Moran's I, Moran scatterplot. Regional heterogeneity: Geo-detector	RO1
Step#3	Analysis of development status of ISU, ISR and IS	Cloud model	RO2
Step#4	Validation of the effect of ISU, ISR, and IS on HQD	The Spatial Durbin Model	RO3

It should be noted that this study adopted quantitative and comparative methods to conduct its empirical analysis.

First, the combined weighting determination procedure was used to calculate HQD in China. At the same time, the regional heterogeneity was then captured by comparing HQD performance among the various provinces and regions (RQ1).

Second, the Cloud model was implemented to display the distribution characteristics of ISU, ISR and IS. Subsequently, the development characteristics and regional heterogeneity were determined by detecting their distributions in three major economic zones (RQ2).

Third, the SDM was performed to examine the effect of ISU, ISR and IS on HQD from regional and national perspectives. Then the influential sign and magnitude were identified by comparing the regression results (RQ3).

4.5.2 Data Sources

Given the data availability, this study used the panel data of 30 provinces in China (excluding Tibet, Taiwan, Hongkong, and Macau because of data unavailability) spanning from 2005 to 2019, thus, yielding 450 observations for each selected variable. The research data were available from the National Bureau of Statistics of China (http://www.stats.gov.cn/). Table 4.11 summarises the detailed data sources employed by this study.

Table 4.11: Data Sources

HQD assessment system	China Statistical Yearbook on Science and Technology (2006~2020), National Bureau of Statistics of China (2006~2020), Statistical Yearbook of each province (2006~2020), China Statistical Yearbook on Environment (2006~2020), Almanac of China's Finance and Banking (2006 ~ 2020), Wind databases
ISU, ISR and IS	National Bureau of Statistics of China (2006~2020) and Statistical Yearbook of each province (2006~2020), Wind databases

Control variables	National Bureau of Statistics of China (2006~2020), Statistical Yearbook of each province (2006~2020), Wind databases

Note: This study obtained economic policy uncertainty (EPU) data from Yu et al. (2021). A similar statistical approach was used to collect data from 2018 to 2019, as the research period of Yu et al. (2021) only covered the period from 2000 to 2017.

It is worth mentioning that all monetary variables were converted into the 2005 constant prices. More specifically, GDP was deflated using the GDP deflator, and total investment in fixed assets was deflated by adopting the price index for investment in fixed assets. Besides, the relevant data concerning FDI were derived by multiplying the actual amount of FDI by the US dollar-RMB exchange rate.

4.6 Chapter Summary

This chapter has developed an integrated methodology including; HQD assessment system construction, strategies for exploring ISTU (i.e., ISU, ISR, and IS) development characteristics, and detailed empirical procedures for modelling the effects of ISTU on China's HQD, a research framework relevant to this study, and data sources.

CHAPTER 5: FINDINGS 1: ASSESSMENT OF CHINA'S HIGH-QUALITY ECONOMIC DEVELOPMENT

5.1 Introduction

This chapter assesses China's HQD development characteristics from temporal-spatial perspectives. At the same time, regional heterogeneity concerning HQD performance is also investigated.

5.2 Results of China's High-Quality Economic Development

It is worth noting that the PCA results reported in Chapter 4 strongly verified the feasibility and reliability of the selected assessment indicators in this study. Therefore, the following section first explores China's HQD performance through three scores: absolute score (AS), relative score (RS), and fluctuating score (FS). At the same time, China's 30 provinces have been further classified into 12 groups concerning the HQD performance of each score. Finally, spatial statistical techniques were implemented to discuss HQD's spatial distribution characteristics.

5.2.1 Results of China's High-Quality Economic Development Based on Absolute Score

Table 5.1 displays the HQEI levels of 30 provinces in China from 2005 to 2019. The HQD levels in China's 30 provinces have exhibited an upward trend from 2005 to 2019, excluding small fluctuations in some provinces, such as; Hainan, Yunnan, Qinghai, etc. This study has only discussed the HQD levels of China's 30 provinces in 2005 and 2019 because of the large sample size.

Specifically, the maximum and minimum values of HQEI in 2005 were 0.427 and 0.053, respectively, with a difference of approximately 8.056 times, indicating a large gap in China's HQD between different provinces. While only nine provinces (i.e., Beijing, Shanghai, Guangdong, Jiangsu, Tianjin, Zhejiang, Fujian, Shandong and Liaoning) exceeded 0.145 (average HQEI) in 2005, accounting for 30% of the whole sample. Still, the top ten provinces with the highest-quality economic development levels were; Beijing, Shanghai, Guangdong, Jiangsu, Tianjin, Zhejiang, Hainan, Fujian, Liaoning, and Shandong. The above top ten provinces are all from China's eastern region. Ningxia, Jilin, Hebei, Hubei, Shanxi, Yunnan, Henan, Anhui, Gansu, and Guizhou ranked in the bottom ten, comprising two eastern, three central, and four western provinces.

In 2019, Beijing had the highest HQD value, at 0.711, which played a leading role in the national HQD process. In contrast, Qinghai had the lowest level, at 0.154. The difference between the maximum and minimum values of HQD was about 4.617 times. Guangdong ranked second, with a value of 0.642. The HQD level in China's various regions was extremely unbalanced. The HQEI values of; Heilongjiang, Inner Mongolia, Ningxia, Xinjiang, Gansu, and Qinghai were less than 0.2, which was about 0.5 lower than Beijing. The top ten provinces in China with the highest-quality economic development levels were; Beijing, Guangdong, Shanghai, Zhejiang, Jiangsu, Shandong, Hainan, Tianjin, Fujian, and Hubei, comprising eight eastern provinces and two central provinces. Yunnan, Jilin, Heilongjiang, Shanxi, Inner Mongolia, Ningxia, Guizhou, Xinjiang, Gansu, and Qinghai were ranked in the bottom ten, comprising two eastern, one central, and seven western provinces. While only 12 provinces were higher than 0.288 (average HQEI), accounting for 40% of the sample.

The eastern region was more affluent in factor resources and experienced significant changes in economic development. Therefore, the HQD status in the eastern region was better than in the central and western regions. The results also show that the development disparity among the various regions and provinces in 2019 was still dominant compared with 2005. Hence, achieving HQD, especially for combating unbalanced and uncoordinated development, requires collaborative efforts.

Figure 5.1 displays the spatial distribution characteristics of HQD in the selected years. Overall, the average HQEI has presented a significant upward trend from 2005 to 2019, suggesting that the economic quality in China increased monotonically, with an average of 0.210 (see Table 5.1). More specifically, the annual average HQEI in the; 11th Five-Year Plan, 12th Five-Year Plan and 13th Five-Year Plan[52] were 0.170, 0.218 and 0.226, respectively. The corresponding annual growth rates were; 5.027%, 4.910% and 5.394%, respectively, thus, creating a "V-shaped" trend. On the one hand, after China entered its new era in 2012, the bottleneck faced by the Chinese central government was downward economic pressure. The GDP growth rate showed a significant downward trend (see Chapter 1).

On the other hand, the negative externalities imposed by traditional economic development patterns have become evident (i.e., ecological deterioration, overcapacity). At the same time, the 12th Five-Year Plan could be regarded as a crucial period for China in building a moderately prosperous society. That is, China emphasised improving economic development quality instead of quantity expansion. Thus, the HQD

[52] However, the actual HQEI in 2020 could not be obtained, because the research period in this research was 2005-2019. In view of this, the HQEI in 2020 was calculated by using the annual growth rate of HQEI, and the average HQEI in 2020 was, thus, 0.305.

comprehensive index first decreased and exhibited an increasing trend during the research period. The empirical findings were consistent with China's economic performance, which proved the feasibility of this study's constructed HQD assessment system.

As for the spatial distribution characteristics, the HQEI in China's three major economic zones improved dramatically, especially for the western region. However, the HQD performance of the eastern region was greater than the central and western regions, forming the following rank: Eastern> Central> Western. By inspection, HQD performance in some eastern coastal provinces (Guangdong, Zhejiang) was better than in other eastern provinces (Liaoning, Jilin). Intuitively, regional development disparity concerning HQD performance was significant. This outcome means that there is greater room for most of China's provinces to improve their HQD.

Table 5.1: HQD Levels of China's 30 Provinces from 2005 to 2019

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average
Beijing	0.427	0.439	0.466	0.474	0.465	0.494	0.513	0.552	0.564	0.577	0.607	0.630	0.674	0.699	0.711	0.553
Tianjin	0.248	0.270	0.284	0.300	0.256	0.268	0.281	0.289	0.291	0.304	0.309	0.305	0.321	0.326	0.322	0.292
Hebei	0.079	0.087	0.094	0.114	0.118	0.128	0.134	0.149	0.163	0.174	0.186	0.195	0.211	0.217	0.227	0.152
Shanxi	0.084	0.074	0.103	0.114	0.113	0.119	0.127	0.136	0.153	0.151	0.154	0.159	0.173	0.186	0.190	0.136
Inner Mongolia	0.114	0.109	0.113	0.113	0.124	0.126	0.132	0.148	0.154	0.155	0.161	0.161	0.169	0.170	0.179	0.142
Liaoning	0.163	0.165	0.168	0.176	0.187	0.188	0.195	0.205	0.210	0.199	0.210	0.211	0.224	0.230	0.240	0.198
Jilin	0.096	0.091	0.110	0.112	0.121	0.124	0.133	0.142	0.158	0.163	0.179	0.180	0.181	0.190	0.201	0.145
Heilongjiang	0.108	0.111	0.118	0.125	0.125	0.140	0.143	0.170	0.156	0.158	0.169	0.169	0.183	0.182	0.194	0.150
Shanghai	0.343	0.379	0.399	0.396	0.386	0.401	0.400	0.399	0.390	0.400	0.416	0.429	0.428	0.452	0.465	0.406
Jiangsu	0.301	0.330	0.341	0.349	0.351	0.376	0.392	0.411	0.414	0.418	0.426	0.434	0.421	0.429	0.444	0.389
Zhejiang	0.225	0.247	0.256	0.263	0.263	0.292	0.307	0.322	0.335	0.348	0.373	0.390	0.414	0.430	0.462	0.329
Anhui	0.053	0.069	0.087	0.094	0.107	0.122	0.143	0.162	0.178	0.187	0.194	0.214	0.226	0.238	0.256	0.155
Fujian	0.181	0.172	0.195	0.198	0.200	0.210	0.224	0.232	0.239	0.245	0.255	0.267	0.289	0.308	0.309	0.235
Jiangxi	0.099	0.115	0.127	0.133	0.142	0.153	0.160	0.166	0.181	0.184	0.192	0.197	0.211	0.221	0.235	0.168
Shandong	0.163	0.162	0.170	0.176	0.188	0.208	0.222	0.239	0.254	0.264	0.279	0.295	0.313	0.331	0.346	0.241
Henan	0.071	0.072	0.083	0.095	0.109	0.116	0.126	0.139	0.152	0.165	0.173	0.184	0.201	0.216	0.230	0.142
Hubei	0.085	0.082	0.101	0.116	0.136	0.150	0.151	0.167	0.197	0.220	0.231	0.245	0.268	0.285	0.308	0.183
Hunan	0.109	0.116	0.119	0.121	0.125	0.134	0.139	0.151	0.162	0.170	0.172	0.187	0.202	0.212	0.235	0.157
Guangdong	0.318	0.334	0.350	0.339	0.316	0.344	0.360	0.373	0.390	0.383	0.412	0.441	0.514	0.533	0.642	0.403
Guangxi	0.099	0.102	0.111	0.123	0.136	0.142	0.146	0.155	0.167	0.180	0.185	0.188	0.197	0.206	0.219	0.157
Hainan	0.135	0.174	0.189	0.167	0.141	0.138	0.161	0.173	0.171	0.167	0.174	0.277	0.313	0.240	0.332	0.197
Chongqing	0.099	0.124	0.138	0.142	0.153	0.168	0.193	0.220	0.225	0.244	0.239	0.254	0.275	0.299	0.299	0.205
Sichuan	0.104	0.112	0.142	0.138	0.144	0.155	0.168	0.172	0.185	0.192	0.200	0.210	0.226	0.250	0.262	0.177
Guizhou	0.078	0.062	0.071	0.083	0.094	0.095	0.096	0.108	0.119	0.128	0.134	0.139	0.154	0.171	0.178	0.114
Yunnan	0.087	0.074	0.104	0.106	0.119	0.128	0.127	0.218	0.230	0.248	0.159	0.167	0.177	0.190	0.202	0.156
Shaanxi	0.102	0.122	0.127	0.134	0.141	0.156	0.177	0.211	0.228	0.239	0.253	0.263	0.292	0.295	0.307	0.203
Gansu	0.059	0.063	0.076	0.078	0.085	0.096	0.114	0.119	0.127	0.134	0.141	0.143	0.155	0.164	0.159	0.114
Qinghai	0.134	0.142	0.143	0.132	0.137	0.127	0.146	0.147	0.148	0.144	0.155	0.164	0.174	0.176	0.154	0.148

Ningxia	0.084	0.093	0.104	0.096	0.093	0.113	0.102	0.108	0.123	0.140	0.149	0.144	0.204	0.172	0.179	0.127
Xinjiang	0.096	0.104	0.118	0.135	0.123	0.135	0.124	0.162	0.159	0.163	0.154	0.158	0.162	0.169	0.164	0.142
Average	0.145	0.153	0.167	0.171	0.173	0.185	0.195	0.211	0.221	0.228	0.235	0.247	0.265	0.273	0.288	0.210

Note: Using the same calculation method, an existing study (Chen et al., 2020) demonstrated that some provinces realised HQD because the estimated index value was equal to 1. The concept of HQD was proposed during the 19th CPC National Congress report (it is only five years from now). However, China treats this strategy as a long-term guiding ideology to develop the economy. Therefore, the corresponding measurement is not appropriate. Although the evaluation index varies from other studies, this study's results were very close to the works of Wei & Li (2018) and Ma et al. (2019). Note people may question that the problem with this type of study is that everything is relative. This outcome means that for Beijing to be considered "Good", it has to have another province to be considered "bad" in comparison. To address this issue, this study used the following classifications to measure HQD performance in China's 30 provinces. Specifically, for every 0.25 as a cutting point, therefore, the whole interval can be divided into four intervals, such as [0.00, 0.25], [0.25, 0.50], [0.50, 0.75], and [0.75, 1.00]. The above four intervals correspond to four development performance levels:, "Excellent", "Good", "Average", and "Poor", respectively.

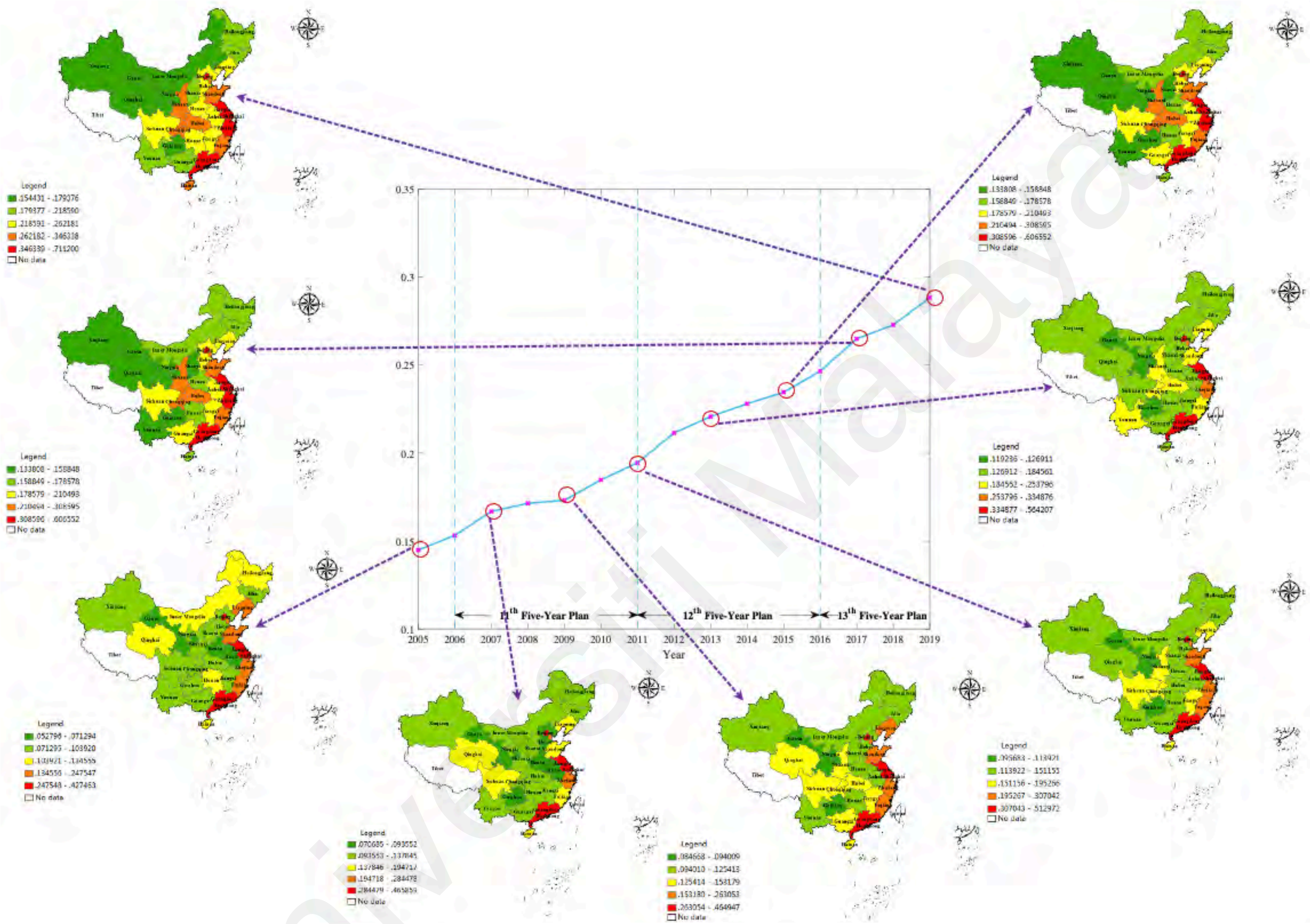

Figure 5.1: Spatial Distribution Characteristics of HQD in the Selected Years
Source: Computed by the Author

5.2.2 Comprehensive Index of Five Subsystems

This section shows the HQD performance of each subsystem in China's 30 provinces. Table 5.2 presents the comprehensive index of each subsystem in 2019, and the values in other years are shown in Appendix A.

1. **ID**. The maximum and minimum values of the ID subsystem were 0.921 and 0.028, a difference of approximately 33 times. The results show a huge gap between the levels of innovative development across various provinces. In addition, the mean value and the coefficient of the ID were 0.167 and 1.038, respectively.
2. **CD**. The CD levels of; Beijing, Shanghai, Tianjin, Zhejiang, and Jiangsu were 0.607, 0.586, 0.559, 0.547, and 0.545, respectively, greater than 0.5. Liaoning, Yunnan, Gansu, Heilongjiang, and Hebei were ranked in the bottom five, with values of 0.352, 0.315, 0.306, 0.302, and 0.302, respectively. The mean value of CD was 0.423, while the coefficient of variation was 0.187.
3. **GD**. The mean value of GD was 0.4937, while the coefficient of variation was 0.146. The top two provinces for GD were Shanghai and Fujian, with values of 0.638 and 0.605, respectively, which were more significant than 0.6. Ningxia, Qinghai, and Xinjiang had the lowest levels, with 0.371, 0.371, and 0.325, respectively, less than 0.4. Thus, the overall development performance of the GD subsystem was better than the other subsystems because of the highest mean value and lowest coefficient of variation.
4. **OD**. Guangdong had the highest level in the OD subsystem, with a value of 0.305. In contrast, Qinghai ranked bottom with a value of 0.003. The OD subsystem had the

lowest mean value, with a value of 0.080, and the coefficient of variation was 0.956. Besides, the OD level in some western provinces (i.e., Qinghai, Ningxia, Gansu) was quite low. It is worth pointing out that the overall development performance of the OD subsystem was not good compared with the other subsystems.

5. **SD**. The top two provinces for the SD subsystem were Shandong and Jiangsu, with values of 0.722 and 0.702, respectively, which were greater than 0.7. In contrast, Chongqing, Tianjin, Hainan, Guizhou, and Heilongjiang ranked bottom, with values of 0.337, 0.333, 0.324, 0.315, and 0.306, respectively, which were less than 0.35. Besides, only 19 provinces exceeded 0.456 (SD's average value), accounting for 63.3% of the whole sample. Besides, the mean value of SD was 0.446, and the coefficient of variation was 0.252.

Table 5.2 also displays households' per capita disposable income (including urban and rural areas). First, the disposable income of residents[53] refers to the income of residents for final expenditure and savings. It includes income in cash and kind. Second, the national per capita disposable income of households in urban and rural areas was 42358.8 Yuan and 30732.8 Yuan, respectively. Still, the average RPCDI in 2019 was 30104.7 Yuan, in which nine provinces exceeded the average value, including; Shanghai, Beijing, Zhejiang, Tianjin, Jiangsu, Guangdong, Fujian, Liaoning, and Shandong.

Moreover, the average UPCDI in 2019 was 41305.4 Yuan, nine provinces exceeded the average value: Beijing, Shanghai, Zhejiang, Jiangsu, Guangdong, Guangxi, Tianjin, Fujian, and Shandong. At the same time, the top ten provinces with a large gap

[53] By sources of income, disposable income includes four categories: income form wages and salaries, net business income, new income from properties and net income from transfer

between RPCDI and UPCDI included two central provinces (i.e., Anhui and Hunan) and eight western provinces (i.e., Guangxi, Yunan, Guizhou, Gansu, Xinjiang, Sichuan, Shaanxi, Qinghai). It is also worth noting that HQD performance in most provinces was consistent with national wealth distribution.

Third, note that the eastern region has a more affluent economic environment than the central and western regions. Taking the financial epicentre as an example, although financial industries have increasingly advanced in China (especially in the eastern region, i.e., Shanghai and Guangdong), they often present significant agglomeration effects (Yuan et al., 2020). However, financial agglomeration could cause the so-called "polarisation effect". This outcome is because provinces (or cities) functioning as financial centres could become; regional innovation centres, capital centres, channel centres, and information centres through the "polarisation effect". The further expansion of financial agglomeration could lead to fierce competition among financial centres of different levels and sizes. In particular, large-scale and high-level financial centres could crowd out small-scale and low-level financial centres, shrinking the financial institutions and industries in neighbouring areas. The expansion of financial agglomeration could absorb scarce resources from surrounding areas. In contrast, the "trickle-down effect" will be triggered when the financial centres become more overcrowded through spatial spillover effects.

Table 5.2: Subsystem Development Levels of HQD in 2019

	ID	CD	GD	OD	SD	Ave_ID	Ave_CD	Ave_GD	Ave_OD	Ave_SD	RPCDI	UPCDI	Diff.
Beijing	0.921	0.607	0.586	0.116	0.585	0.655	0.495	0.501	0.131	0.488	67755.9	73848.5	6092.6
Tianjin	0.275	0.559	0.456	0.092	0.333	0.208	0.470	0.387	0.150	0.265	42404.1	46118.9	3714.8
Hebei	0.078	0.302	0.537	0.025	0.545	0.046	0.295	0.410	0.028	0.351	25664.7	35737.7	10073
Shanxi	0.052	0.362	0.462	0.023	0.458	0.233	0.504	0.614	0.236	0.338	23828.5	33262.4	9433.9
Inner Mongolia	0.036	0.383	0.426	0.016	0.475	0.238	0.416	0.409	0.152	0.640	30555.0	40782.5	10227.5
Liaoning	0.136	0.352	0.490	0.047	0.438	0.201	0.439	0.531	0.144	0.383	31819.7	39777.2	7957.5
Jilin	0.088	0.426	0.499	0.020	0.388	0.113	0.344	0.401	0.100	0.408	24562.9	32299.2	7736.3
Heilongjiang	0.130	0.302	0.534	0.021	0.306	0.196	0.354	0.467	0.302	0.395	24253.6	30944.6	6691.0
Shanghai	0.358	0.586	0.638	0.202	0.384	0.094	0.369	0.540	0.119	0.272	69441.6	73615.3	4173.7
Jiangsu	0.332	0.545	0.445	0.117	0.702	0.033	0.353	0.500	0.121	0.255	41399.7	51056.1	9656.4
Zhejiang	0.357	0.547	0.564	0.142	0.592	0.102	0.340	0.415	0.066	0.325	49898.8	60182.3	10283.5
Anhui	0.182	0.435	0.482	0.047	0.382	0.062	0.363	0.381	0.024	0.291	26415.1	37540.0	11124.9
Fujian	0.146	0.485	0.605	0.130	0.375	0.099	0.268	0.386	0.034	0.251	35616.1	45620.5	10004.4
Jiangxi	0.110	0.467	0.563	0.050	0.359	0.127	0.304	0.401	0.044	0.285	26262.4	36545.9	10283.5
Shandong	0.164	0.415	0.447	0.095	0.722	0.054	0.299	0.390	0.024	0.316	31597.0	42329.2	10732.2
Henan	0.087	0.377	0.480	0.028	0.534	0.070	0.355	0.450	0.032	0.265	23902.7	34201.0	10298.3
Hubei	0.243	0.435	0.527	0.058	0.433	0.093	0.370	0.372	0.041	0.232	28319.5	37601.4	9281.9
Hunan	0.124	0.406	0.526	0.043	0.399	0.039	0.302	0.343	0.024	0.344	27679.7	39841.9	12162.2
Guangdong	0.293	0.455	0.584	0.305	0.643	0.053	0.410	0.493	0.045	0.259	39014.7	48117.6	9102.9
Guangxi	0.051	0.448	0.527	0.074	0.374	0.075	0.406	0.425	0.046	0.300	23328.2	47744.9	24416.7
Hainan	0.050	0.463	0.576	0.275	0.324	0.038	0.384	0.476	0.047	0.261	26679.5	36016.7	9337.2
Chongqing	0.128	0.443	0.485	0.178	0.337	0.081	0.340	0.465	0.119	0.228	28920.4	37938.6	9018.2
Sichuan	0.144	0.386	0.474	0.060	0.480	0.032	0.189	0.473	0.084	0.264	24703.1	36153.7	11450.6
Guizhou	0.089	0.404	0.495	0.014	0.315	0.102	0.331	0.443	0.059	0.356	20397.4	34404.2	14006.8
Yunnan	0.041	0.315	0.540	0.068	0.391	0.061	0.263	0.267	0.011	0.304	22082.4	36237.7	14155.3
Shaanxi	0.198	0.421	0.528	0.062	0.511	0.068	0.331	0.370	0.011	0.345	24666.3	36098.2	11431.9
Gansu	0.068	0.306	0.408	0.006	0.394	0.041	0.310	0.420	0.020	0.204	19139.0	32323.4	13184.4
Qinghai	0.041	0.420	0.371	0.003	0.407	0.051	0.355	0.307	0.038	0.247	22617.7	33830.3	11212.6
Ningxia	0.072	0.415	0.371	0.026	0.394	0.031	0.386	0.249	0.056	0.328	24411.9	34328.5	9916.6
Xinjiang	0.028	0.430	0.325	0.047	0.386	0.111	0.356	0.422	0.077	0.318	23103.4	34663.7	11560.3

Notes: Ave_ID, Ave_CD, Ave_GD, Ave_OD, and Ave_SD represent the average ID, CD, GD, OD, and SD, respectively, in each subsystem in each province. RPCDI and UPCDI denote the rural per capita disposable income of households and urban per capita disposable income of households, respectively. The unit for the two indicators mentioned above is Yuan. The data were obtained from the National Bureau of Statistics of China (2021). Diff. represents the difference between the urban per capita disposable income of households and the rural per capita disposable income of households.

Again, as Huang et al. (2020) highlighted, China's HQD system should be a system that achieves the sustainable development of each subsystem to a high degree and maintains balanced and steady development among these subsystems.

First, similarly to Shi & Li (2019) and Wang (2020), this study's results show that the performance of the OD subsystem was quite poor among the five subsystems. Specifically, Guangdong played a leading role in national OD, with a value of 0.305, while Qinghai ranked bottom with a value of 0.003, a difference of about 101.57 times. At the same time, such unbalanced development of the OD subsystem may play an inhibitory role in China's HQD process. The other possible illustration is that Qinghai may be less open because it is landlocked from the perspective of geographical locations.

Second, Chen et al. (2021) pointed out that TI plays a decisive role in digital automation and transformation. TI is crucial for stimulating economic development, especially in China's current transition period. However, China's provincial innovative capability has not been of high quality because of the high coefficient of variation, which was significantly higher than other subsystems.

Third, Jiang et al. (2021) stated that China's ecological environment had experienced a historical transition from partial improvement to overall improvement. Indeed, the results also show that the GD subsystem had the highest value among the five subsystems, indicating that the GD subsystem was well developed in most of China's provinces.

Finally, Beijing played a leading role in the national ID, CD and SD, while Shanghai and Guangdong played leading roles in the national GD and OP. Beijing, Shanghai and Guangdong are the most developed regions in China. At the same time, all of them have different advantages because of their differences in functions and geographical locations. More specifically, Beijing acts as the political, economic, and cultural centre of modern China and is one of China's most developed cities. Therefore, its technological and economic strength is better than the other provinces. In the south of China, Guangdong is the most well-known coastal province. Therefore, its OD performance was relatively better than the other provinces. It is also interesting that Shanghai's GD subsystem development status was better than other provinces. Not surprisingly, the fiscal expenditure for environmental protection in Shanghai has exhibited a significant upward trend in recent years. In contrast, the government expenditure to environmental protection ratio amounted to 92.65%[54] in 2020.

This study adopted a line chart to intuitively present the HQD status across various regions and provinces, as presented in Figure 5.2. Firstly, HQD performance in most Chinese provinces has shown an upward trend year on year, except for slight fluctuations in provinces such as Heilongjiang, Yunnan and Ningxia. This outcome indicates that the "Five-in-one" overall policy of socialism with Chinese characteristics proposed by the CPC has been vigorously promoted, whereas the "Five-in-one" overall policy refers to economy, politics, culture, society, and ecology, which corresponds to the "Five new development concepts". Secondly, HQD's performance among China's three regions was

[54] See https://www.shanghai.gov.cn/cmsres/19/19a9d148b6054f6880e50cccb3405b13/ccaf197e1a438688c3ab50455480db47.pdf

quite uncoordinated. More specifically, HQD performance in the eastern region was better than in the central and western regions. However, the HQD performance in some western provinces was better than in some central regions. For example, Chongqing's HQD status was better than Anhui's during the sample period.

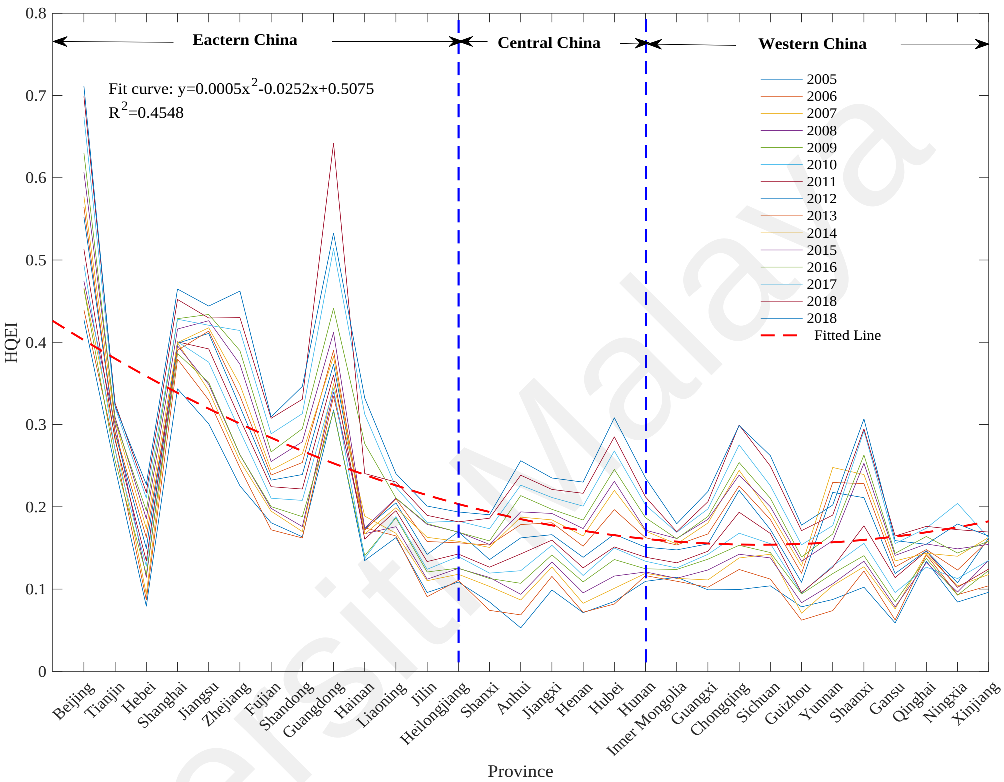

Figure 5.2: HQD Status of China's 30 Provinces
Source: Computed by the Author

5.2.3 Results of High-Quality Economic Development Based on Relative Score

Firstly, Table 5.3 shows that China's 30 provinces underwent an overall positive change during the research period, indicating that HQEI improved by 0.459 since 2005. All annual average HQDI values displayed a positive shift, indicating that most provinces have improved their HQD. However, the change rate of HQEI was relatively low, implying that HQD in China's provinces developed slowly. Among them, Anhui, Hubei, and Zhejiang had the highest growth rates, greater than 0.48%. Besides, the top ten provinces included seven western provinces, two central provinces and one western province. However, the average relative score of HQEI in Qinghai was relatively low, with a value of 0.426. Thus, Qinghai must enhance further its ability to stimulate HQD growth. Based on the above analysis, one can see that China has made progress in promoting its HQD.

Secondly, for the increment level of the five subsystems, Table 5.3 shows that the OD subsystem had the largest mean, with a value of 0.867. Moreover, the levels of all the provinces were greater than 0.80, excluding Guangdong, with a value of 0.766. This outcome suggested that China should concentrate more on the quality improvement of its OD. The average ID subsystem was 0.684, and the value of this subsystem in all Chinese provinces was more significant than 0.65, except for Gansu (0.540) and Qinghai (0.485). However, the GD was still backwards compared with the other subsystems. This outcome indicated that it has been difficult for provinces to eliminate the negative impacts imposed by the past economic development model in the short run, requiring the relevant departments to spare no effort in improving GD by introducing powerful initiatives. In addition, the CD and SD subsystem's development status was relatively low. Nonetheless, the results display that China's 30 provinces have experienced overall positive changes in the ID, CD, GD, OD and SD subsystems during the research period, with mean values of 0.684, 0.490, 0.321, 0.867, and 0.483, respectively.

Table 5.3: Subsystem Development Levels of Relative Score in 2018/2019

	ID	CD	GD	OD	SD
Beijing	0.668	0.486	0.271	0.865	0.529
Tianjin	0.665	0.507	0.423	0.830	0.457
Hebei	0.692	0.443	0.308	0.878	0.486
Shanxi	0.666	0.455	0.347	0.883	0.476
Inner Mongolia	0.729	0.491	0.262	0.851	0.517

Liaoning	0.724	0.451	0.316	0.867	0.468
Jilin	0.754	0.483	0.342	0.876	0.472
Heilongjiang	0.764	0.467	0.326	0.889	0.457
Shanghai	0.702	0.617	0.300	0.866	0.508
Jiangsu	0.687	0.488	0.322	0.863	0.478
Zhejiang	0.715	0.567	0.344	0.869	0.496
Anhui	0.725	0.476	0.368	0.864	0.490
Fujian	0.634	0.504	0.378	0.869	0.483
Jiangxi	0.726	0.490	0.313	0.866	0.475
Shandong	0.628	0.488	0.302	0.872	0.499
Henan	0.683	0.478	0.265	0.867	0.478
Hubei	0.732	0.501	0.348	0.881	0.483
Hunan	0.721	0.492	0.342	0.898	0.469
Guangdong	0.717	0.483	0.345	0.766	0.506
Guangxi	0.666	0.492	0.330	0.903	0.463
Hainan	0.708	0.490	0.285	0.912	0.506
Chongqing	0.657	0.492	0.299	0.854	0.494
Sichuan	0.695	0.446	0.310	0.881	0.501
Guizhou	0.699	0.488	0.344	0.831	0.458
Yunnan	0.676	0.525	0.319	0.895	0.483
Shaanxi	0.697	0.474	0.357	0.854	0.477
Gansu	0.540	0.497	0.313	0.879	0.465
Qinghai	0.485	0.502	0.291	0.849	0.487
Ningxia	0.668	0.475	0.307	0.878	0.473
Xinjiang	0.682	0.456	0.244	0.864	0.463

Notes: The relative scores of other years are reported in Appendix B.

Thirdly, the average RS of HQD of different regions over time was plotted, as shown in Figure 5.3. The RS of HQD in the three regions fluctuated together. Specifically, there was a "N-shaped" trend from 2007/2008-2012/2013; the index then showed a decreasing trend. Overall, the development performance of the relative score in the eastern and central areas was better than in the western area. The central area was better than the eastern area, thus forming the following rank: central>eastern>western (the annual average relative score of the eastern, central and western regions were 0.458, 0.470 and 0.455, respectively). The central area developed rapidly with national support, such as the policy of Rise of Central China. Therefore, HQD in some provinces developed rapidly, such as Anhui and Hubei (see Table 5.4). It has been acknowledged that the eastern region is the most developed area in China. However, promoting HQD remains a pressing issue facing some provinces, such as; Liaoning, Jilin and Heilongjiang. These provinces belong to the northeast area and are the traditional northeast old-industrial bases. Therefore, the relevant provinces need to accelerate their old and new kinetic energy transformation, thereby realising HQD.

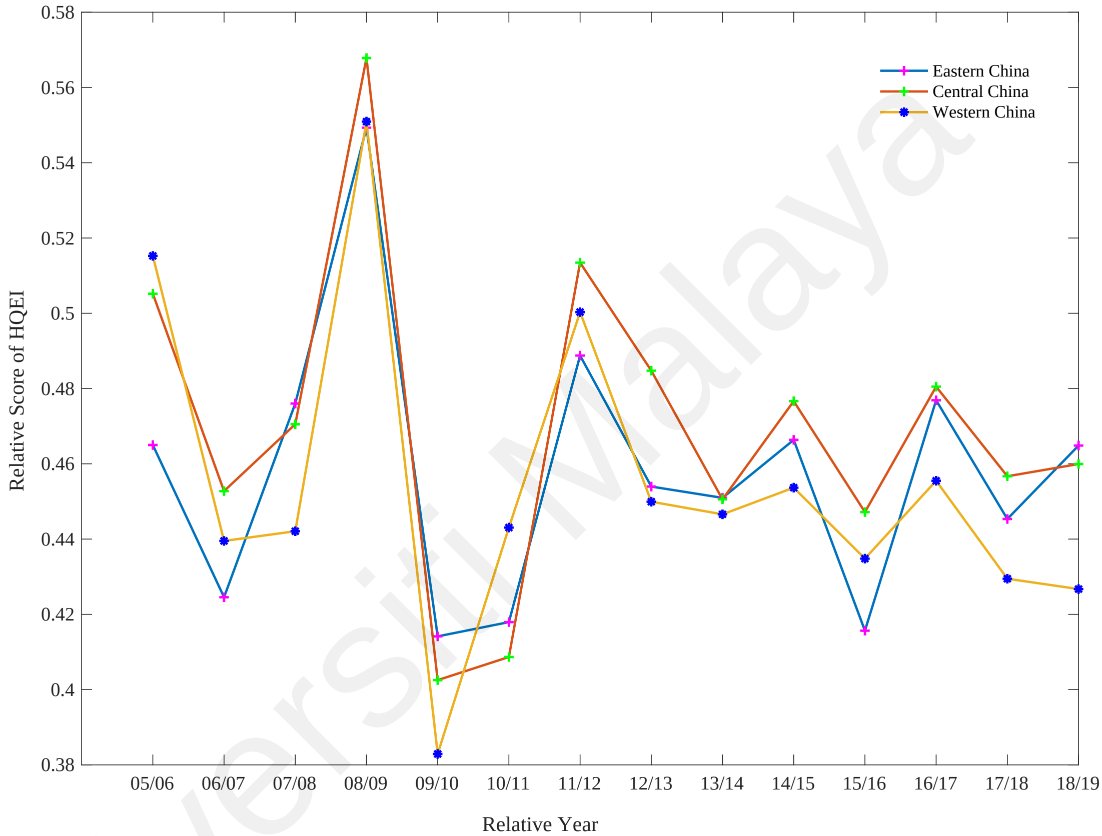

Figure 5.3: The Average Relative Score of HQD Across Various Regions
Source: Computed by the Author

Table 5.4: Relative Scores of HQD from 05/06 to 18/19

	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	Average	Rank
Beijing	0.503	0.441	0.393	0.485	0.447	0.450	0.505	0.444	0.511	0.442	0.414	0.428	0.679	0.448	0.471	9
Tianjin	0.502	0.413	0.513	0.456	0.435	0.426	0.485	0.433	0.459	0.463	0.375	0.598	0.358	0.480	0.457	18
Hebei	0.445	0.420	0.482	0.554	0.362	0.395	0.524	0.495	0.479	0.495	0.401	0.491	0.430	0.430	0.457	17
Shanxi	0.451	0.511	0.419	0.475	0.372	0.407	0.492	0.515	0.426	0.457	0.442	0.439	0.454	0.441	0.450	21
Inner Mongolia	0.610	0.395	0.472	0.473	0.355	0.418	0.508	0.431	0.346	0.495	0.387	0.389	0.439	0.456	0.441	26
Liaoning	0.384	0.405	0.519	0.521	0.407	0.356	0.488	0.449	0.389	0.478	0.326	0.468	0.367	0.434	0.428	29
Jilin	0.417	0.383	0.481	0.505	0.404	0.424	0.510	0.471	0.506	0.411	0.415	0.452	0.411	0.478	0.448	23
Heilongjiang	0.432	0.424	0.420	0.517	0.438	0.383	0.487	0.413	0.455	0.452	0.354	0.520	0.339	0.458	0.435	27
Shanghai	0.480	0.426	0.418	0.513	0.438	0.374	0.398	0.412	0.435	0.417	0.453	0.467	0.439	0.518	0.442	25
Jiangsu	0.527	0.496	0.557	0.594	0.387	0.463	0.519	0.460	0.454	0.493	0.422	0.450	0.442	0.446	0.479	4
Zhejiang	0.570	0.461	0.497	0.539	0.482	0.426	0.494	0.462	0.473	0.487	0.448	0.482	0.417	0.518	0.483	3
Anhui	0.521	0.464	0.491	0.591	0.467	0.472	0.530	0.504	0.472	0.487	0.430	0.504	0.431	0.490	0.489	1
Fujian	0.456	0.429	0.490	0.634	0.377	0.372	0.518	0.466	0.449	0.507	0.465	0.454	0.472	0.470	0.469	10
Jiangxi	0.555	0.398	0.477	0.593	0.388	0.366	0.528	0.485	0.407	0.477	0.486	0.476	0.467	0.456	0.468	11
Shandong	0.374	0.459	0.472	0.557	0.441	0.452	0.538	0.466	0.480	0.485	0.457	0.489	0.430	0.431	0.466	13
Henan	0.518	0.496	0.498	0.587	0.375	0.432	0.520	0.451	0.456	0.519	0.435	0.502	0.478	0.409	0.477	5
Hubei	0.525	0.481	0.488	0.602	0.427	0.390	0.484	0.482	0.480	0.493	0.436	0.486	0.498	0.491	0.483	2
Hunan	0.461	0.366	0.451	0.559	0.387	0.386	0.527	0.471	0.462	0.427	0.454	0.477	0.413	0.473	0.451	20
Guangdong	0.490	0.443	0.536	0.645	0.467	0.396	0.462	0.466	0.394	0.435	0.454	0.487	0.470	0.467	0.472	8
Guangxi	0.493	0.357	0.498	0.688	0.349	0.348	0.503	0.513	0.515	0.443	0.413	0.417	0.381	0.442	0.454	19
Hainan	0.467	0.318	0.409	0.621	0.300	0.516	0.427	0.464	0.379	0.497	0.419	0.415	0.536	0.466	0.445	24
Chongqing	0.595	0.486	0.468	0.509	0.398	0.478	0.513	0.441	0.445	0.502	0.459	0.497	0.427	0.434	0.475	7
Sichuan	0.487	0.500	0.370	0.543	0.426	0.471	0.514	0.467	0.456	0.431	0.420	0.483	0.435	0.445	0.460	15
Guizhou	0.432	0.448	0.521	0.646	0.351	0.393	0.494	0.468	0.477	0.452	0.481	0.473	0.451	0.441	0.466	14

Yunnan	0.475	0.458	0.481	0.577	0.447	0.446	0.480	0.431	0.441	0.446	0.463	0.493	0.437	0.467	0.467	12
Shaanxi	0.567	0.445	0.461	0.561	0.417	0.458	0.571	0.472	0.435	0.488	0.420	0.472	0.438	0.461	0.476	6
Gansu	0.470	0.460	0.426	0.498	0.480	0.531	0.474	0.426	0.406	0.455	0.433	0.403	0.437	0.384	0.449	22
Qinghai	0.490	0.386	0.344	0.567	0.321	0.447	0.464	0.443	0.380	0.419	0.454	0.484	0.405	0.363	0.426	30
Ningxia	0.575	0.421	0.420	0.523	0.247	0.446	0.502	0.446	0.560	0.442	0.467	0.532	0.409	0.425	0.458	16
Xinjiang	0.474	0.479	0.403	0.475	0.421	0.439	0.483	0.410	0.454	0.418	0.387	0.367	0.464	0.376	0.432	28
Average	0.491	0.436	0.462	0.554	0.400	0.425	0.498	0.459	0.449	0.464	0.429	0.470	0.442	0.450	0.459	/

Notes: (1) 05/06 means the relative growth rate of HQD between 2005 and 2006, and others have the same meanings.
(2) The last column is the rank of the average RS.

5.2.4 Results of High-Quality Economic Development Based on Fluctuating Score

Table 5.5 displays the FS of HQD. The maximum value was 0.747, indicating that Beijing's HQD performance was more stable than other regions. Shanghai ranked second with a value of 0.684. The top ten regions included nine eastern provinces (Beijing, Shanghai, Tianjin, Liaoning, Jiangsu, Zhejiang, Hainan, Shandong, and Jilin) and one western province (Sichuan). In contrast, the bottom ten regions included seven western provinces and three central regions. From the empirical results, it can be detected that China's eastern provinces have taken the lead in developing their economy and improving the quality of the economy, which is associated with their initial endowment and policy preferences. However, the economic development level was not stable in some regions, such as; Ningxia, Guizhou, and Inner Mongolia. It has been difficult for these regions to achieve HQD in a short period.

Table 5.5: Results for Fluctuating Score

Province	Score	Rank	Province	Score	Rank	Province	Score	Rank
Beijing	0.747	1	Heilongjiang	0.550	11	Xinjiang	0.480	21
Shanghai	0.684	2	Guangdong	0.544	12	Gansu	0.434	22
Tianjin	0.679	3	Hebei	0.534	13	Hubei	0.425	23
Liaoning	0.673	4	Henan	0.524	14	Qinghai	0.415	24
Jiangsu	0.664	5	Yunnan	0.522	15	Chongqing	0.415	25
Zhejiang	0.651	6	Shanxi	0.521	16	Guangxi	0.409	26
Hainan	0.602	7	Fujian	0.510	17	Anhui	0.368	27
Shandong	0.587	8	Jiangxi	0.510	18	Ningxia	0.364	28
Jilin	0.584	9	Hunan	0.506	19	Guizhou	0.301	29
Sichuan	0.555	10	Shaanxi	0.481	20	Inner Mongolia	0.288	30

5.2.5 Results of Cluster Analysis

China's HQD has been classified into three categories according to the results of the K-means cluster analysis: Good, Average, and Poor. The performance of these three scores was identified by comparing the distance between the final cluster centres and their initial values. Specifically, the final cluster centres of the three scores were classified as follows:

$$\begin{cases} \text{AS} = (0.60, 0.39, 0.19) \\ \text{RS} = (0.47, 0.43, 0.46) \\ \text{FS} = (0.67, 0.53, 0.38) \end{cases} \quad (5-1)$$

Subsequently, China's HQD was mapped according to the cluster analysis results to intuitively present the regional spatial distribution, as depicted in Figure 5.4.

Figure (A) shows the regional HQD level based on the AS. It can be seen that, from 2005 to 2019, only Beijing met the "Good" grade, accounting for 3.3% of the whole sample. Tianjin, Shanghai, Jiangsu, Zhejiang, and Guangdong met the "Average" grade, accounting for 16.67% of the sample. However, 24 provinces comprised the "Poor" grade, accounting for 80% of the sample. The results indicated that the development disparity was relatively great and highlighted that the overall performance of China was not high quality.

Figure (B) presents the regional HQD level based on the RS. Beijing, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, and Shaanxi met the "Good" grade, accounting for 30% of the overall sample. Six provinces met the "Average" grade, accounting for 20% of the total sample. Besides, the growth rate of HQD in the remaining 15 provinces remained low, such as Yunnan, Guizhou, Chongqing, Sichuan, etc.

Figure (C) displays the regional HQD level based on the FS. Compared with other provinces, the development performance in Beijing, Tianjin, Liaoning, Shanghai, Jiangsu, Zhejiang, and Hainan was more stable from 2005 to 2019, accounting for 23.33% of the total sample. Inner Mongolia, Anhui, Hubei, Guangxi, Chongqing, Guizhou, Gansu, Qinghai, and Ningxia were in the "Average" grade, accounting for 30% of the sample. Nevertheless, 14 provinces exhibited relative fluctuations in the process of HQD.

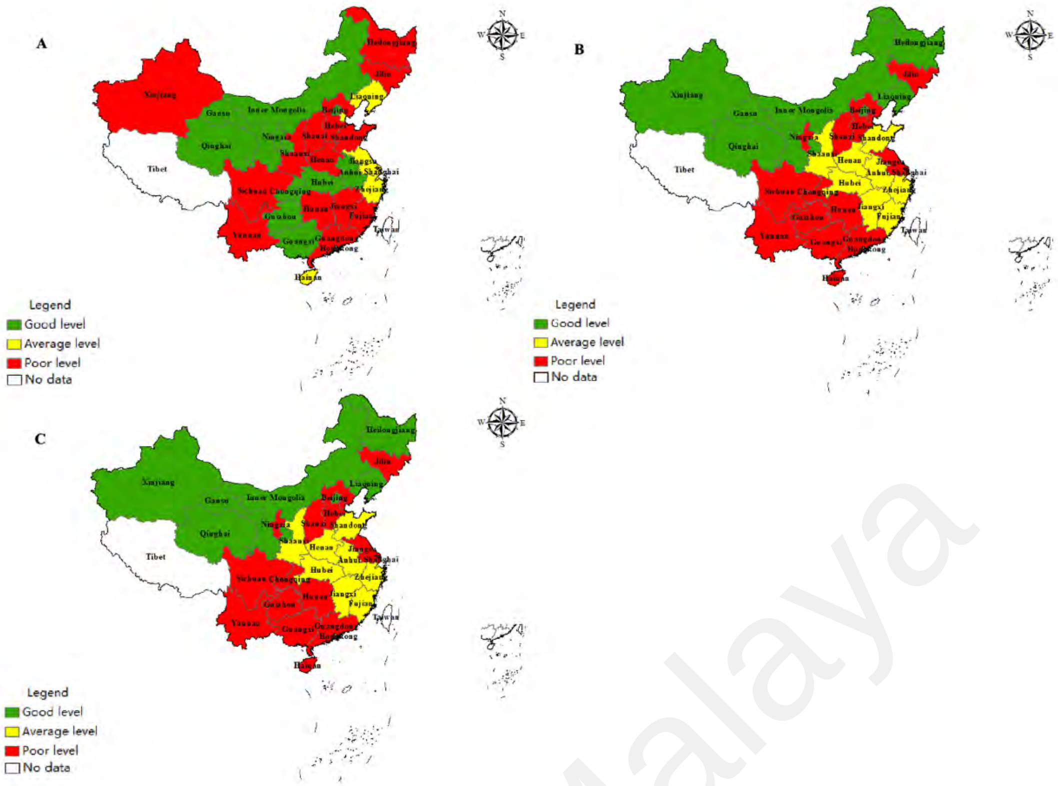

Figure 5.4: Spatial Distribution of HQD Based on Three Scores
Source: Computed by the Author

According to the Cluster analysis, China's 30 provinces were divided into 12 groups, as shown in Table 5.6. Subsequently, two important points were identified. First, some Chinese provinces had high-level HQD but low growth rates (RS), or provinces had high-degree growth rates but high volatility (FS). Taking the Beijing, Tianjin, and Hebei region as an example, the Outline of the Plan for Coordinated Development for the Beijing-Tianjin-Hebei Region, released in April 2015, proposed development-oriented solutions to ecological, social, and economic problems. The purpose was to relocate in an orderly manner all non-essential functions from Beijing, the national capital, to neighbouring locations. However, this initiative may not work in the short term. According to Table 5.6, Hebei was in the backward position during the sample period compared to Beijing. Besides, although Tianjin's HQD was more stable than Hebei's, its growth rate was relatively lower, making its overall HQD level relatively low. Therefore, authorities need to vigorously solve the "real problems" existing in the development process, overcome the bottlenecks in the quality improvement of economic development, and gradually achieve HQD.

Moreover, some eastern provinces need to improve their HQD, such as Hainan, Guangdong, Jilin, etc. Second, provinces with high-level AS (or RS, FS) were concentrated. For example, Sichuan is geographically adjacent to Yunnan, and both are classified into Group 8 with low AS, RS and FS. This outcome shows that the HQD growth rates in these provinces were relatively low but with huge fluctuations. To this end, a regional sharing mechanism should be established to help those provinces develop their HQD by providing sufficient funds and diffusing technical support.

Table 5.6: Classification Results for Cluster Analysis

Category	Province	AS	RS	FS	Category	Province	AS	RS	FS
Group 1	Beijing	G	G	G	Group 6	Xinjiang	P	A	P
Group 2	Tianjin	A	P	G	Group 7	Guangxi	P	P	A
	Shanghai	A	P	G		Chongqing	P	P	A
	Jiangsu	A	P	G		Guizhou	P	P	A
Group 3	Anhui	P	G	A		Ningxia	P	P	A
	Hubei	P	G	A	Group 8	Hebei	P	P	P
Group 4	Fujian	P	G	P		Shanxi	P	P	P
	Jiangxi	P	G	P		Jilin	P	P	P
	Shandong	P	G	P		Hunan	P	P	P
	Henan	P	G	P		Sichuan	P	P	P
	Shaanxi	P	G	P		Yunnan	P	P	P
Group 5	Inner Mongolia	P	A	A	Group 9	Zhejiang	A	G	G
	Gansu	P	A	A	Group 10	Guangdong	A	P	P
	Qinghai	P	A	A	Group 11	Liaoning	P	A	G
Group 6	Heilongjiang	P	A	P	Group 12	Hainan	P	P	G

Note: Abbreviations "G", "A" and "P" represent the Good, Average and Poor, respectively.

5.2.6 Results of Spatial Analysis

Figure 5.5 shows the Global Moran I of HQEI in China's 30 provinces from 2005 to 2019 under an economic-geographical spatial weight matrix. First, China's HQEI passed the significance test, which rejected the null hypothesis that there was no spatial autocorrelation of HQEI. Therefore, it was reasonable for this study to conduct an empirical analysis by adopting spatial econometrics. Second, the values of Moran's I of the HQE index were positive during the research period, indicating a significant positive spatial correlation between provinces in China. Third, the Global Moran's I of the HQD index (HQEI) has exhibited a significant downward trend since 2008. The sharp decrease in the Moran's I may have stemmed from the global financial crisis, negatively affecting China's economic development quality improvement. In addition, the corresponding p-value also exhibited an upward trend since 2005, suggesting that the spatial autocorrelation of China's HQEI has weakened year by year. In other words, the decline of the Moran's I suggested a decreasing trend in spatial dependence of China's HQD during the research period. This study further adopted Geary's C to verify the robustness of the spatial autocorrelation test results[55], as reported in Table 5.7. The estimated results proved the reliability of Moran's I, implying that China's HQD did have spatial autocorrelations during the research period.

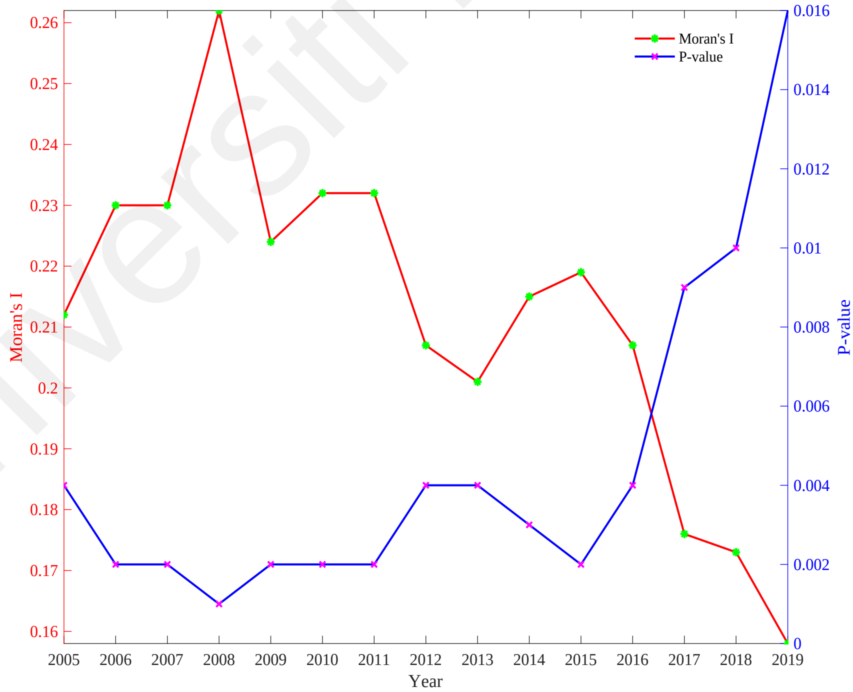

Figure 5.5: Global Moran I and Corresponding p-value of HQD
Source: Computed by the Author

Table 5.7: Geary's C of HQEI

[55] The specific calculation formula for Geary's C is defined as follows: $\text{Geary's C} = \frac{1}{2}\cdot\frac{(n-1)\sum_{i=1}^{n}\sum_{j=1}^{n}W_{ij}(x_i-x_j)^2}{\left(\sum_{i=1}^{n}\sum_{j=1}^{n}W_{ij}\right)\left[\sum_{i=1}^{n}(x_i-\bar{x})^2\right]}$, $\text{Geary's C} \in [0,2]$, $\text{Geary's C} > 1$ suggests a negative spatial autocorrelation, while $\text{Geary's C} < 1$ denotes a positive spatial autocorrelation. When $\text{Geary's C} = 1$, HQEI has no spatial autocorrelation. Other information is consistent with Eq. (4-17).

Year	2005	2006	2007	2008	2009
Geary's C	0.749***	0.736***	0.733***	0.709***	0.728***
z-value	(-2.943)	(-3.094)	(-3.129)	(-3.424)	(-3.206)
Year	2010	2011	2012	2013	2014
Geary's C	0.725***	0.724***	0.75***	0.754***	0.742***
z-value	(-3.246)	(-3.252)	(-2.958)	(-2.914)	(-3.065)
Year	2015	2016	2017	2018	2019
Geary's C	0.733***	0.736***	0.769***	0.820***	0.750***
z-value	(-3.171)	(-3.134)	(-2.745)	(-2.145)	(-2.961)

Notes: * p<0.10, ** p <0.05, *** p<0.01, z-values are shown in parentheses, two-tail test.

This section discusses the inter-province clustering features. The ArcGIS software was adopted to plot the spatial distribution characteristics for Moran's I scatterplot in the selected years, as shown in Figure 5.6. Subsequently, China's 30 provinces were divided into H-H, L-H, L-L, and H-L types. The years 2005 and 2019 were taken as cases to discuss the spatial distribution characteristics of HQD, as shown in Table 5.8.

First, there were six H-H-type and 17 L-L-type provinces in 2005. Therefore, the positive spatial clusters accounted for approximately 76.67% of the total number in 2005. Similarly, the L-H and H-L type regions were 4 and 3, accounting for 23.33% of the total. There was a positive spatial autocorrelation of HQD. All the H-H-type provinces were located in the eastern region.

In contrast, the western region was the L-L type. Most provinces in the central region were of the L-H or H-L types, suggesting that positive and negative spatial autocorrelation co-existed. The results indicated significant spatial positive autocorrelation in China's eastern and western regions. In contrast, negative spatial autocorrelation was found in China's central region. Therefore, the HQE of the eastern, central and western regions exhibited a 'ladder' pattern.

Second, 8 and 12 provinces were of the H-H and L-L types in 2019, accounting for 66.67% of the total. 6 and 4 provinces were of L-H and H-L types, accounting for

33.33% of total provinces. However, the proportion of H-H and L-L type provinces decreased, meaning China's positive spatial autocorrelation decreased. Compared with 2005, the number of H-H type provinces increased while that of L-L type provinces decreased. This situation indicated that the number of provinces with higher HQD increased due to the effect of adjacent provinces. However, the number of provinces with lower HQD decreased due to the impact of neighbouring areas. Besides, H-H and H-L type provinces were mainly in coastal areas, implying that the 'central rising' and 'western development' policies were pivotal and needed to be rolled out further. The corresponding results were consistent with the findings obtained in Figure 5.8.

Third, it was found that there were 20 provinces with their initial type unchanged, accounting for 66.67% of the total provinces. Ten provinces changed concerning the type, around 33.33% of the overall provinces. The above results indicate a significantly locking effect, resulting in improved spatial agglomeration of HQD in China.

Table 5.8: Spatial Distribution of 30 Provinces in Four Quadrants of Moran's Scatterplot

Year	H-H type	L-H type	L-L type	H-L type
2005	Beijing, Tianjin, Shanghai, Fujian, Zhejiang, Shandong	Hebei, Anhui, Inner Mongolia, Hainan	Shanxi, Jilin, Jiangxi, Heilongjiang, Henan, Hubei, Hunan, Gansu, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Qinghai, Ningxia, Xinjiang	Liaoning, Jiangsu, Guangdong
2019	Beijing, Tianjin Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Hainan	Tianjin, Anhui, Inner Mongolia, Jiangxi, Hunan, Guangxi,	Shanxi, Jilin, Henan, Liaoning, Sichuan, Guizhou, Yunnan, Heilongjiang, Gansu, Qinghai, Ningxia, Xinjiang	Hubei, Shaanxi, Guangdong, Chongqing

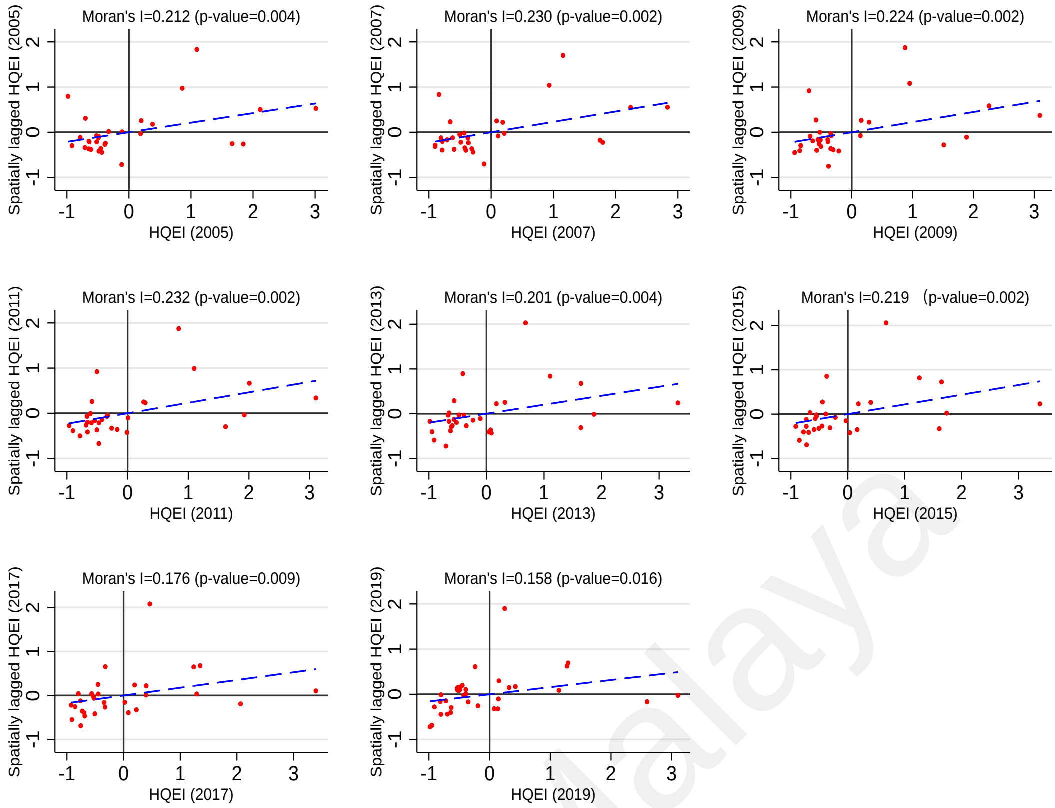

Figure 5.6: Local Moran I of HQEI in the Selected Years
Source: Computed by the Author

5.2.7 Results of Regional Heterogeneity Using Geo-detector

Based on the methodology discussed in Chapter 4, Figure 5.7 presents the top five influencing factors in China's three economic zones.

First, the top five influencing factors for HQD were R&D input intensity, R&D personnel input intensity, S&T output proxied by the number of granted patents per 10,000 people, industrialisation rate and the binary contrast index in China's eastern region. All values were greater than 0.5, and all passed the significance test at a 1% level, rejecting the null hypothesis that the stratified heterogeneity was insignificant. Therefore, the q-statistics were valid. Three elements were sourced from the ID subsystem, and two factors were sourced from the CD subsystem to classify the top five influential factors. In recent years, China has been concentrating more and more on cultivating innovation capacity through funding R&D activities (see Chapter 3: ID), especially for the eastern region. The results highlighted that TI played a pivotal role in the process of HQD in

China's eastern region. The eastern region has an economic development environment and ample innovation resources, such as industry-university research cooperation, policy guarantees and incentives, and a high capacity for collaborative innovation. Still, Xi Jinping's thought of strengthening the nation by taking advantage of talent is a fundamental guideline for developing China's talent in the new era. Therefore, China needs to vigorously strengthen talent and provide personnel support for the rejuvenation of the eastern region. In addition, a reasonable industrial structure is also an essential component of realising HQD in the eastern region. However, rapid industrialisation has also brought negative impacts, such as expanding development disparities between the poor and the rich (see, for example, Ye (2019)).

Second, the five most influential factors for HQD were the urbanisation rate, S&T output proxied by the number of granted patents per 10,000 people, the industrialisation rate, the GDP growth rate, and R&D personnel input intensity in China's central region. All the q-statistics results were greater than 0.5 with a significance level of 1%. It can be seen that a reasonable industrial structure was also the primary factor for the quality improvement in economic development in the central region. With the strong implementation of SSSR in the central region, energy-intensive and low-efficiency industries have gradually succeeded in industrial transmission. Besides, the local government's efforts in institutional innovation and policy adjustment have also attracted some high-tech talents to participate in economic construction and development in the central region. Therefore, economic efficiency and quality have been improved progressively. At the same time, the high-tech and emerging industries have consequently been growing rapidly under the support of the local government, which will, in turn, positively affect central economic development in Central China. Table 5.6 (see Group 8) shows that AS in some central provinces, such as Hunan and Shanxi, was not high quality.

Moreover, the RS was not good compared to other western provinces, such as Qinghai and Inner Mongolia. Therefore, economic growth remains a prerequisite for central provinces to enhance the quality of economic development. Similarly, factors related to TI remain crucial for the central region to realise HQD.

Third, the five most influential factors were S&T output proxied by the number of granted patents per 10,000 people, number of buses per 10,000 people, the urbanisation rate, the forestry coverage rate, and health technical personnel in health care and institutions per 10,000 people in the western region. Their significant coefficients were higher than 0.35 and passed the 1% significance level test. After inspecting the empirical results, it was seen that HQD in the SD subsystem played a decisive role in promoting HQD in the western region. The results showed that the western region has lagged far behind the central and eastern regions regarding economic foundation or basic infrastructure construction. For example, educational resources remain relatively scarce, government funding is limited, and transportation construction remains sub-optimal in the western region.

Moreover, most of China's impoverished population is distributed in the western provinces, i.e., Yunnan has the greatest number of poor counties at 71, followed by Inner Mongolia, Xinjiang, Henan, Tibet and Sichuan at 65, 60, 58, 56 and 55 poor counties, respectively (UNDP, 2016). Besides, the proportion of the three industries is also crucial for improving the quality of the western economy. However, high-tech industries develop slowly due to factor endowment and geographical limitations. Therefore, it is difficult for traditional sectors represented by heavy industries (i.e., steel and cement) to achieve self-adjustment successfully.

Consequently, overall economic efficiency and quality improvement have been relatively slow, resulting in the western regions' backward position. The scarcity of education resources has caused a lack of skilled labour. Hence, few technical talents have been available to participate in economic construction and R&D activities, thus, resulting in low output in R&D activities. In this regard, local governments need to introduce stronger initiatives to revitalise the western economy, such as the Western Development Strategy, to eliminate development disparities gradually and realise prosperous development.

The cutting-off point for discussion of economic development should be dated back to a country's endowments. Endowments in any given country at a specific time are changeable over time. Following the conventional assumptions of economics, economists regard a given country's factor endowments as consisting only of its labour, capital (including both human and physical capital), and land (i.e., natural resources). These elements are typical factor endowments which enterprises use in the production process. Note that new structural economics emphasises capital/labour ratio dynamics because the natural resources in a given country are exogenously given. Theoretically, adding infrastructureas one more component of one country's endowments is also necessary. This situation is because infrastructure could influence individual enterprises' business transaction costs and the marginal rate of return on investment.

Countries (or regions, for example, Eastern China, Central China, and Western China) have different economic structures due to differences in endowments. In particular, factor endowments in developing countries are typically dominated by a relative scarcity of capital and a relative abundance of resources or labour. Therefore, they mainly focus on resource-intensive or labour-intensive production activities, such as mining industry, fisheries, etc. At the same time, they also adopted mature and conventional technologies. In contrast, at the other extreme of the development spectrum, developed economies present a completely different structure of factor endowments. That is, capital investment has become necessary for factor endowment. In the meantime, the various kinds of infrastructure (including both tangible and intangible infrastructure) that are required must comply with the necessities of global and national markets, where business transactions are large in value and quantity. Therefore, to improve the quality of economic development in China's three major economic zones, "one-size-fits-all" policies should be abandoned.

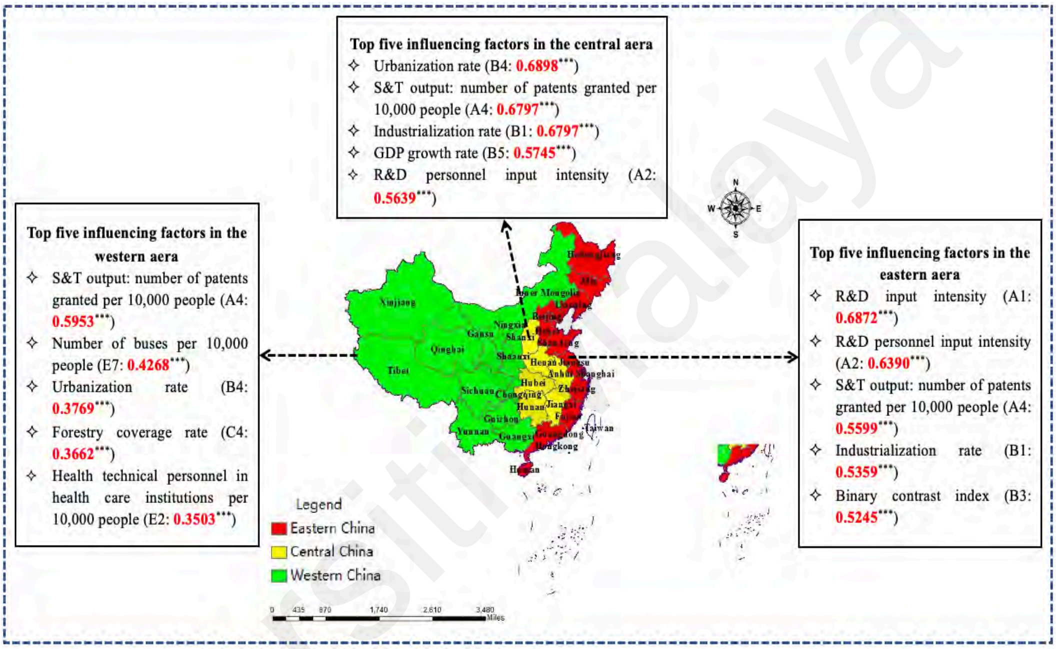

Figure 5.7: Top Five Influencing Factors for Regional HQD
Source: Computed by the Author

5.3 Chapter Summary

This chapter discussed China's HQD performance based on three scores: AS, RS, and FS. The Cluster analysis method was applied to classify China's 30 provinces into different categories according to HQD's performance of three scores. Spatial statistical techniques, such as Global Moran I and Local Moran I, were implemented to conduct spatial analysis. Finally, the Geo-detector method was used to investigate the reasons causing regional heterogeneity concerning HQD. Based on the above analysis, this study concluded the following:

1. From the temporal perspective, the value of HQEI in most provinces has displayed a

significant upward trend (albeit with small fluctuations in some provinces), implying that most Chinese provinces have progressively improved their HQD levels year by year. At the same time, Beijing has always played a leading role in the process of national HQD. It is also worth noting that the path of HQD in most Chinese provinces is unsustainable. Some provinces have high HQD levels but low HQD growth rates, or some have high levels of HQD but high volatility. Overall, China's economic development path has not followed the HQD model, with an average HQEI of 0.210. Still, China's economic development progressively pursues the HQD model, with an annual HQEI increase of 0.459%.

2. From the spatial perspective, the significant positive value of the Global Moran I implied that China's HQD exhibited significant spatial autocorrelation. In contrast, spatial autocorrelation exhibited a significant downward trend after the global financial crisis. This outcome meant that the spatial autocorrelation of China's HQD had decreased year by year. Besides, China's HQD has shaped a significant spatial distribution pattern, namely, "eastern> central> western".
3. For the Geo-detector method analysis, all the q-statistic coefficients passed the significance level test at 1%, indicating stratified heterogeneity. Thus, the application of the q-statistic method was reasonable. Specifically, TI and industrial structure strongly impacted the eastern region HQD. Similarly, TI and a reasonable industrial structure also played an essential role in the central region HQD. Still, economic growth was necessary for HQD in the central region. While compared with the eastern and central regions, improving basic infrastructure construction and formulating a reasonable industrial structure was crucial for the western region to develop its HQD.

It will be difficult for China to achieve HQD in a short period, as it requires joint efforts, looking at the overall analysis. On the one hand, regardless of either temporal or spatial analysis, the results show that development inequality among different provinces and regions was still evident. Unfortunately, although provincial HQD has exhibited an upward trend, some provinces remain restricted because of their economic strength, natural resources, etc. Moreover, the spatial agglomeration effect in western provinces was extremely significant because provinces with low HQD levels tended to be clustered (see Table 5.7). At the same time, the results in Section 5.2.7 also revealed that socio-economic development in the western area was quite poor compared with that in the eastern and western regions. Therefore, a regional coordinated mechanism should be established to support the construction of the western area, thus, breaking bottlenecks and improving HQD further. On the other hand, the q-statistics demonstrated that industrial structure had a certain impact on HQD. Moreover, this study also identified other key factors that affect China's HQD, such as TI, urbanisation, etc., thereby leaving research opportunities for future studies.

CHAPTER 6: FINDINGS 2: INDUSTRIAL STRUCTURE TRANSFORMATION AND UPGRADING DEVELOPMENT PERFORMANCE AND ITS DISTRIBUTION CHARACTERISTICS

6.1 Introduction

This chapter analyses the development status and distribution characteristics of ISU, ISR and IS.

6.2 Results for Industrial Structure Transformation and Upgrading

The following section analyses ISTU's distribution characteristics from two aspects. This study first analysed the development status of ISU, ISR and IS over time. While the Cloud model was then applied to identify their distribution characteristics from regional and national perspectives.

6.2.1 Results for Industrial Structure Transformation and Upgrading from Temporal Perspectives

ISU level. China's interprovincial ISU level from 2005 to 2019 was calculated using the ISU measurement scheme IV. According to Figure 6.1, the ISU level was categorised into three types. First, ten provinces, including Beijing, Tianjin, Jilin, Jiangsu, Shandong, Guangdong, Anhui, Guangxi, Chongqing, and Ningxia, exhibited an upward trend. Among which were six eastern provinces, one central province and three western provinces. These provinces have led by utilising science and technology to develop the economy, vigorously optimising and upgrading their industrial structures. In the meantime, these provinces have had advantages in terms of geographical locations and abundant resources. Thus, numerous traditional industries have been transferred into new industrial sectors, mainly in the development of modern agriculture, high-tech industries, and advanced manufacturing industries. The advantages of industrial sectors have been successfully shifted from primary to tertiary industry. Second, ten provinces showed a

"U-shaped" trend: Hebei, Inner Mongolia, Heilongjiang, Zhejiang, Jiangxi, Henan, Hubei, Hunan, Sichuan and Xinjiang. In the early stages of this study, industrial development was constrained by traditional manufacturing industries, i.e., the northeast old-industrial base, which inhibited their ISU improvement. Therefore, their ISU levels were relatively low. While with the significant improvement of technological capability and economic strength, backward industries and "zombie enterprises" have been replaced.

In contrast, industries with high efficiency and high energy utilisation have risen. Thus, their ISU levels have begun to improve. Third, ten provinces showed a decreasing trend: Shanxi, Liaoning, Shanghai, Fujian, Hainan, Guizhou, Yunnan, Shaanxi, Gansu, and Qinghai. While these provinces mainly come from the western region, their industrial development has been restricted because of limited economic resources and insufficient external financial support. At the same time, the provinces mentioned above emphasised shifting their industries to secondary industries instead of tertiary industries. It is hard for the backward industrial sectors to realise self-transformation; thus, their ISU levels have decreased.

ISR level. China's interprovincial ISR level from 2005 to 2019 was calculated using ISR measurement scheme IV. According to Figure 6.1, the ISR level was categorised into four types. Eleven provinces showed an upward trend, including Hebei, Zhejiang, Anhui, Shandong, Henan, Guangdong, Guangxi, Hainan, Guizhou, Yunnan, and Gansu. During industrial structural transformation, these provinces have taken advantage of policies, geographical location, and economy to effectively accelerate the optimisation of their industrial structure. Therefore, their industrial structures have become more stable and reasonable. Second, four provinces presented a "U-shaped" trend: Jilin, Heilongjiang, Shaanxi, and Hebei. Their industrial structures were distorted in the early stages of development because of their economic foundation and science and technology limitations. But with the technological process and improvement of economic strength, their industrial structures have been rearticulated and adjusted by strongly implementing policies, i.e., China's SSSR. Thus, their ISR levels have started to increase. Third, six provinces exhibited an inverted "U-shaped" trend: Shanxi, Inner Mongolia, Shanghai, Fujian, Chongqing, and Qinghai. Although various industries maintained relatively steady development in the early stages, intensively pursuing ISU has distorted economic relationships among the three major industries. For example, Chongqing's ISU exhibited a significant upward trend. While its ISR first increased and then presented a decreasing trend. Finally, seven provinces displayed a downward trend: Beijing, Tianjin, Liaoning, Hunan, Sichuan, Ningxia, and Xinjiang. Although most are resource-based provinces, such rapid industrialisation has negatively impacted ISR, which wastes economic resources and causes environmental issues, thus affecting the sustainability and stability of the industrial structure. It is worth mentioning that Beijing has achieved the highest level of advancement in industrial structure in recent years. Still, economic development has dropped, and its ISR level has shown a downward trend.

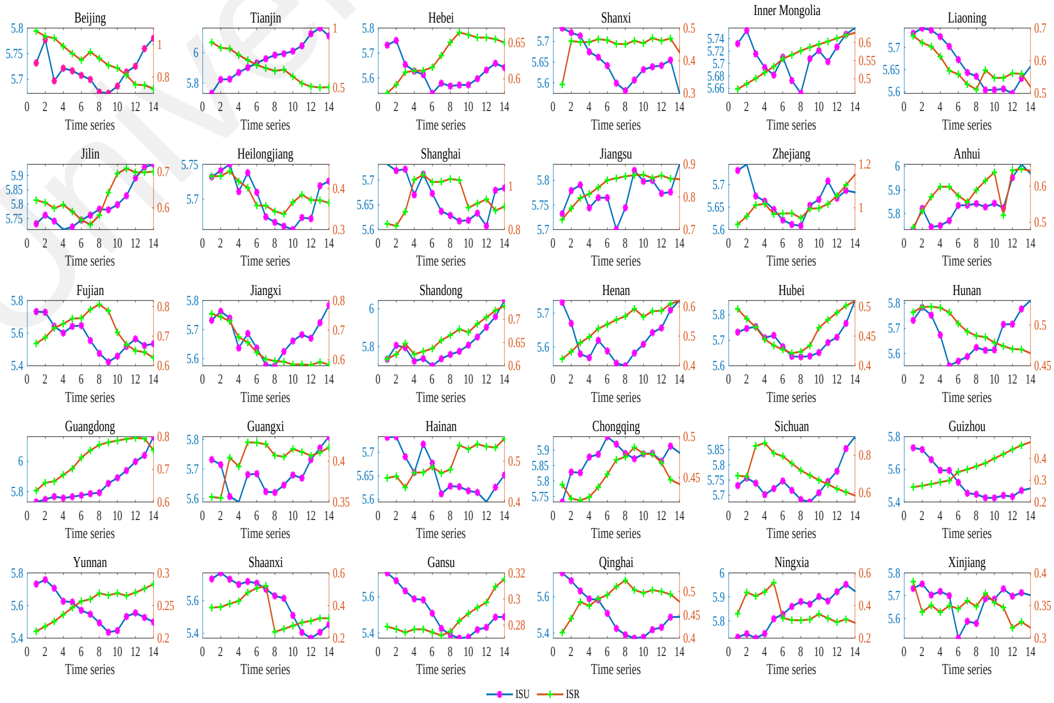

Figure 6.1: China's Interprovincial ISU and ISR Levels, 2005 to 2019
Source: Computed by the Author

6.2.2 Results for the Cloud Model

Following the Cloud model methodology, parameters E_x, E_n and H_e were then determined. The FCT algorithm processing procedure was then used to obtain the comprehensive certainty degree of each evaluation indicator. This study adopted an average of 1000 program run results, considering the uncertainty and randomness of membership, to derive the final membership. The upper-level indicator features were measured by iterating ISU, ISR, and IS, respectively, and gathering 5000 cloud drops from the FCT algorithm to obtain a cloud map for each evaluation indicator.

Figures 6.2 - 6.4 show the cloud maps of ISU, ISR and IS with the whole sample. Firstly, Chinese ISU was higher than the "Excellent" level, while ISR was higher than the "Normal" level. And IS was mainly distributed in the "Good" level. Secondly, it was detected that the values of H_e of ISR and IS approached zero. However, the larger H_e (0.0008) indicated considerable uncertainty in ISU, which injected overall uncertainty into China's ISTU from the national perspective. The results designated that the overall development level of ISR and IS were better than ISU. Therefore, the cloud drops of ISR and IS were relatively thin. The ranking among these three variables was derived by integrating the cloud map results: IS> ISR> ISU. Based on the estimated results, China should concentrate on optimising and upgrading its industrial structure, gradually transforming from labour-intensive to capital-intensive industries.

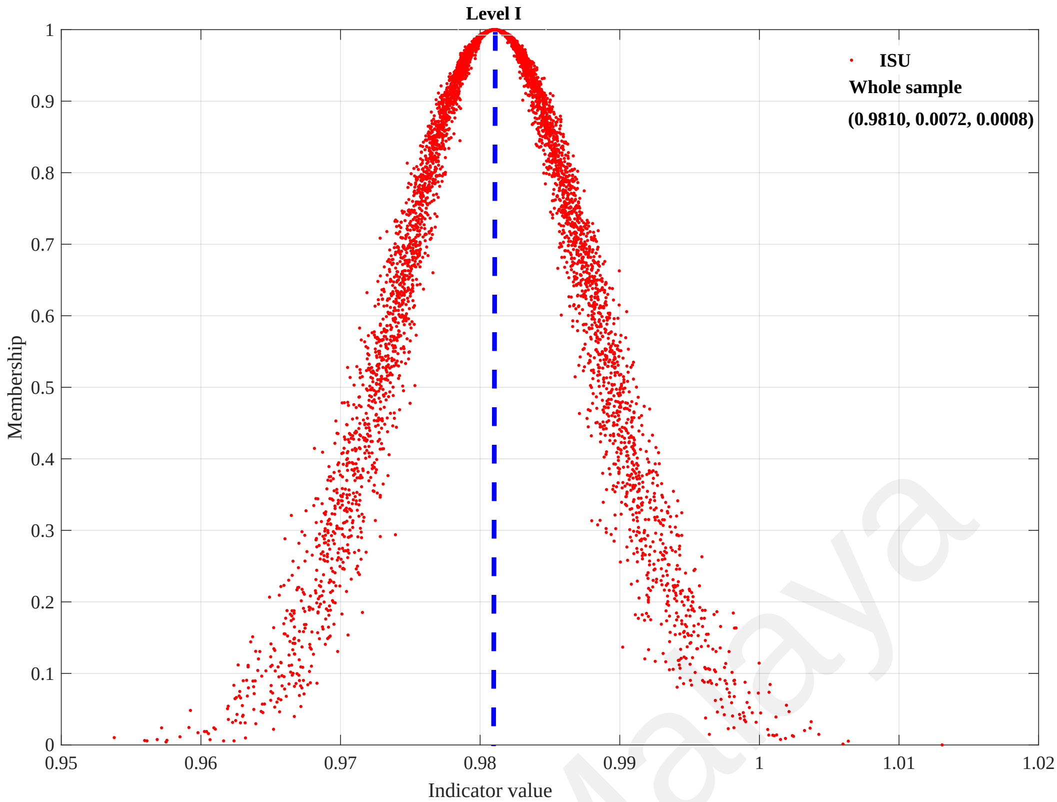

Figure 6.2: Cloud Map for ISU of China's 30 Provinces
Source: Computed by the Author

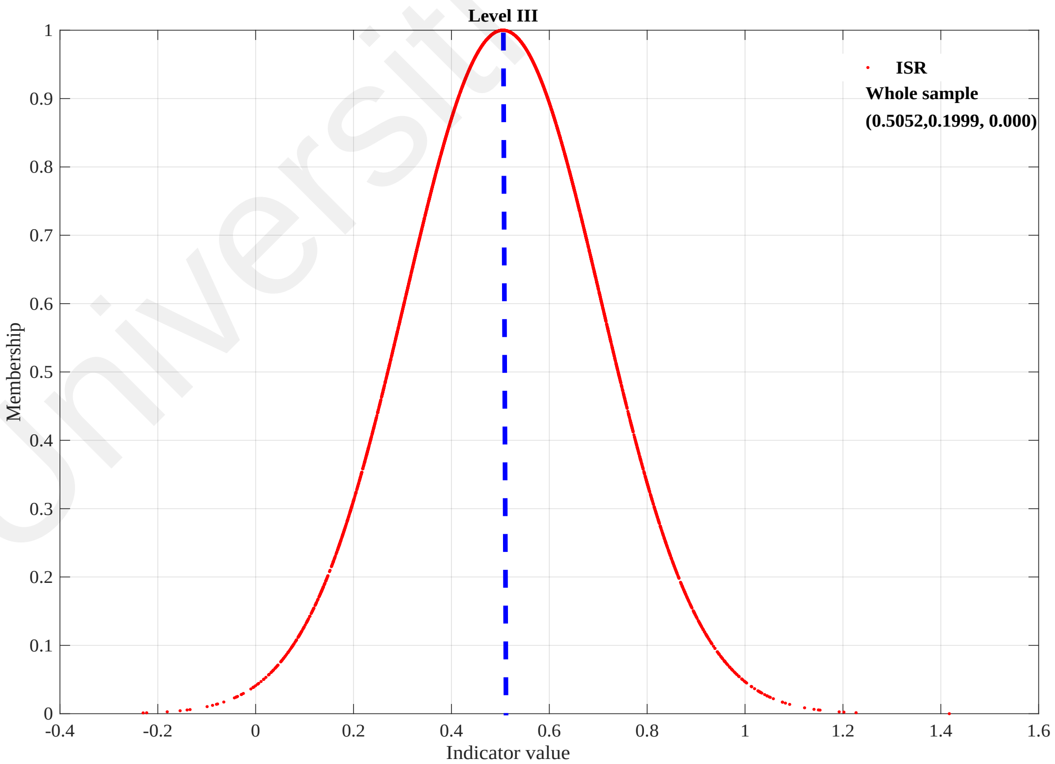

Figure 6.3: Cloud Map for ISR of China's 30 Provinces
Source: Computed by the Author

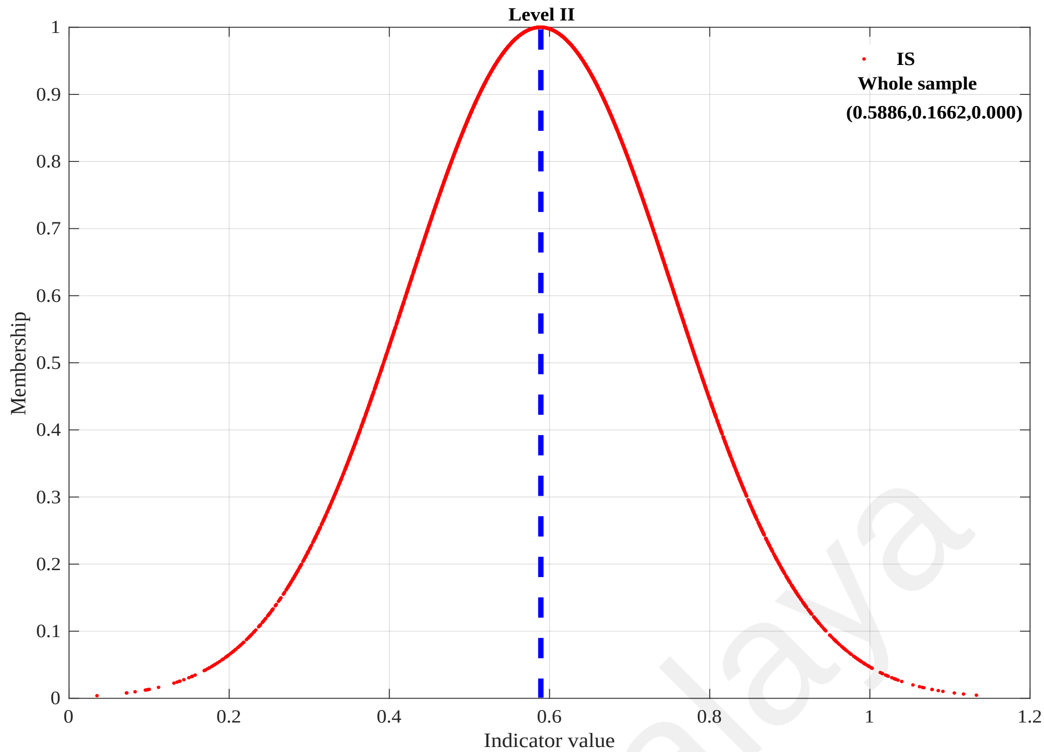

Figure 6.4: Cloud Map for IS of China's 30 Provinces
Source: Computed by the Author

The cloud maps for distribution characteristics of ISU, ISR and IS in China's three major regions are presented in Figures 6.5 - 6.7.

Figure 6.5 shows the ISU distribution features in China's eastern, central, and western regions. The results show that although the regional ISU level in all regions was higher than the "Excellent" level, there remained a great need for further improvement. This outcome was because H_e values in central and western regions were higher than the national and eastern levels. Moreover, the ISU development performance in most provinces was not stable, with significant fluctuations, as shown in Figure 6.1.

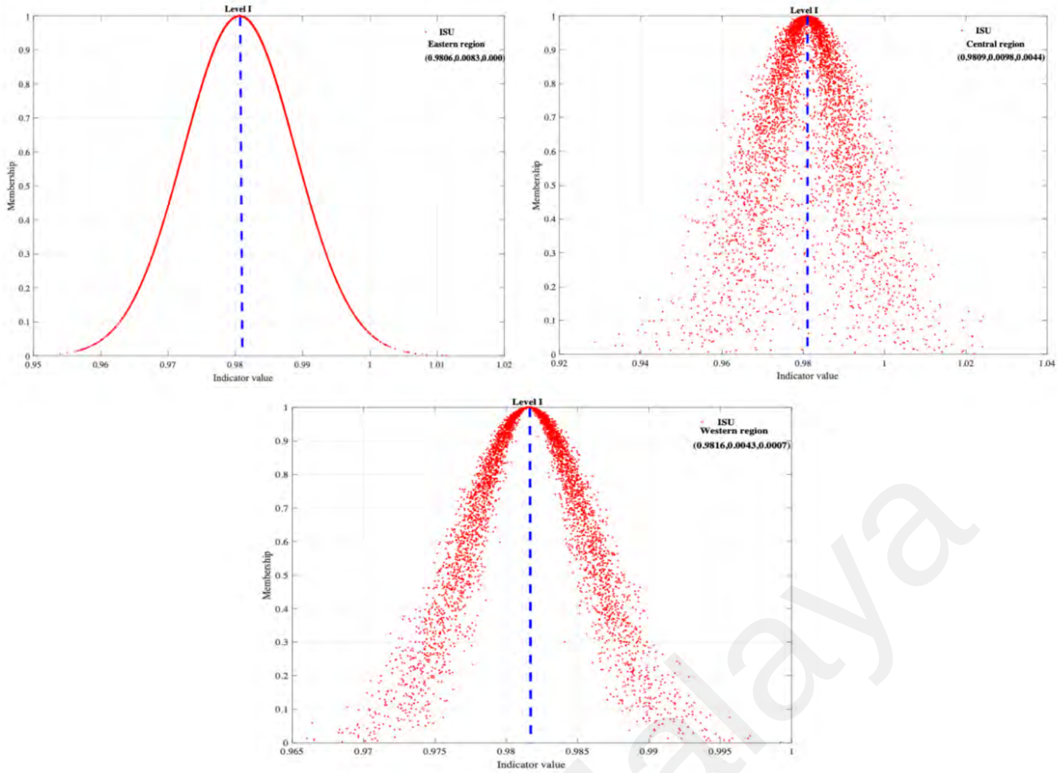

Figure 6.5: Cloud Map for ISU of China's Three Major Regions
Source: Computed by the Author

Secondly, Figure 6.6 shows the ISR distribution characteristics. Unfortunately, regional ISR levels were relatively poor. More specifically, $\mathrm{H_e}$ values in eastern ($\mathrm{H_e} = 0.0411$), central ($\mathrm{H_e} = 0.0803$) and western ($\mathrm{H_e} = 0.0639$) were significantly higher than the national level ($\mathrm{H_e} \approx 0$). Therefore, the cloud maps were randomly distributed, and their cloud maps were more scattered. Figure 6.1 shows that the provincial ISR performance was not good. Moreover, the ISR levels in some provinces even exhibited a decreasing trend. Thus, the ISR distribution characteristics were more random and scattered than the ISU distribution characteristics.

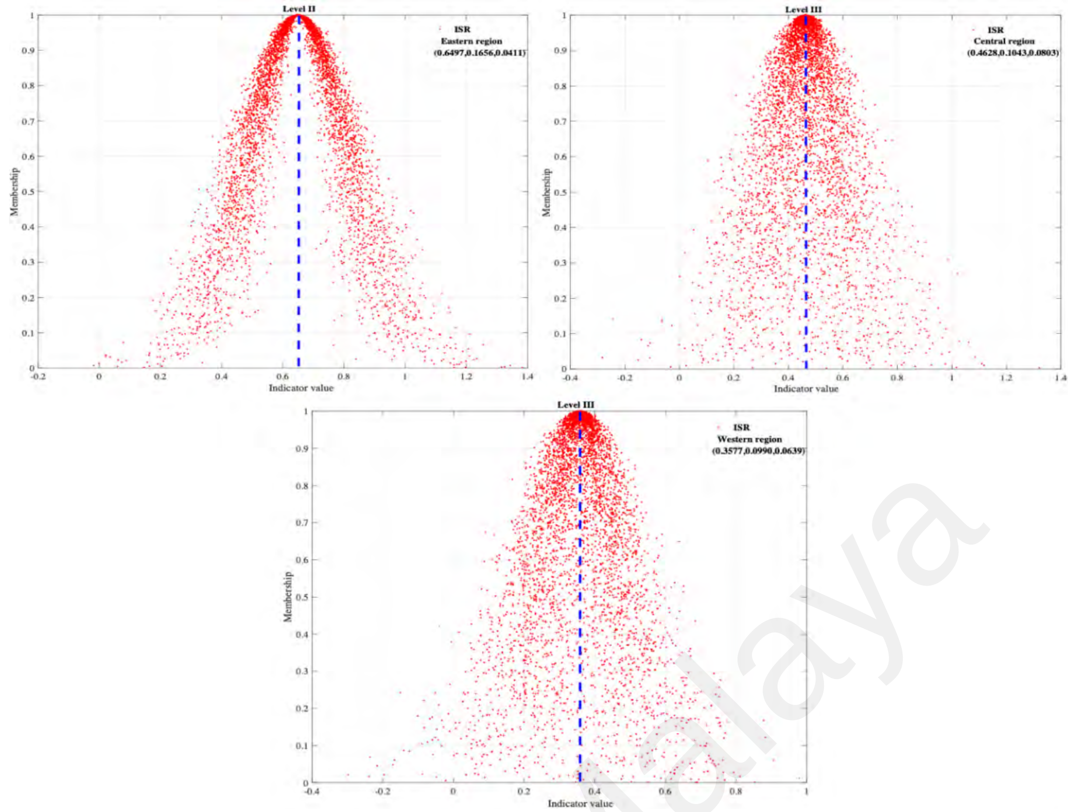

Figure 6.6: Cloud Map for ISR of China's Three Major Regions
Source: Information provided by the Author

Thirdly, Figure 6.7 represents the regional IS distribution characteristics. Similarly, the national IS development level was higher than the three major regions. The IS level in the eastern and central regions was slightly higher than the "Good" level, while the western region was higher than the "Normal" level. Moreover, H_e values in the eastern ($H_e = 0.0342$), central ($H_e = 0.0668$) and western regions ($H_e = 0.0532$) were significantly higher than the national level ($H_e \approx 0$). Therefore, compared with the eastern region, IS distribution features in central and western regions were more dispersed.

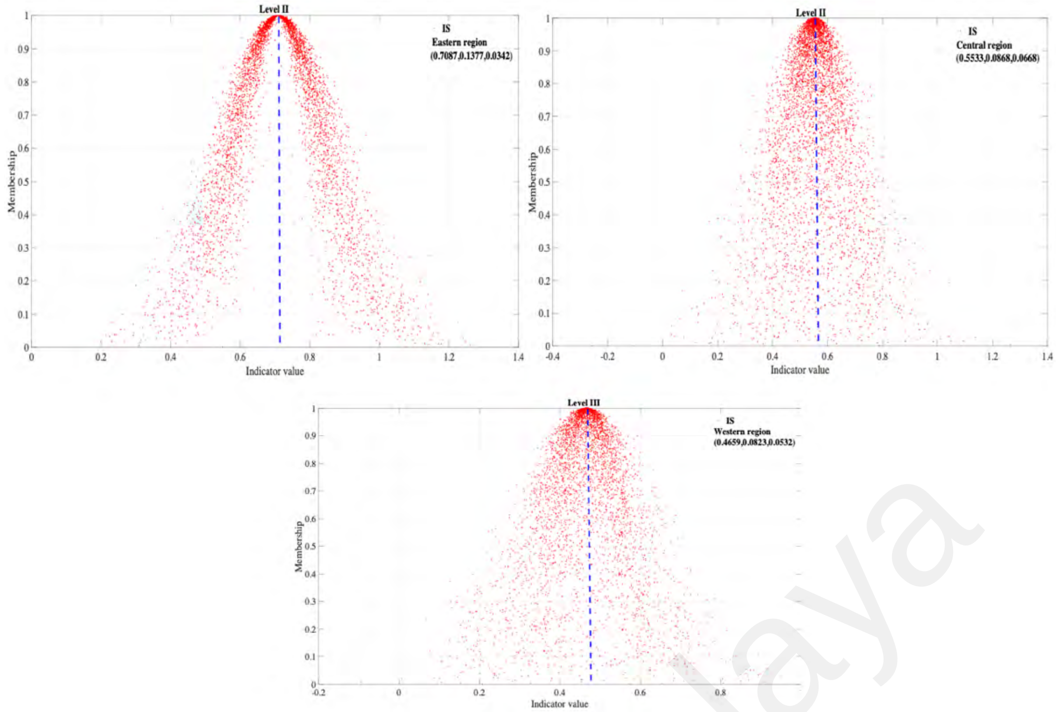

Figure 6.7: Cloud Map for IS of China's Three Major Regions
Source: Computed by the Author

6.3 Chapter Summary

The following research conclusions were drawn based on this chapter's overall analysis and derived empirical findings.

First, regional ISU, ISR and IS distribution characteristics existed in the following ranks: ISU: Eastern> Central> Western; ISR: Eastern> Western> Central; IS: Eastern> Central> western.

Second, compared with the contribution of ISU, the results show that IS distribution characteristics largely depended on ISR. Taking China's eastern region as an example, the ISU distribution status in the eastern region was greater than ISR. In other words, the ISR level was more random because of the large value of H_e. This outcome shows that the ISU level moderated in the development of China's ISTU. At the same time, the unreasonable industrial structure was the main reason causing the unbalanced development of ISTU.

Third, the overall level of the eastern region in terms of ISU, ISR, and IS distribution characteristics was better than the central and western regions. Thus, uneven development concerning ISTU could also be identified.

CHAPTER 7: FINDINGS3: IMPACT OF HIGH-QUALITY ECONOMIC DEVELOPMENT BASED ON SPATIAL ANALYSIS

7.1 Introduction

This chapter examines whether ISU, ISR and IS promoted HQD. The regional heterogeneity was then captured based on the benchmark regression model. Accordingly, the effects of ISTU on HQD were modelled by performing the SDM.

7.2 Definitions and Descriptive Statistics of the Selected Variables

Table 7.1 reports all the selected variables used in this study for the empirical analysis. Also, the related definitions and expected signs for all selected variables are reported simultaneously.

Table 7.1:Definitions of All Selected Variables

	Symbol	Definition	ES
Y	HQEI	HQEI	/
X	ISU	See ISU measurement scheme IV	+
	ISR	See ISR measurement scheme IV	+
	IS	See Section 4.3.3	+
M	GE	Government expenditure = Total government expenditure/GDP	+
	FDI	Foreign direct investment = Total amount of foreign direct investment utilised/GDP	+
	MI	Marketisation index= Number of industrial and commercial registered employed persons in private and self-employed individuals/Total number of employed persons	+
	EI	Education input intensity = Fiscal expenditure on education/government expenditure	+
	TI	R&D input intensity = R&D input for new products development/Total industrial enterprises	+
	CP	Per capita capital stock = Provincial capital stock/Total population	+
	RP	Number of R&D personnel in industrial enterprises in natural logarithm form	+
	EPU	See Yu et al. (2021)	−

Notes: (1) Abbreviations "Y", "X" and "M" represent the explained variables, explanatory variables and control variables, respectively.
(2) "ES" means the expected sign of the selected variables.
(3) "P1" and "P99" represent the 1st percentile and 99th percentile of the variables, respectively.
(4) Capital per capita was taken in natural logarithm form to deal with potential heteroscedasticity.

(5) For the empirical section, only the impacts of ISTU on China's HQD were analysed based on AS.

Table 7.2 presents the descriptive statistics of all the selected variables. Firstly, the minimum and maximum values of HQEI were 0.053 and 0.711, with a mean of 0.210 from 2005 to 2019. This result shows that China's overall interprovincial HQD level was not good, and there was a large disparity across the provinces. Secondly, the maximum and minimum values for ISU were 6.163 and 5.370, respectively, indicating a difference of about 1.150 times. The most significant value of ISR was 0.998, and the lowest value was 0.474, indicating a difference of about 2.11 times. This outcome shows that China's interprovincial ISR level varied considerably compared with the ISU level. Finally, for IS, the highest value was 0.791, and the lowest was 0.046, indicating a difference of about 17.20 times. While IS containing ISU and ISR showed a relatively large gap among provinces, thus, some provinces may have had a high ISU level (or ISR), but the ISR (or ISU) was relatively low.

Table 7.2: Descriptive Statistics of All Selected Variables

Variable	Obs.	Mean	S.D.	Min	Max	Skew.	Kurt.	p1	p99
HQDI	450	0.210	0.115	0.053	0.711	1.550	5.615	0.069	0.630
ISU	450	5.707	0.133	5.370	6.163	0.299	3.951	5.406	6.111
ISR	450	0.812	0.120	0.474	0.998	0.599	2.887	0.239	1.055
IS	450	0.400	0.143	0.046	0.791	0.143	2.479	0.083	0.702
GE	450	0.286	0.174	0.003	1.047	1.588	6.705	0.006	0.978
FDI	450	0.031	0.021	0.000	0.101	0.883	3.398	0.001	0.090
MI	450	0.289	0.179	0.057	1.127	1.684	6.198	0.075	0.933
EI	450	0.159	0.032	0.021	0.248	-0.563	3.946	0.09	0.221
TI	450	0.313	0.285	0.012	2.656	3.567	23.011	0.036	1.593
CP	450	9.583	0.917	6.879	11.491	-0.411	2.415	0.518	4.237
RP	450	10.242	1.408	4.443	13.407	-0.609	4.120	6.676	12.968
EPU	450	4.459	0.502	0.826	6.472	-1.241	13.106	3.095	5.763

7.3 Unit Root Test

This study conducted panel data stationarity testing to avoid false regression caused by nonstationary data. Sequentially, the Levin-Lin-Chu (LLC) test, Fisher-ADF test and

Fisher-Phillips-Perron (Fisher-PP) test were adopted to identify the stationarity of the selected variables. The results shown in Table 7.3 were statistically significant. They rejected the null hypothesis that all panels contained a unit root favouring the alternative hypothesis that a nonzero fraction of panels represented the stationarity process. Hence, it was reasonable to conduct the panel data regression.

Table 7.3:Unit Root Testing Results

Variable	LLC Test	Fisher-ADF Test	Fisher-PP Test
HQEI	-3.5622***	3.6133***	3.8304***
ISU	-5.7598***	7.2834***	1.4152*
ISR	-9.0226***	8.3385***	5.0414***
IS	-6.6734***	7.0903***	1.4628*
GE	-3.1305***	12.1139***	5.3493***
FDI	-5.9816***	9.4318***	3.8380***
MI	-1.8028**	3.9178***	1.6659**
EI	-17.3869***	11.1723***	29.3911***
TI	-5.4261***	10.9428***	3.6884***
CP	-7.8530***	9.3014***	14.7796***
RP	-2.8132***	9.0895***	1.8399**
EPU	-11.9781***	12.0778***	13.1759***

*p<0.10, **p<0.05, ***p<0.01

7.4 Stationarity Test

Based on the previous unit root tests, this study adopted Kao's panel data cointegration testing approach to detect whether there was a long-term equilibrium relationship between the stationary variables. The test's output reports the values of all test statistics with their respective p-values. The results in Table 7.4 show that all the statistics rejected the null hypothesis of no cointegration. They favoured the alternative hypothesis that the variables were cointegrated in all the panels.

Table 7.4: Panel Cointegration Test Results

	ISU model		RIS model		IS model	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
Modified Dickey-Fuller t	3.0367***	0.0012	3.3043***	0.0005	3.2254***	0.0006
Dickey-Fuller t	2.7513***	0.0030	3.2901***	0.0005	3.1383***	0.0008
Augmented Dickey-Fuller t	4.0941***	0.0000	4.4356***	0.0000	4.4314***	0.0000

Unadjusted modified Dickey-Fuller t	-2.8990***	0.0019	-2.5193***	0.0059	-2.5909***	0.0048
Unadjusted Dickey-Fuller t	-2.6066***	0.0046	-2.2083**	0.0136	-2.2889**	0.0110

**p<0.05, ***p<0.01.

7.5 Multicollinearity Test

For validating the multicollinearity issue, this study reported the Pearson correlation matrix. According to Table 7.5, the estimated coefficients were smaller than 0.80, thus, exhibiting a low correlation among the explanatory variables in the three models. Moreover, this study carried out the variance inflation factor (VIF) test. As shown in Table 7.6, the estimated results showed that the VIF test values were lower than the recommended limit of 5 (Armstrong & Overton, 1977). Thereby, there were no multicollinearity issues in all models.

Table 7.5: Pearson Correlation Matrix

Variable	ISU	GE	FDI	MI	EI	TI	CP	RP	EPU
ISU	1.000								
GE	-0.363*	1.000							
FDI	0.311*	-0.330*	1.000						
MI	0.147*	-0.028	0.227*	1.000					
EI	0.024	-0.328*	0.043	-0.071	1.000				
TI	-0.022	0.356*	-0.269*	-0.085	-0.195*	1.000			
CP	0.134*	0.155*	0.151*	0.717*	-0.044	0.126*	1.000		
RP	0.241*	-0.556*	0.193*	0.377*	0.405*	-0.204*	0.434*	1.000	
EPU	0.051	-0.027	0.042	0.100*	-0.093*	0.036	0.064	-0.018	1.000
Variable	ISR	GE	FDI	MI	EI	TI	CP	RP	EPU
ISR	1.000								
GE	-0.377*	1.000							
FDI	0.471*	-0.330*	1.000						
MI	0.518*	-0.028	0.227*	1.000					
EI	0.204*	-0.328*	0.043	-0.071	1.000				
TI	-0.248*	0.356*	-0.269*	-0.085	-0.195*	1.000			
CP	0.352*	0.155*	0.151*	0.717*	-0.044	0.126*	1.000		
RP	0.556*	-0.556*	0.193*	0.377*	0.405*	-0.204*	0.434*	1.000	
EPU	0.019	-0.027	0.042	0.100*	-0.093*	0.036	0.064	-0.018	1.000
Variable	IS	GE	FDI	MI	EI	TI	CP	RP	EPU
IS	1.000								
GE	-0.490*	1.000							
FDI	0.529*	-0.330*	1.000						
MI	0.468*	-0.028	0.227*	1.000					
EI	0.164*	-0.328*	0.043	-0.071	1.000				
TI	-0.195*	0.356*	-0.269*	-0.085	-0.195*	1.000			
CP	0.338*	0.155*	0.151*	0.717*	-0.044	0.126*	1.000		
RP	0.550*	-0.556*	0.193*	0.377*	0.405*	-0.204*	0.434*	1.000	
EPU	0.044	-0.027	0.042	0.100*	-0.093*	0.036	0.064	-0.018	1.000

*p<0.05.

Table 7.6: Results of the Variation Inflation Factor Test

Variable	VIF	1/VIF	Variable	VIF	1/VIF	Variable	VIF	1/VIF
ISU	1.284	0.779	ISR	2.165	0.462	IS	2.320	0.432
GE	2.646	0.378	GE	2.412	0.415	GE	2.560	0.391
FDI	1.321	0.757	FDI	1.492	0.670	FDI	1.550	0.644
MI	2.308	0.433	MI	2.683	0.373	MI	2.510	0.398
EI	1.332	0.751	EI	1.333	0.750	EI	1.330	0.754
TI	1.294	0.773	TI	1.272	0.786	TI	1.280	0.781
CP	3.302	0.303	CP	3.307	0.302	CP	3.260	0.307
RP	2.876	0.348	RP	3.174	0.315	RP	3.010	0.332
EPU	1.029	0.972	EPU	1.029	0.971	EPU	1.030	0.972

Note: The mean of the VIF values for the ISU model, ISR model, and IS model were 1.932, 2.096 and 2.090, respectively.

7.6 Feasibility Verification of the Spatial Durbin Model

Before performing the spatial regression, it was necessary to conduct the Lagrange Multiplier (LM) test on the models to examine whether they had spatial autocorrelation. The null hypothesis regarding the LM test was that there was no spatial error term and spatial lag term in the specified models. Table 7.7 shows that both the LM and robust LM tests rejected the null hypothesis (see Panel A). Then this study considered whether China's HQEI exhibited significant spatial spillover effects. This result was consistent with Moran's I statistical values reported in Chapter 5. Hence, the implementation of spatial analysis was necessary.

Besides, to ensure that the specified models were more robust, this study adopted the Wald and Likelihood ratio (LR) tests to determine whether the SDM would be degraded to the SLM or SEM. According to Table 7.7, both the LR (see Panel B) and Wald test (see Panel C) results rejected the null hypothesis, indicating that the SDM specified in this study was reasonable.

The Hausman test was performed to examine whether the model should adopt a fixed or random-effect analysis. The Hausman test results in Table 7.7 (see Panel D) rejected the random-effect hypothesis at a 1% significance level, suggesting that the following test would be carried out for fixed-effect analysis.

Table 7.7: Model Selection and Diagnostics

Panel A Lagrange multiplier (LM) test and Robust LM tests								
ISU model	Statistics	p-value	ISR model	Statistics	p-value	IS model	Statistics	p-value
Moran's I	24.75^{***}	0.000	Moran's I	25.736^{***}	0.000	Moran's I	24.299^{***}	0.000
Spatial I LM	396.18^{***}	0.000	Spatial I LM	367.004^{***}	0.000	Spatial I LM	337.571^{***}	0.000
Robust LM	49.50^{***}	0.000	Robust LM	23.71^{***}	0.000	Robust LM	34.328^{***}	0.000
Spatial II LM	557.39^{***}	0.000	Spatial II LM	603.175^{***}	0.000	Spatial II LM	536.930^{***}	0.000
Robust LM	210.70^{***}	0.000	Robust LM	259.881^{***}	0.000	Robust LM	233.687^{***}	0.000
Panel B Likelihood Ratio (LR) test								
ISU model	Statistics	p-value	ISR model	Statistics	p-value	IS model	Statistics	p-value
LR (I)	180.98^{***}	0.000	LR (I)	129.61^{***}	0.000	LR (I)	204.10^{***}	0.000
LR (II)	149.91^{***}	0.000	LR (II)	79.99^{***}	0.000	LR (II)	171.14^{***}	0.000
Panel C Wald test								
ISU model	Statistics	p-value	ISR model	Statistics	p-value	IS model	Statistics	p-value
Wald (I)	25.72^{***}	0.002	Wald (I)	26.09^{***}	0.000	Wald (I)	19.14^{**}	0.024
Wald (II)	26.39^{***}	0.002	Wald (II)	25.25^{***}	0.003	Wald (II)	19.39^{***}	0.022
Panel D Hausman test								
ISU model	Statistics	p-value	ISR model	Statistics	p-value	IS model	Statistics	p-value
Hausman	97.19^{***}	0.000	Hausman	43.30^{***}	0.000	Hausman	48.21^{***}	0.000

Notes: (1) $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$.
(2) I and II represent the Spatial Lag and Spatial Error Models, respectively.

7.7 Results for Spatial Regression

7.7.1 Regression Scatter Diagram

Before discussing the effects of ISTU on China's HQD, it was necessary to make sense of the data. For the improvement of HQD: does China's ISTU matter? Subsequently, this study ran the regression scatter diagram between ISU, ISR, IS, and HQEI. Moreover, the red dot line shown in Figures 7.1 - 7.3 regulated the 45-degree line. Provinces moving along this line exhibited a good relationship between ISU (ISR/IS) and HQEI.

Figure 7.1 represents the correlation between ISU and HQEI. With the continuous optimisation of the industrial structure, HQD in all Chinese provinces exhibited an upward trend. This result shows that ISU is positively correlated with HQD. Besides, ISU and HQEI exhibited a better fit in seven provinces, i.e., Tianjin, Fujian, Jiangxi, Henan, Yunnan, Gansu, Qinghai, and the R^2 values of the above provinces were greater than 0.95. In contrast, the relationship between ISU and HQEI was badly fitted in the following provinces: Jilin, Shanghai, Anhui, Chongqing, Ningxia and Xinjiang, and the R^2 values of the above provinces were smaller than 0.90.

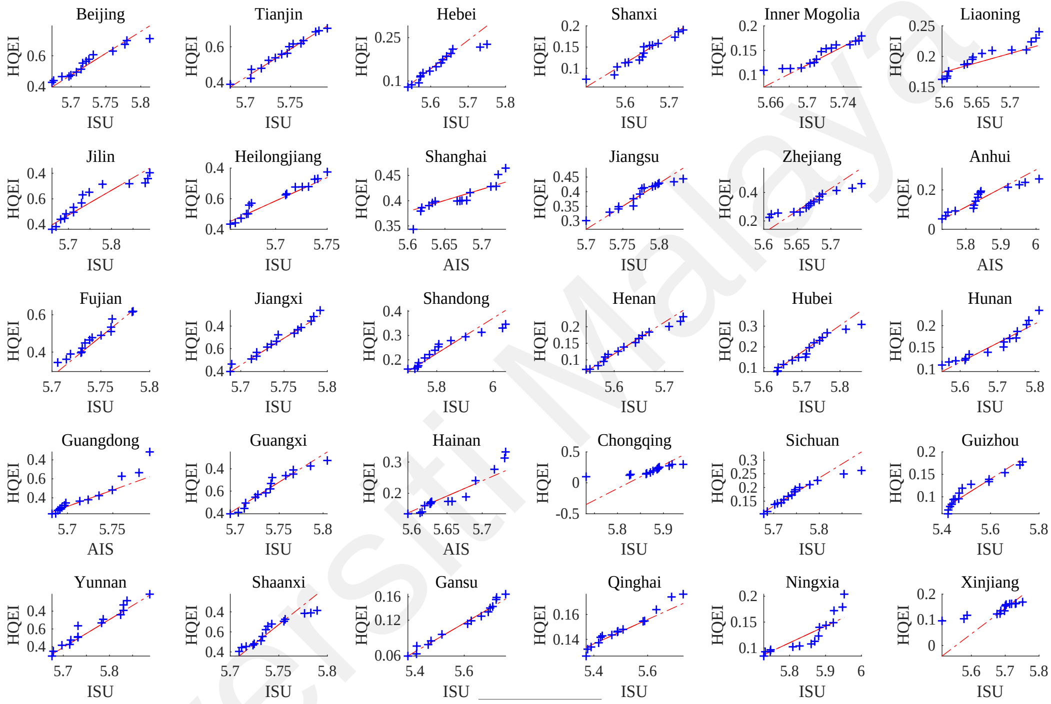

Figure 7.1: Interprovincial Regression Scatter Diagram Between ISU and HQEI
Source: Computed by the Author

Figure 7.2 displays the correlation between ISR and HQEI. The R^2 values in six provinces were greater than 0.90, i.e., Beijing, Jilin, Shandong, Hubei, Shaanxi and Guizhou, indicating that the dots were mainly distributed along the 45-degree line; thus, reflecting a good fit between ISR and HQEI. However, the diagram intuitively shows that with continuous improvement and re-articulation of the industrial structure, provincial high-quality economic development levels showed an upward trend. In contrast, the unreasonable industrial structure inhibited provincial HQD, i.e., Heilongjiang, Shanghai, Jiangsu, Henan, Guangdong, Guangxi, Yunnan, Gansu, Qinghai, Ningxia and Xinjiang.

The R^2 values of the above provinces were lower than 0.90. The fit between ISR and HQEI in Guangdong province was significantly lower than in other provinces, at 0.5381.

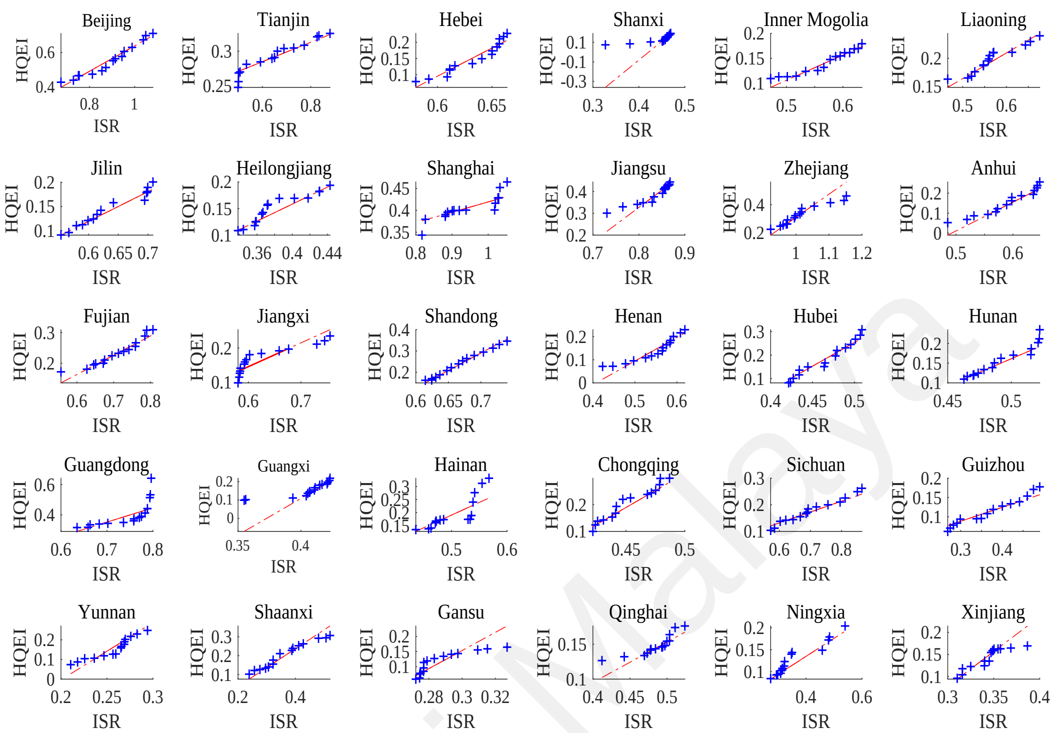

Figure 7.2: Interprovincial Regression Scatter Diagram Between ISR and HQEI
Source: Computed by the Author

Figure 7.3 shows the correlation between IS and HQEI. The relationship between IS and HQEI was better fitted than the previous results. In general, IS positively affected HQEI. Specifically, the R^2 values in the following provinces were higher than 0.90: Beijing, Hebei, Zhejiang, Jiangxi, Hubei, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, and Qinghai. Conversely, the R^2 values in Tianjin, Shanxi, Liaoning, Shanghai, Henan, Guangdong, Hainan, Chongqing, Ningxia and Xinjiang were lower than 0.90.

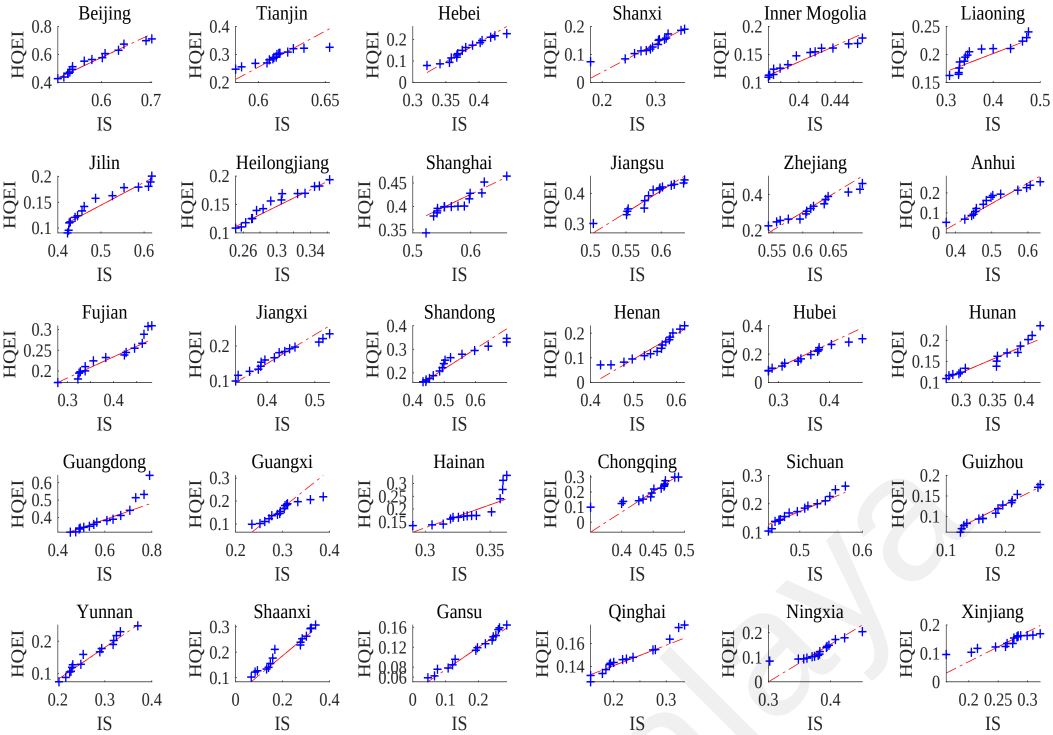

Figure 7.3: Interprovincial Regression Scatter Diagram Between IS and HQEI
Source: Computed by the Author

Based on the scatter diagrams, it can be concluded that vigorously upgrading and optimising China's industrial structure has been conducive to improving the quality of China's economic development. Moreover, the relationship between ISTU and HQD in the eastern region was significantly better than in the central and western regions. However, the results also show that the fitted state in some eastern provinces, such as Guangdong and Hainan, lagged compared with some western provinces, i.e., Gansu and Qinghai.

Moreover, the development status between ISTU and HQD in the eastern region exhibited a "mismatching" phenomenon, i.e., HQD could not match the rapid development of the industrial structure or the contrary. Taking Guangdong as an example, its economic strength and industrial structure are well developed as a coastal province. Guangdong's average HQEI annual growth rate was 4.21% from 2005 to 2019, and its average ISU, ISR, and IS annual growth rates were 0.47%, 1.41% and 3.86%, respectively. Thus, Guangdong's economic growth rate was considerably greater than the development speed of the industrial structure. Hence, Guangdong province needed to balance the relationship between industrial structure development and economic development, thus, gradually realising synergy and sustainable development.

7.7.2 Benchmark Regression Results

This study adopted the Ordinary Least Squares (OLS), two-step SYS-GMM and SDM models to analyse the effects of ISU, ISR and IS on HQD, respectively, and facilitate comparison and improvement of the robustness of the empirical results, as reported in Table 7.8.

Firstly, according to the OLS model (Models 1 - 3), ISU, ISR, and IS positively affected HQEI after adding control variables, with the significance level being 1%. The results implied that actively implementing ISTU was helpful for China to achieve HQD. By inspecting the results, the magnitude of ISR on HQEI was higher than ISU, and the magnitude of ISTU composite system IS was higher than ISU and ISR.

Secondly, this study could not obtain an effective and appropriate instrument variable considering the endogeneity concern of ISU (ISR and IS) to HQEI and data availability. So finally, the dynamic panel data model was used to control the possible endogenous problems. Consequently, the two-step SYS-GMM model was adopted to estimate the dynamic panel model, and the estimated results are shown in Models 4 - 6. The instrument variables' effectiveness and the model's rationality were also examined to improve the reliability of the results. The results in Columns 4 - 6 implied first-order autocorrelation in the difference of the disturbance term. Still, there was no second-order autocorrelation in all models. This result meant that the null hypothesis of no autocorrelation in the disturbance term needed to be accepted. The p-values of the Sargan test were higher than 0.10, meaning the null hypothesis that all instrument variables were valid should be accepted. The results show that the three core independent variables were still significantly positive after addressing the endogeneity problems, whereas the estimated coefficients were smaller than the OLS model.

Thirdly, this study extended traditional econometric models by incorporating spatial elements and geographical factors. Corresponding effects were then further captured by using Eqs. (4-39) - (4-41), as shown in Models 7 - 9. First, the spatial autoregressive coefficients (Spatial ρ) in Models 7 - 9 were positive and passed the significance test with a value of 1%, indicating that HQEI had an obvious spatial spillover effect. The results were consistent with the Moran's I and LM test results. They revealed that the HQEI agglomeration in neighbouring areas had a tremendous positive impact on the local improvement in the quality of economic development. Improving the quality of economic development in surrounding areas facilitated quality transmission between these regions, thus, driving economic development. Second, considering that R^2 can only reflect the goodness of fit of the regression. Therefore, the Adj R^2 was reported to eliminate the influence of the number of independent variables on R^2. The goodness of fit of the OLS model in Models 1 - 3 for the ISU, ISR, and IS models were 0.7530, 0.7690 and 0.7760, respectively. The results were smaller than 0.9290, 0.8750 and 0.9302 for the SDM. Meanwhile, the values were significantly positive at the significance level of 1%, which indicated that the spatial overflow existed in HQEI. Compared with the OLS and dynamic panel data models, the accuracy of the SDM was greatly improved. Thus, the spatial econometric model was more reasonable. The estimated results show that economic quality improvement was affected by local economic development levels and neighbouring areas and related explanatory variables. Third, ISU, ISR, IS, and their spatial lag terms (i.e., W∗ISU, W∗IRS, W∗IS) positively affected HQEI. This outcome again reinforced the previous analysis, that is, vigorously implementing ISTU was conducive to promoting China's HQD from a national perspective.

Finally, the influential signs were consistent with this study's expectations regarding the control variables, as shown in Table 7.1. (1) The impact of GE was positive, which verified the effectiveness of the Keynesian effect in China. On the one hand, the government has provided funds to support public infrastructure construction, i.e., transportation infrastructure (Transportation infrastructure was demonstrated by Liang & Li (2021) to play a crucial role in promoting China's GTFP growth). On the other hand, a good public service system can enhance people's lives and gradually realise collaborative development among different regions[56].

(2) FDI positively affected HQEI. That is, FDI promoting activities are crucial contributions to China's HQD. It has been stated that FDI inflows contribute to economic growth through stimulating domestic investment and facilitating improvements in human capital and technological spillover efficiency (Borensztein et al., 2001; Zhang & Yang, 2016; Akinlo, 2004; Zhao & Du, 2007), thereby contributing to HQD.

(3) A higher level of the marketisation process positively promoted HQEI. The results show that China needs to establish and build a sound market-oriented economic system. This outcome was because a well-developed marketisation mechanism can significantly facilitate TFP[57] growth at the industrial level (Zhang & Du, 2020). On the other hand, an effective marketisation system could help improve the economy's quality by increasing technological progress and reducing investment risks and transaction costs.

(4) The effect of EI on HQEI was positive. Education can increase the human capital development of the labour force, which would improve economic growth and

[56] This study discussed the positive effect of GE on HQEI based on two perspectives, i.e., coordination development and sharing development. These two aspects are the components of a high-quality economic development system, thus, forming the following relationships: GE → coordination development → HQEI; GE → sharing development → HQEI.

[57] More emphasis was put on the TFP growth rate when analysing the role of marketisation in the process of HQD. This study fully reviewed the existing literature regarding the proxy variable for measuring China's HQD. TFP was the first indicator used for measuring the HQEI level (see Chapter 2). However, the Chinese extensive economic model cannot be sustained in the long term because it mainly depends on a high quantity of inputs and pollution emissions without significant improvements in TFP. Thus, a sound marketisation system is helpful to achieve the optimisation and effective allocation of resource endowments.

labour productivity (Benos & Zotou, 2014). The expansion of education could provide all kinds of professional education and training, promoting the basic skills and literacy of the labour force. Moreover, education can be regarded as one of the reasons why most developing countries cannot fully use the benefits package of technological progress. Paying bills online, for instance, asks vendors to maintain billing technology, but the buyers need to have internet knowledge (Donou-Adonsou, 2019). Thus, education is an essential driver for economic growth and technological progress. That is why globally, many countries have aspired to establish world-class universities.

(5) CP had a positive effect on HQEI. After examining the relationships between; energy consumption, environmental degradation, economic growth and financial development, Khan et al. (2019) demonstrated that a one-unit increase in capital or domestic investment would raise the economic growth by 28.97. Thus, higher capital formation is essential to realise HQD.

(6) The R&D input intensity for new product development negatively affected HQEI, while R&D personnel input positively affected HQEI. Both theoretical and empirical studies have proven that TI does play an important role in driving economic growth. Moreover, Salman et al. (2019) also suggested that the Chinese government should concentrate more on TI as a key driver of economic growth to maintain the steady growth of China's HQD. However, this study has shown that TI (only R&D input intensity for new product development) negatively affected economic development. After checking the data, it was found that the growth of R&D input intensity for new product development was not stationary. Moreover, this indicator in most provinces exhibited a downward trend (see Appendix C). Therefore, the negative effects of R&D input intensity for new product development could be identified.

Besides, (7) This study demonstrated that economic policy uncertainty negatively impacted HQEI, while such an effect was insignificant. Uncertainty shocks could impede macroeconomic activities with negative effects on socioeconomics, i.e., unemployment, economic growth, private consumption and investment. The comparisons between the estimated and expected signs are shown in Table 7.9.

Table 7.8: Benchmark Regression Results with Whole Sample

Model	1	2	3	4	5	6	7		8		9	
Model type		OLS			SYS-GMM				SDM			
Variable	HQEI	HQEI	HQEI	HQEI	HQEI	HQEI	HQEI	W_x	HQEI	W_x	HQEI	W_x
ISU	**0.073*****			**0.013****		**0.010*****	**0.107*****	**0.534*****				
	(3.18)			(2.46)		(4.10)	(5.54)	(8.07)				
L.HQEI				0.662***	0.620***	0.606***						
				(38.36)	(21.82)	(19.86)						
GE	0.039	0.016	0.058**	0.001	0.005	0.018**	0.132***	-0.030	0.076***	-0.197***	0.138***	-0.124**
	(1.54)	(0.67)	(2.44)	(0.12)	(0.45)	(1.96)	(5.78)	(-0.46)	(3.01)	(-2.85)	(6.20)	(-2.12)
FDI	0.455***	0.180	0.062	0.308***	0.244***	0.352***	0.331**	-0.088	0.422***	1.123***	0.224	-0.168
	(3.11)	(1.19)	(0.41)	(4.53)	(4.94)	(5.06)	(2.41)	(-0.26)	(2.88)	(3.52)	(1.63)	(-0.51)
MI	0.458***	0.400***	0.408***	0.117***	0.132***	0.122***	0.481***	0.014	0.444***	-0.209***	0.385***	-0.216***
	(19.97)	(16.72)	(17.92)	(18.15)	(12.85)	(24.33)	(25.06)	(0.26)	(18.21)	(-3.38)	(17.94)	(-4.11)
EI	0.374***	0.311***	0.353***	0.233***	0.207***	0.244***	0.561***	1.995***	0.314***	1.400***	0.396***	1.568***
	(3.88)	(3.34)	(3.86)	(15.55)	(8.53)	(11.91)	(7.06)	(7.19)	(3.70)	(4.70)	(5.21)	(5.85)
TI	-0.043***	-0.037***	-0.045***	-0.005***	-0.004***	-0.004***	-0.043***	0.033	-0.042***	0.049	-0.048***	0.063**
	(-3.98)	(-3.55)	(-4.40)	(-5.44)	(-4.98)	(-4.00)	(-4.54)	(1.16)	(-4.26)	(1.63)	(-5.41)	(2.34)
CP	-0.000	0.006	0.002	0.006***	0.007**	0.007***	0.017***	-0.031***	0.000	-0.027**	0.006	-0.053***
	(-0.07)	(1.07)	(0.32)	(4.70)	(2.55)	(2.60)	(2.61)	(-2.64)	(0.06)	(-2.07)	(0.97)	(-4.35)
RP	0.016***	0.010***	0.011***	0.001	-0.000	0.002*	0.022***	-0.067***	0.017***	-0.080***	0.015***	-0.090***
	(5.06)	(2.92)	(3.46)	(1.14)	(-0.28)	(1.87)	(8.08)	(-7.50)	(5.56)	(-7.56)	(5.45)	(-10.01)
EPU	-0.006	-0.005	-0.006	-0.001*	-0.001*	-0.001***	-0.006	0.013	-0.006	0.037***	-0.004	0.028**
	(-1.12)	(-1.00)	(-1.09)	(-1.67)	(-1.79)	(-3.18)	(-1.49)	(1.08)	(-1.24)	(2.78)	(-0.89)	(2.34)
ISR		**0.122*****			**0.055*****				**0.094*****	**0.116***		
		(6.31)			(3.85)				(4.44)	(1.85)		
IS			**0.205*****			**0.071*****					**0.219*****	**0.716*****
			(7.51)			(8.10)					(8.74)	(8.79)
Constant	-0.551***	-0.112***	-0.141***	-0.100***	-0.037**	-0.065***						
	(-3.96)	(-2.74)	(-3.52)	(-2.92)	(-2.42)	(-6.57)						
AR (1)				-2.57**	-2.493***	-2.528**						
AR (2)				-0.613	-0.639	-0.484						
AR (3)				-0.304	-0.297	-0.304						
Sargan test (p-value)				20.789	21.681	21.699						
Spatial ρ							0.404***		0.480***		0.309***	

							(6.07)	(7.36)	(4.42)
$Sigma^2\_e$							0.002***	0.002***	0.002***
							(15.01)	(14.60)	(14.71)
L-ratio test							774.865	745.254	793.438
Obs.	450	450	450	420	420	420	450	450	450
Adj R^2	0.7530	0.7690	0.7760				0.9290	0.8750	0.9302

Notes: *p<0.1, **p<0.05, ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis

Table 7.9: Sign Comparison of the Selected Variables

Variable	ES 1	ES 2	Does it fit?	Variable	ES 1	ES 2	Does it fit?
ISU	+	+	Yes	EI	+	+	Yes
ISR	+	+	Yes	TI	+	−	**No**
IS	+	+	Yes	CP	+	+	Yes
GE	+	+	Yes	RP	+	+	Yes
FDI	+	+	Yes	EPU	−	−	Yes
MI	+	+	Yes				

Notes: Abbreviations "ES 1" and "ES 2" represent the expected and estimated signs, respectively.

7.7.3 Effect's Verification Based on the Five Subsystems of High-Quality Economic Development

Based on the benchmark regression models, the following question was further discussed: Does ISTU positively affect high-quality economic development subsystems?

Since it has been empirically demonstrated that ISU, ISR, and IS positively affected HQEI, logically, if ISTU exhibited a certain impact on HQD, it could be further inferred that ISU, ISR, and IS also positively affected HQD subsystems. Therefore, Eqs. (4-39) - (4-41) were then adopted to capture the relevant effects, as presented in Table 7.10.

Firstly, ISU positively affected ID, CD, and SD with 0.129, 0.050 and 0.082 values, respectively and significantly. ISU also had a positive effect on OD, but the effect was not significant. The results also indicated that the advancement of the industrial structure at high speed negatively impacted green development. A possible explanation is that China has experienced rapid economic growth since 1978. The output value of the tertiary industry has successfully surpassed the secondary and primary industries and has become the leading industry among the three industries. Thus, the ISU level in most provinces has exhibited an upward trend. However, the rapid evolution speed of the industrial structure should attribute to resource-intensive manufacturing, exports and low-paid labour, resulting in economic, social, and environmental imbalances[58]. Therefore, the negative effect of ISU on GD was identified.

Secondly, ISR positively affected all HQD subsystems. At the same time, the effects of ISR on ID and OD were insignificant. Compared with the effect of ISU on GD, the impact of ISR on GD was positive at the significance level of 1%, designating that the rationalisation of industrial structure could help China to eliminate the negative impacts imposed by economic development. A possible illustration is as follows: it is acknowledged that rapid economic growth is characterised by energy consumption and resource abundance, causing low resource allocation and utilisation efficiency and hindering sustainable development. However, ISR mainly refers to the coupling degree of resource utilisation efficiency among various industries, indicating that provinces with a high ISR level will better address environmental issues than those with a relatively high ISU level.

Thirdly, IS positively affected HQD subsystems and was significant except for GD. By comparison, the impact of GD largely depended on the ISU level. Hence, IS also negatively impacted GD. In contrast, the sign and magnitude of the impacts of the spatially lagged independent variables were heterogeneous.

Finally, it should be noted that the spatial autoregressive parameters (Spatial ρ) of the SD in ISU and ISR models were significantly negative, while the corresponding value in the IS model was positive and insignificant. The negative sign of Spatial ρ indicated that the SD subsystem in most Chinese provinces was unbalanced and underdeveloped. It exhibited a spatial clustering pattern from the negative agglomeration effect. Provinces with low (or high) values tended to be clustered. At the same time, the

[58] The World Bank in China (see https://www.worldbank.org/en/country/china/overview).

results also demonstrate that IS could moderate the distribution pattern of SD. To this end, China must advance and rationalise its industrial structure and gradually realise balanced development by enacting powerful initiatives, consequently improving people's living standards.

Table 7.10: Benchmark Regression Results Based on the Five Subsystems of HQD

Model	11					12					13				
Variable	ID	CD	GD	OD	SD	ID	CD	GD	OD	SD	ID	CD	GD	OD	SD
ISU	0.129***	0.050***	-0.172***	0.023	0.082***										
	(4.86)	(3.17)	(-7.06)	(1.22)	(3.06)										
ISR						0.017	0.047**	0.154***	0.010	0.134***					
						(0.58)	(2.51)	(5.88)	(0.46)	(4.60)					
IS											0.166***	0.070***	-0.056*	0.043*	0.237***
											(4.65)	(3.43)	(-1.67)	(1.76)	(7.22)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
W∗ISU	0.955***	0.015	-0.037	-0.036	0.523***										
	(10.59)	(0.43)	(-0.43)	(-0.84)	(5.64)										
W∗ISR						0.077	-0.195***	0.324***	0.144***	-0.094					
						(0.91)	(-4.52)	(4.17)	(2.73)	(-1.10)					
W∗IS											0.993***	-0.103**	0.251**	0.064	-0.106
											(8.63)	(-2.13)	(2.35)	(1.08)	(-1.35)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effect	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Spatial ρ	0.384***	0.235***	0.321***	0.341***	-0.436***	0.541***	0.167**	0.222***	0.284***	-0.353***	0.416***	0.259***	0.340***	0.334***	0.020
	(6.34)	(3.21)	(4.08)	(4.61)	(-5.14)	(9.66)	(2.21)	(2.63)	(3.64)	(-4.05)	(6.95)	(3.64)	(4.32)	(4.50)	(0.24)
$Sigma^2$_e	0.003***	0.000***	0.003***	0.001***	0.004***	0.004***	0.000***	0.003***	0.001***	0.004***	0.004***	0.000***	0.003***	0.001***	0.001***
	(15.40)	(14.93)	(14.84)	(14.84)	(14.79)	(15.18)	(14.97)	(14.92)	(14.89)	(14.75)	(14.49)	(14.92)	(14.82)	(14.85)	(15.00)
Obs.	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450
Adj R^2	0.530	0.568	0.018	0.211	0.682	0.476	0.540	0.094	0.355	0.601	0.196	0.593	0.038	0.267	0.468
L-ratio test	642.58	1096.95	663.61	1008.39	618.037	587.344	1102.76	662.642	1011.84	611.137	626.841	1099.77	644.817	1009.45	885.009

Notes: $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.

7.7.4 Spatial Spillover Effect Decomposition

The regression coefficients estimated by the SDM cannot be directly explained by the marginal effect of the independent variables on the dependent variable. This outcome was because the spatial econometric model analysed the sophisticated dependence among spatial entities, and the coefficients of the x and W_x cannot reflect the real spatial effect. The present study needed to decompose the total effect into direct and indirect effects using Eqs. (4-42) - (4-43). Therefore, a partial differential approach was applied to decompose the relevant and partial derivatives to interpret the effects caused by the changes of independent variables from different models.

According to Table 7.11, Model 14 represents the ISU model; the results indicated that both direct and indirect effects had a positive effect on HQEI, consistent with the empirical regression results, as documented in Table 7.8. Additionally, the indirect effect of ISU on HQEI was higher than the direct effect, showing that ISU in surrounding regions positively affected the local improvement in the quality of economic development. Specifically, the direct and indirect effects accounted for 14.30% and 85.70% of the total effect. Secondly, Model 15 shows that continuously rationalising industrial structure played an important role in promoting HQD in local and neighbouring areas. Moreover, the direct and indirect effects accounted for 27.18% and 72.82% of the total effect, respectively. Overall, with both direct and indirect effects, the impacts of ISU on HQEI were larger than ISR. The estimated results contrasted with Gan (2011) but were consistent with Zhao et al. (2021)[59], highlighting that vigorously upgrading industrial structure, especially for emerging industries, i.e., high-end manufacturing and e-

[59] Here some explanations have been made regarding the cited literature. First, in the work of Gan (2011), he analysed the relationships between industrial structure and economic growth, and then empirically explored the mechanism of rationalisation and optimisation of industrial structure on economic fluctuations. Finally, he found that ISR could moderate economic fluctuations, while ISU negatively affected economic fluctuations. Second, Zhao et al. (2021) discussed the impacts of ISU and ISR on TFP in the Yellow River Basin, and they pointed out that ISU positively contributed to TFP; conversely ISR negatively affected TFP. Third, although the research theme is different, to a certain extent, TFP can better reflect China's economic development status.

commerce industries, was more helpful in driving China's HQD. This outcome was because emerging industries mainly refer to technology and capital-oriented industrial sectors.

Hence, during such a process, resource utilisation and allocation efficiency can gradually improve, thus, ISR also positively contributed to HQD, but the effect was relatively small. Thirdly, the effects of IS positively affected both local and neighbouring areas, with a significance level of 1%. The results again highlighted ISTU's importance in China's economic development process. Besides, the direct and indirect effects of IS on HQEI accounted for 19.53% and 80.47% of the total effect, respectively. Finally, an interesting finding emerged in light of the estimated results. The indirect effects in all models were higher than the direct effects, indicating that strongly implementing ISTU on HQD in surrounding areas was significantly higher than the effects in local regions. A possible explanation is that the spatial units, such as China's western provinces, lacked TI capabilities and were limited by endowment factors. Thus, economic efficiencies and HQD levels were relatively low. However, outdated industrial sectors from the eastern regions could be adopted by western provinces to develop their industrial structure by introducing technologies and borrowing advanced management experience from developed regions. This solution would help them improve resource utilisation efficiency, thus improving their quality of economic development, but it could also gradually eliminate development disparities. Correspondingly, the indirectly active effects may, in turn, accelerate the "catching-up" process in China's central and western regions. However, underdeveloped regions should consider the "over-industrialisation" problem. Fast industrialisation potentially causes many problems, i.e., environmental pollution, ecological deterioration, income disparity, etc.

Table 7.11: Spatial Spillover Effect Decomposition

Model	14			15			16		
Effect	DE	IE	TE	DE	IE	TE	DE	IE	TE
ISU	**0.155***** (7.34)	**0.929***** (6.51)	**1.084***** (7.07)						
GE	0.134*** (5.50)	0.040 (0.36)	0.173 (1.41)	0.058** (2.22)	-0.295** (-2.33)	-0.237* (-1.71)	0.132*** (5.87)	-0.113 (-1.35)	0.019 (0.20)
FDI	0.349** (2.34)	0.121 (0.20)	0.471 (0.67)	0.575*** (3.43)	2.497*** (3.19)	3.072*** (3.40)	0.231 (1.62)	-0.101 (-0.20)	0.130 (0.22)
MI	0.498*** (24.16)	0.330*** (4.40)	0.827*** (9.36)	0.443*** (15.24)	-0.001 (-0.01)	0.442*** (3.23)	0.378*** (16.46)	-0.140** (-2.12)	0.238*** (2.87)
EI	0.743*** (8.68)	3.587*** (6.23)	4.330*** (6.97)	0.475*** (4.99)	2.862*** (4.38)	3.337*** (4.71)	0.496*** (6.38)	2.372*** (5.48)	2.868*** (6.15)
TI	-0.041*** (-4.24)	0.025 (0.56)	-0.016 (-0.33)	-0.038*** (-3.65)	0.054 (0.98)	0.016 (0.26)	-0.045*** (-4.97)	0.067* (1.82)	0.022 (0.56)
CP	0.015** (2.26)	-0.039** (-2.02)	-0.024 (-1.18)	-0.003 (-0.37)	-0.050** (-1.99)	-0.053* (-1.93)	0.003 (0.46)	-0.071*** (-3.81)	-0.069*** (-3.48)
RP	0.017*** (6.24)	-0.093*** (-6.03)	-0.076*** (-4.50)	0.010*** (2.96)	-0.131*** (-5.98)	-0.121*** (-5.14)	0.010*** (3.73)	-0.119*** (-8.24)	-0.109*** (-7.02)
EPU	-0.005 (-1.16)	0.017 (0.80)	0.012 (0.51)	-0.002 (-0.37)	0.062** (2.33)	0.060** (2.06)	-0.002 (-0.43)	0.037** (2.07)	0.035* (1.80)
ISR				**0.112***** (4.70)	**0.300**** (2.53)	**0.412***** (3.16)			
IS							**0.266***** (10.08)	**1.096***** (7.63)	**1.362***** (8.72)

Notes: (1) *p<0.1; **p<0.05; ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis
(2) Abbreviations "DE", "IE" and "TE" denote direct, indirect and total effects, respectively.

7.7.5 Regional Heterogeneity Analysis

China's regional development has been uncoordinated, and the economic strength of the central and western regions has lagged economically compared with China's eastern region. To effectively examine and analyse the heterogeneity of ISTU on regional HQD, this study adopted Eqs. (4-38) - (4-40) to capture the effects, and the results are shown in Table 7.12.

Firstly, ISU, ISR, and IS and their corresponding spatially lagged terms exhibited positive effects on HQD, which were significant (Model 17). China's eastern region has traditionally been the country's most economically developed, with an advanced industrial structure dominated by tertiary industry and the highest degree of technological innovation. Consequently, its economic structure has been more balanced and coordinated, and resource utilisation efficiency has been relatively high. Besides, most eastern provinces are also coastal cities, i.e., Guangdong, Hainan, and Shanghai; thus, foreign trade has been more advanced than in other provinces, accelerating economic development. At the same time, many professional talents have been attracted to participate in the construction of the eastern economy because of the confluence of cluster effects, the significant scale of high-tech corporations, and the geographical advantages of the Eastern region. Hence, the industrial structure can promote HQD.

Secondly, the results indicate that ISU also positively affected local areas and negatively affected surrounding areas. ISR positively affected HQD in local and surrounding areas than ISU effects, while the direct effect was insignificant. In recent years, China's central government has implemented a series of initiatives to develop the central region, i.e., the country's central rise policy. Thus, the central region has developed quickly, and its economic strength and TI level have largely increased.

Meanwhile, ISTU development in the central region has made remarkable achievements. However, there remains significant room for the central region to improve, especially concerning its industrial structure compared with the eastern region. Based on the estimated results, the IS on HQD results were similar to the ISU model, designating that the impacts of ISTU on HQD in the central region largely depended on the ISU level. The feedback in the SDM indicated that changes in the independent variable in a region caused a reaction in the surrounding areas. It then returned to the region through the so-called spatial overflow effect, among which one part was mainly from the coefficient of the spatially lagged term of the dependent variable. The other part was sourced from the coefficient of the independent variable. By checking the results, this study concluded that the central region's uneven development status could also be identified because of the negative sign of IS's spatially lagged term. That is, although the coefficients of the Spatial ρ in all models were positive, meaning that the local HQD level positively contributed to its neighbouring areas. The advancement of industrial structure in the local area was unsuitable for promoting HQD in its surrounding areas[60]. Thus, the negative indirect effect could be captured.

Thirdly, models (23) - (25) show that ISU, ISR, and IS negatively affected HQD in local and surrounding areas, and the corresponding values are statistically significant.

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[60] The explanation of this idea can be easily understood: the local ISU level could positively affect HQEI in its neighboring aeras assuming that the surrounding areas had the same level in HQEI. This is because ISU positively affected local HQEI at the significance level of 1%.

This outcome shows that implementing the ISTU was not helpful for the western region in promoting HQD. Under the influence of the western development policy, China's western region has made great progress in its economic development. The central government invested more resources to support the construction and development of high-tech industries. The western region had undertaken backward production capacity. The delay in education caused a lack of skilled labour and technical talents, traffic construction was not optimal, and financial support was also limited. Therefore, its development degree was far behind China's eastern and central regions regarding economic development and industrial structure levels.

Moreover, models' (23) - (25) results also reflected that the coefficients of the Spatial ρ of the dependent variable were not significant. However, they were positive, meaning that HQEI did not have a significant spatial spillover effect, highlighting that the overall HQD performance in the western region was poor. The current relationship between ISTU and HQD exhibited an apparent "mismatching" phenomenon in most western provinces. The representative provinces included Gansu, Guizhou, Xinjiang, and Guangxi. However, the relationship in other provinces, such as Inner Mongolia and Chongqing, demonstrated a good synergy effect (see Section 7.7.1).

Table 7.12: Regional Heterogeneity Regression Results

Model	17	18	19	20	21	22	23	24	25
Region		Eastern China			Central China			Western China	
Variable	HQEI	HQEI	HQEI	HQEI	HQEI	HQEI	HQEI	HQEI	HQEI
Direct effect									
ISU	0.370***			0.099***			-0.055**		
	(10.00)			(4.41)			(-2.16)		
ISR		0.189***			0.100***			-0.115***	
		(3.78)			(3.41)			(-4.28)	
IS			0.556***			0.128***			-0.126***
			(12.41)			(5.29)			(-3.94)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Indirect effect									
ISU	0.847***			-0.052			-0.129**		
	(7.38)			(-1.04)			(-2.11)		
ISR		0.223*			0.051			-0.177**	
		(1.77)			(0.57)			(-2.19)	
IS			1.127***			-0.069			-0.191**
			(7.83)			(-1.20)			(-2.21)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Total effect									
ISU	1.216***			0.047			-0.184**		
	(8.92)			(0.81)			(-2.42)		
ISR		0.412***			0.150*			-0.291***	
		(2.72)			(1.81)			(-3.16)	
IS			1.683***			0.059			-0.316***
			(9.78)			(0.98)			(-3.29)
Covariables	**Yes**	**Yes**	**Yes**	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial ρ	0.151*	0.406***	0.143*	0.254**	0.008	0.187	0.061	0.010	0.030
	(1.68)	(5.17)	(1.72)	(1.97)	(0.06)	(1.44)	(0.47)	(0.07)	(0.24)
$Sigma^2\_e$	0.002***	0.003***	0.002***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(9.62)	(10.04)	(9.76)	(6.64)	(6.71)	(6.67)	(9.08)	(9.08)	(9.08)
Adj R^2	0.713	0.427	0.433	0.949	0.916	0.933	0.762	0.747	0.735
L-ratio test	333.450	293.574	350.386	310.221	307.269	312.976	451.415	457.514	458.135
Obs.	195	195	195	90	90	90	165	165	165

Notes: $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.

7.7.6 Robustness Checking

This study conducted a robustness analysis to verify the empirical results estimated by the SDM. Subsequently, the proxy variables were used to re-measure ISU and ISR levels using ISU measurement scheme III and the reciprocal form of ISR measurement scheme III. Besides, this study adopted the same procedure to calculate the ISTU composite system (IS), as recorded in Section 4.3.3.

Firstly, the ISU and ISR estimations were plotted using new measurement schemes, shown in Figure 7.4. Figure 7.4 and Figure 6.1 were also compared for differences, as shown in Table 7.13. The new estimated results were consistent with the previous results. This outcome was important for this study to verify the corresponding effects further.

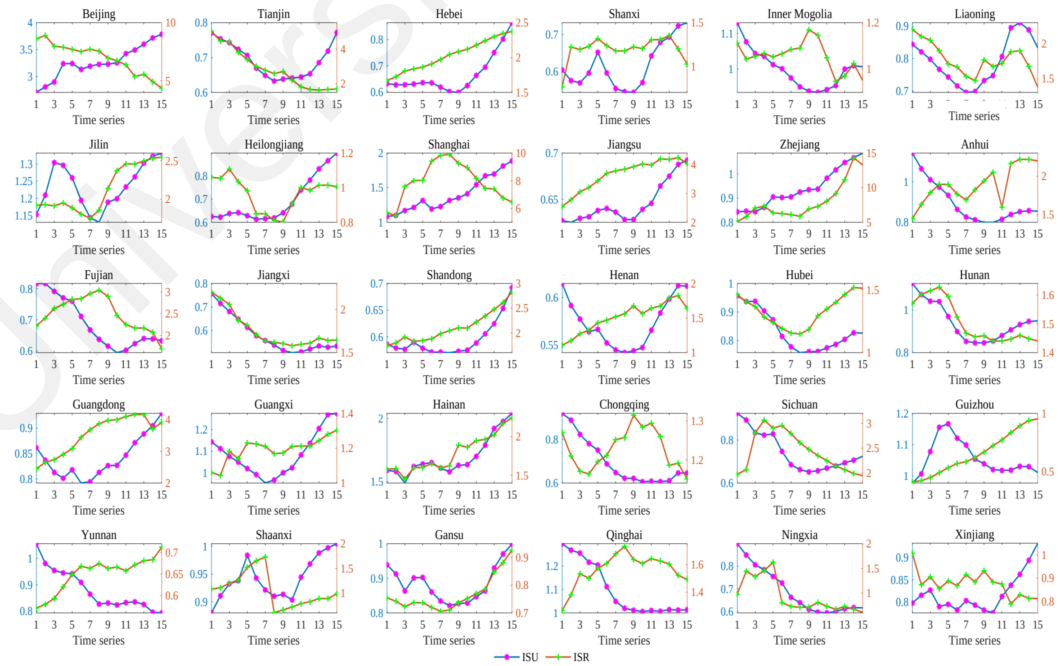

Figure 7.4: Interprovincial ISU and ISR Levels with New Measurement Schemes
Source: Computed by the Author

Table 7.13: Summary Table for ISU and ISR Development Performance

Type of trend	Provinces	Summary	Comparison
Panel A: ISU development trend			
Upward	BJ, HE, HLJ, SH, JS, ZJ, SD, HA, XJ	9	10
Downward	IM, AH, FJ, JX, HB, CQ, SC, YN, QH, NX	10	10
U-shaped	TJ, SX, LN, JL, HN, HU, GD, GX, SA, GS	10	10
IU	GZ	1	0
Sample		30	30
Panel B: ISR development trend			
Upward	HB, JL, JS, AH, SD, HN, GD, GX, HA, GZ, YN, GS	12	11
Downward	BJ, TJ, IM, LN, ZJ, JX, HN, SA, NX, XJ	10	7
U-shaped	HLJ, HB	2	4
IU	SX, SH, FJ, CQ, SC, QH	6	6
Sample		30	30

Note: (1) Abbreviation "IU" means the inverted "U-shaped" trend.
(2) The last column denotes the comparisons between Figure 7.7 and Figure 6.2.

Secondly, this study adopted the new indicators to process the data in the following order: whole sample, HQD five subsystems, and three major regions.

This study conducted a range of necessary tests to examine the feasibility of the SDM. According to Table 7.14, the LM test and its robust LM test in all models rejected the null hypothesis, suggesting that HQEI had spatial autocorrection. The LR and Wald tests rejected the original hypothesis, indicating that the SDM did not degrade the SLM and SEM. The Hausman test results show that the fixed effect was more applicable. Sequentially, the new results could be derived by using Eqs. (4-38) - (4-40).

Whole sample. According to Table 7.14, ISU, ISR, and IS positively affected HQEI; the only differences were: (1) the Spatial ρ coefficient in the ISU model was negative but not significant; (2) the Spatial ρ coefficient in the IS model was positive but not significant.

HQD five subsystems. Overall, the estimated results in Table 7.15 were the same as the previous results. However, ISU positively affected GD with a value of 0.059 at the significance level of 1%. The results also supported the former analysis; that is, the impact of IS on GD largely depended on the ISU level. Thus, the positive effect in Model 31 $\left(\text{IS} \xrightarrow{\text{positive effects}} \text{GD}\right)$ could be determined.

Three major regions. Table 7.16 presents the eastern region's estimated results. All core variables' magnitude and influential signs were similar to the previous analysis. Still, the Spatial ρ coefficient in the ISU model was positive but insignificant. The results in Table 7.17 present the central region's estimated results, and all core independent variables had positive effects on both local and neighbouring HQD. However, some regression coefficients were not significant. Moreover, the Spatial ρ coefficients in all models were negative. According to Table 7.18, ISU, ISR, and IS negatively affected HQD in the western region, consistent with the former analysis.

The specified SDM and the corresponding results proved that this study's empirical results were relatively robust by comparing the results of the robustness testing.

Table 7.14: Robustness Tests with the Whole Sample

Model	26					27					28				
Model			ISU model					ISR model					IS model		
Effect				Effect decomposition					Effect decomposition					Effect decomposition	
Variable	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE
ISU	0.097***	0.107***	0.096***	0.096***	0.193***										
	(15.89)	(8.55)	(16.75)	(7.66)	(15.19)										
ISR						0.008***	0.008***	0.009***	0.019***	0.028***					
						(7.73)	(2.88)	(8.02)	(3.89)	(5.24)					
IS											0.383***	0.455***	0.392***	0.536***	0.928***
											(14.86)	(7.85)	(15.91)	(7.85)	(12.73)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effect	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Spatial ρ	-0.057					0.431***					0.096				
	(-0.69)					(6.43)					(1.21)				
Sigma2_e	0.001***					0.002***					0.001***				
	(15.00)					(14.46)					(14.92)				
Adj R^2	0.869					0.899					0.500				
Obs.	450					450					450				
L-ratio test	849.698					765.071					837.617				
LM(Error)	435.652***					485.737***					416.244***				
RLM(Error)	203.187***					216.473***					207.031***				
LM (Lag)	273.877***					292.860***					232.445***				
RLM (Lag)	41.412***					23.596***					23.252***				

Notes: (1) *p<0.1; **p<0.05; ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.
(2) Abbreviations "DE", "IE" and "TE" denote direct effect, indirect effect and total effect, respectively.
(3) All the regressors have been spatially lagged.
(4) For the ISU model: Wald test (Error)=24.74 (p-value=0.0033), Wald test (Lag)=26.00 (p-value=0.0020); LR (Error) test =181.31 (p-value=0.0000); LR (Lag)=194.55 (p-value=0.0000); Hausman test =32.91 (p-value=0.0246).
(5) For the ISR model: Wald test (Error)=20.03 (p-value=0.0177), Wald test (Lag)=20.64 (p-value=0.0143); LR (Error) test =138.40 (p-value=0.0000); LR (Lag)=90.91 (p-value=0.0000); Hausman test =56.23 (p-value=0.0000).
(6) For the IS model: Wald test (Error)=19.48 (p-value=0.0214), Wald test (Lag)=19.64 (p-value=0.0203); LR (Error) test =179.12 (p-value=0.0000); LR (Lag)=176.55 (p-value=0.0000); Hausman test =65.19 (p-value=0.0000).

Table 7.15: Results Tests Based on HQD Subsystems

Model	29					30					31				
Variables	ID	CD	GD	OD	SD	ID	CD	GD	OD	SD	ID	CD	GD	OD	SD
ISU	0.151***	0.016	0.059***	0.008	0.014										
	(21.71)	(1.23)	(3.22)	(1.21)	(1.52)										
ISR						0.011***	0.003***	0.009***	0.001	0.002*					
						(7.31)	(2.68)	(6.82)	(1.28)	(1.89)					
IS											0.551***	0.043	0.221***	0.085***	0.084
											(17.86)	(1.20)	(6.28)	(3.03)	(1.41)
W∗ISU	0.062***	0.179***	0.097**	0.060***	0.044**										
	(3.38)	(6.82)	(2.32)	(5.08)	(2.54)										
W∗ISR						-0.000	0.005*	0.009***	0.001	-0.004					
						(-0.09)	(1.96)	(2.93)	(0.80)	(-1.64)					
W∗IS											0.183**	0.059	0.038	0.277***	-0.273**
											(2.35)	(0.77)	(0.54)	(5.06)	(-2.11)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effect	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Spatial ρ	0.340***	0.140*	0.334***	0.322***	-0.439***	0.623***	0.028	0.261***	0.333***	-0.284***	0.488***	0.240***	0.308***	0.253***	0.014
	(4.71)	(1.88)	(5.04)	(4.09)	(-5.17)	(11.96)	(0.32)	(3.20)	(4.48)	(-3.03)	(8.02)	(3.33)	(3.87)	(3.15)	(0.16)
sigma^2_e	0.002***	0.000***	0.001***	0.002***	0.004***	0.004***	0.002***	0.003***	0.001***	0.001***	0.002***	0.000***	0.003***	0.002***	0.001***
	(14.63)	(14.98)	(14.88)	(14.84)	(14.79)	(14.55)	(15.00)	(14.90)	(14.85)	(14.88)	(15.51)	(14.93)	(14.86)	(14.91)	(15.00)
Obs.	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450
Adj R^2	0.847	0.520	0.202	0.521	0.577	0.264	0.466	0.070	0.251	0.078	0.466	0.580	0.020	0.474	0.521
L-ratio test	765.820	1116.73	933.299	776.464	603.714	610.958	767.437	664.250	1008.45	895.568	706.566	1092.95	658.882	778.726	862.775

Notes: (1) *p<0.1, **p<0.05, ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.
(2) Abbreviations "ID", "CD", "GD", "OD" and "SD" represent HQD's five subsystems, namely, Innovative development, Coordinative development, Green development, Opening development and Sharing development. All of them are dependent variables.

Table 7.16: Robustness Tests in Eastern China

Model	32					33					34				
Model			ISU model					ISR model					IS model		
Effect				Effect decomposition					Effect decomposition					Effect decomposition	
Variable	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE
ISU	0.140***	0.073***	0.141***	0.078***	0.219***										
	(15.74)	(4.52)	(16.30)	(4.70)	(12.45)										
ISR						0.006***	0.006*	0.008***	0.013**	0.020***					

						(3.98)	(1.91)	(4.01)	(2.42)	(3.09)					
IS											0.459***	0.398***	0.486***	0.534***	1.020***
											(11.36)	(5.06)	(11.84)	(5.48)	(8.87)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effect	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Spatial ρ	0.026					0.394***					0.159*				
	(0.28)					(4.96)					(1.78)				
Sigma2_e	0.001***					0.003***					0.002***				
	(9.92)					(9.93)					(9.93)				
Adj R^2	0.714					0.314					0.295				
Obs.	195					195					195				
L-ratio test	378.937					294.761					343.288				

Notes: (1) *p<0.1; **p<0.05; ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.
(2) Abbreviations "DE", "IE" and "TE" denote direct effect, indirect effect and total effect, respectively.
(3) All the regressors have been spatially lagged.

Table 7.17: Robustness Tests in Central China

Code	35					36					37				
Model	ISU model					ISR model					IS model				
Effect			Effect decomposition					Effect decomposition					Effect decomposition		
Variable	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE
ISU	0.507**	0.920**	0.430***	0.534*	0.964**										
	(2.53)	(1.99)	(2.64)	(1.70)	(2.04)										
ISR						0.022***	0.026	0.022***	0.026	0.048**					
						(2.78)	(1.26)	(2.68)	(1.20)	(2.50)					
IS											0.158	0.652*	0.156	0.613	0.769***
											(0.76)	(1.72)	(0.70)	(1.55)	(2.98)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effect	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Spatial ρ	-0.534***					-0.015					-0.056				
	(-3.03)					(-0.10)					(-0.37)				
Sigma2_e	0.000***					0.000***					0.000***				
	(8.07)					(6.71)					(6.70)				
Adj R^2	0.939					0.928					0.924				
Obs.	90					90					90				
L-ratio test	305.901					306.978					306.260				

Notes: (1) *p<0.1; **p<0.05; ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.
(2) Abbreviations "DE", "IE" and "TE" denote direct effect, indirect effect and total effect, respectively.
(3) All the regressors have been spatially lagged.

Table 7.18: Robustness Tests in the Western Region

Model	38					39					40				
Model			ISU model					SIR model					IS model		
Effect				Effect decomposition					Effect decomposition					Effect decomposition	
Variable	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE	HQEI	W_x	IE	TE	DE
ISU	-0.015	-0.124**	-0.015	-0.125**	-0.139*										
	(-0.62)	(-2.06)	(-0.60)	(-1.97)	(-1.92)										
ISR						-0.024***	-0.040**	-0.024***	-0.040**	-0.064***					
						(-3.32)	(-2.14)	(-3.16)	(-2.01)	(-2.85)					
IS											-0.234*	-0.740**	-0.231	-0.733**	-0.964**
											(-1.70)	(-2.36)	(-1.61)	(-2.21)	(-2.55)
Covariables	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effect	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Spatial ρ	0.029					0.006					0.004				
	(0.22)					(0.05)					(0.03)				
Sigma2_e	0.000***					0.000***					0.000***				
	(9.08)					(9.08)					(9.08)				
Adj R^2	0.721					0.689					0.712				
Obs.	165					165					165				
L-ratio test	449.501					453.883					450.992				

Notes: (1) *p<0.1; **p<0.05; ***p<0.01, two-tailed test. Heteroskedasticity-robust standard errors are shown in parenthesis.
(2) Abbreviations "DE", "IE" and "TE" denote direct effect, indirect effect and total effect, respectively.
(3) All the regressors have been spatially lagged.

7.8 Discussions

China has experienced long-term traditional industrial structure adjustments and industrialisation, from heavy/light industry to the technological and capital-intensive industrial sector (Wang et al., 2013). The secondary industry is a pillar driving China's economic growth (Zhang et al., 2017). However, the secondary industry has been characterised by high-energy consumption and high-pollution emissions among the three key industries. The iron, steel, and cement industries are the representative industries. Specifically, according to the NBS statistics, the share of the GDP linked to the secondary industry in 2005 accounted for 47%.

In contrast, the industrial sector accounted for 41.6% of the GDP. In 2019, the GDP linked to the secondary industry was 39.0%, and the industrial sector accounted for 32.0% of the GDP. There has been a significant decrease in the share of secondary industry, implying that China is re-articulating its industrial structure. However, the industrial sector's total energy consumption (TEC) has increased. The TEC of heavy industry in 2005 was $187{,}914\times10^4$ tce. While the TEC of heavy industry in 2019 was $311{,}151\times10^4$ tce[61] accounting for 65.93% of China's TEC.

Zhu et al. (2021) pointed out that China couldn't achieve sustainable economic development in the long run by simply using a factor (the consumption of various economic resources) to accelerate its industrial economic growth. Based on the previous empirical findings, this study also believes that a reasonable and advanced industrial

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[61] See http://www.stats.gov.cn/tjsj/.

structure could help to promote economic resource reallocation, sustain economic growth, and eventually contribute to China's HQD. This study made a concrete decision by adopting Figs. 7.5-7.7[62] to derive more robust results.

The panels in the following diagrams divide China's 30 provinces into four sub-regions, each with distinctive distribution characteristics. For example, provinces with high average ISU and HQEI levels were placed in Sub-region I. Conversely, provinces with low average ISU and HQEI levels were placed in Sub-region III. Moreover, the path from Sub-region III to Sub-region IV or Sub-region III to Sub-region II could be successful. This outcome was because a province could achieve self-adjustment by improving economic development quality or optimising its industrial structure.

Firstly, Figure 7.5 shows the average ISU and HQEI for each of China's provinces. It can be seen that the ISU in the eastern region was always higher than in the other two regions. However, the ISU values in the central and western areas fluctuated during the research period. Moreover, all of China's central and western provinces were located in Sub-region III and Sub-region IV, indicating that central and western provinces needed to emphasise improving the quality of economic development and upgrading their industrial structure. However, another crucial issue in Figure 7.5 was also identified; the relationship between ISU and HQEI exhibited a scattered distribution characteristic. In

[62] To effectively present the regional heterogeneity, this study used different colours to mark the corresponding provinces. Specifically, Red, Blue, and Green in Figure 7.5-7.8 represent China's eastern, central and western provinces, respectively.

other words, ISU's "promoting effect" on HQEI was not distinct because the dots distributed throughout the panel appeared disordered[63].

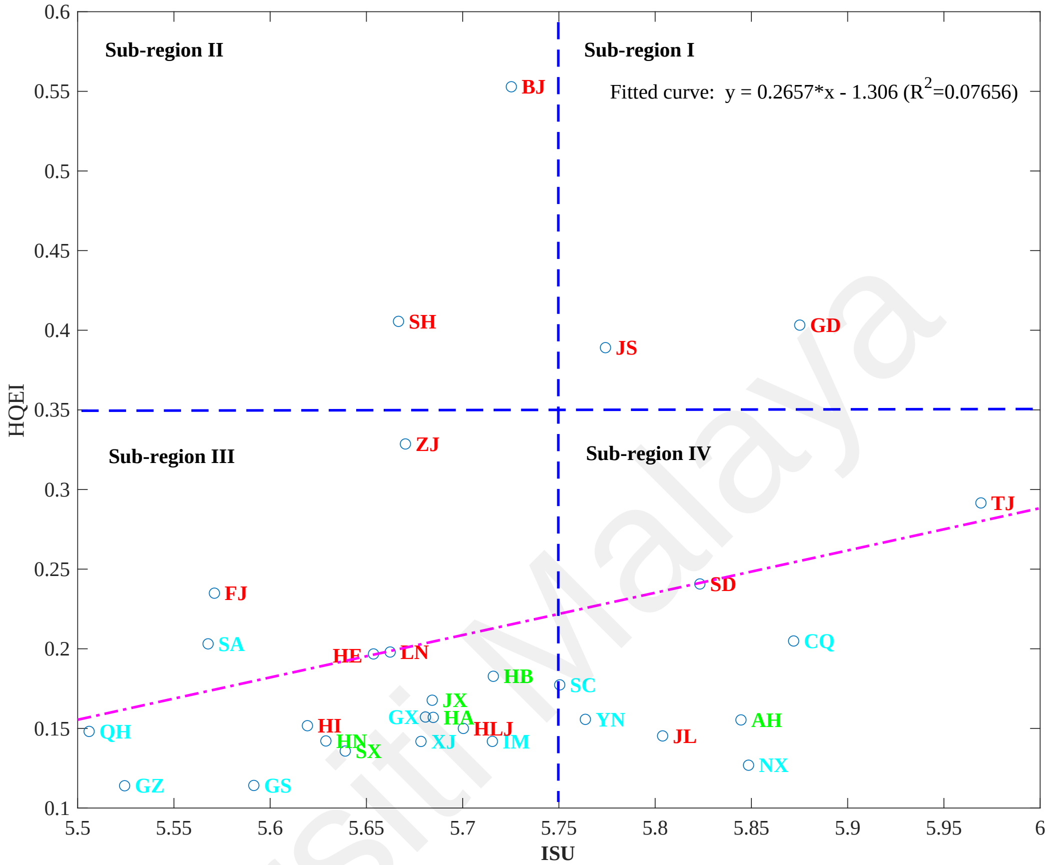

Figure 7.5: Average ISU and HQEI Distribution Characteristics of Each Province
Source: Computed by the Author

Secondly, Figure 7.6 presents the average ISR and HQEI for each of China's provinces. Specifically, Sub-region I included four eastern provinces, the most in China. Twenty-one provinces were located in Sub-region III, including ten western provinces

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[63] The promoting effect of ISR on HQD was not significant compared with ISR, this is because the goodness-of-fit between ISU and ISR was smaller than that of the goodness-of-fit between ISR and HQD. Theoretically, ISU refers to a process whereby economies strengthen their capabilities and capacities and move into technologically sophisticated and/or more profitable economic niches along with the value chain. Emerging markets are often limited at the "lower jaw" part of the smiling curve of value added in supply chain processes, thus, capturing little value added from their manufacturing activities. The country's position may therefore be the greatest concern of the policy makers. More specifically, a movement up the value chain asks a shift from exsiting low value-added economic activities to high value-added ones. Hence, common sense is that the promoting effect of ISU on HQD is more significant compared with ISR.

and six central provinces, while provinces in Sub-region IV were all eastern provinces, excluding Sichuan. In contrast with Figure 7.5, the "promoting effect" of ISR on HQEI was significant. Intuitively, most provinces, especially provinces in Sub-region III, exhibited an upward trend. HQEI will improve dramatically, provided there is a significant improvement in ISR levels.

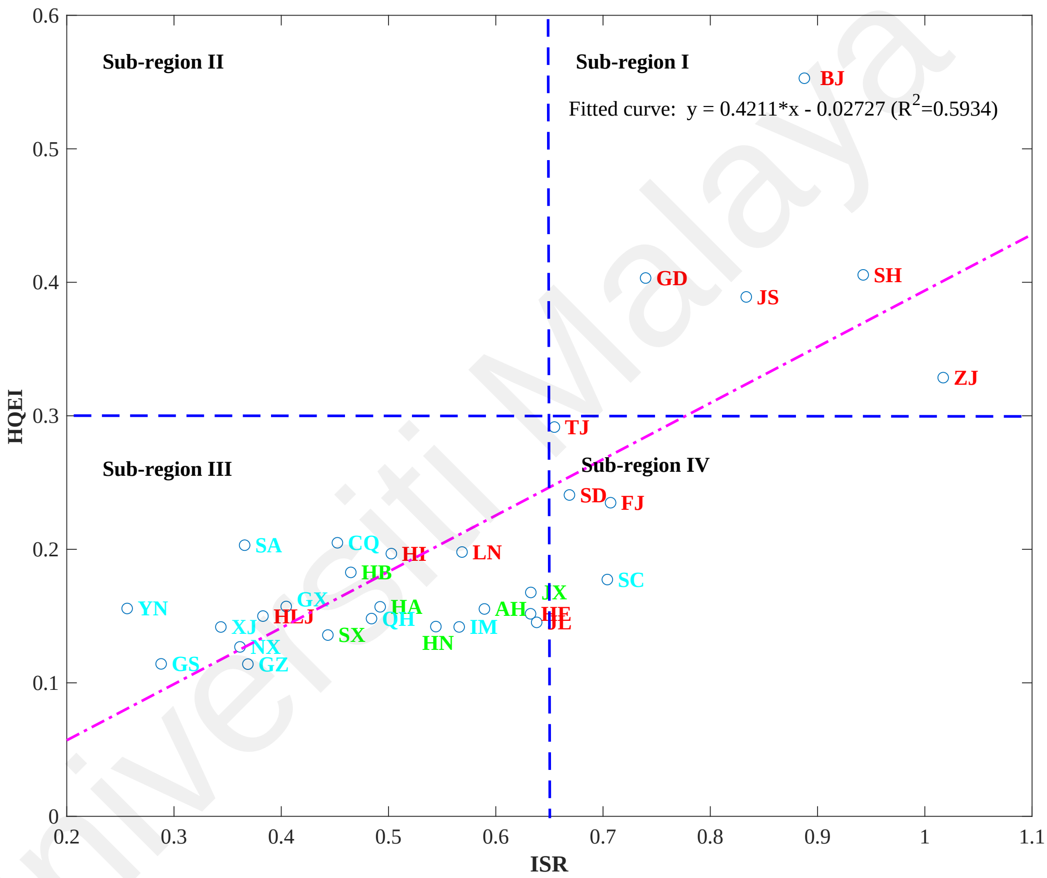

Figure 7.6: Average ISR and HQEI Distribution Characteristics of Each Province
Source: Computed by the Author

Thirdly, Figure 7.7 represents the average IS and HQEI of each of China's provinces. Sub-region I included four eastern provinces. Sub-region III included 17 provinces, while nine were distributed in Sub-region IV. The derived research findings were very interesting, and the results verified this study's conjecture that ISR did not play a moderating role in balancing China's ISTU system compared with ISU. On the one hand, a province with a high ISR level could improve its HQD.

On the other hand, the development state of the industrial structure composite system would become more stable with improvements in the ISR level. Although the role of ISR on HQEI was important, its positive effect on HQEI was relatively small (see Figure 7.8). Specifically, Zhejiang was in Sub-region IV in 2005 and moved to Sub-region I in 2019, implying that Zhejiang had successfully achieved transformation through the path of IV → I. However, despite the upward trend in ISR values (where Zhejiang's ISR values in 2005 and 2019 were 0.9236 and 1.0171, respectively), the increase in HQEI was relatively small, with a value of 0.1031[64]. In addition, Anhui and Henan were also good cases for illustrating the phenomenon illustrated above. At the same time, the corresponding effects could not be observed in Beijing and Inner Mongolia because the ISR levels in those provinces exhibited a decreasing trend.

[64] The HQEI values of Zhejiang in 2005 and 2019 were 0.2255 and 0.3286, respectively.

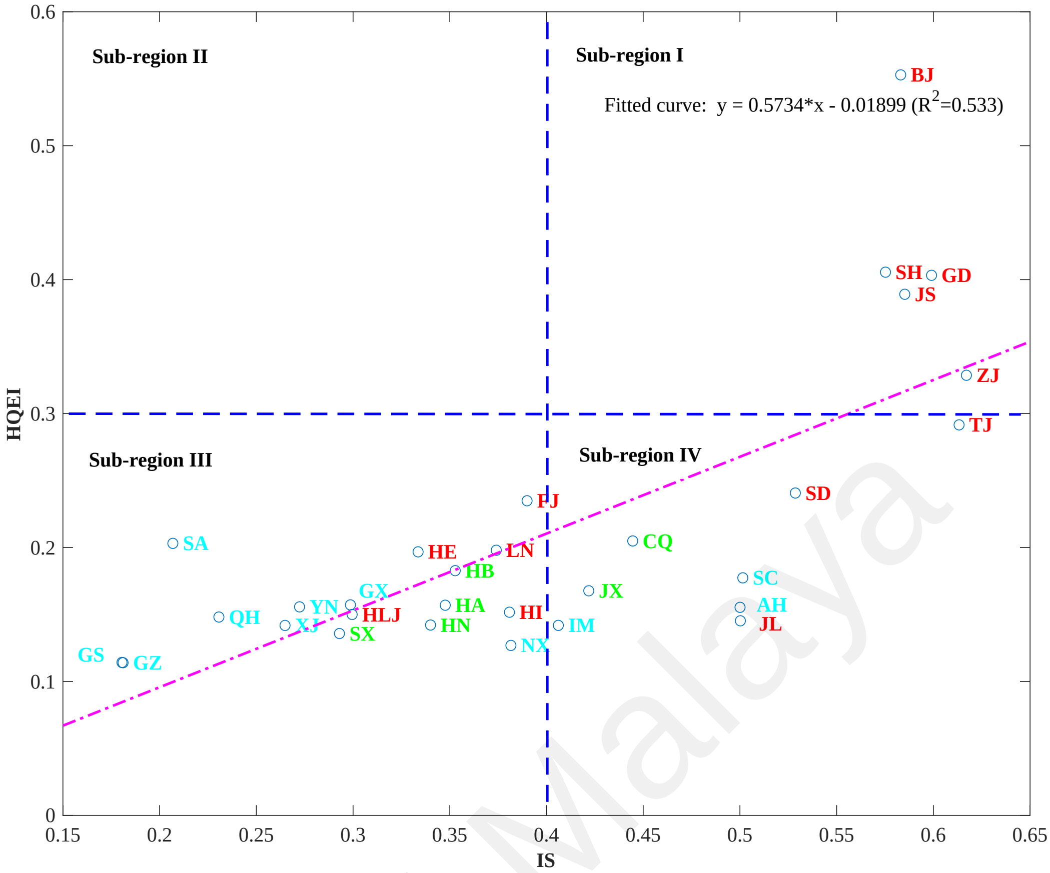

Figure 7.7: Average IS and HQEI Distribution Characteristics of Each Province

Source: Computed by the Author

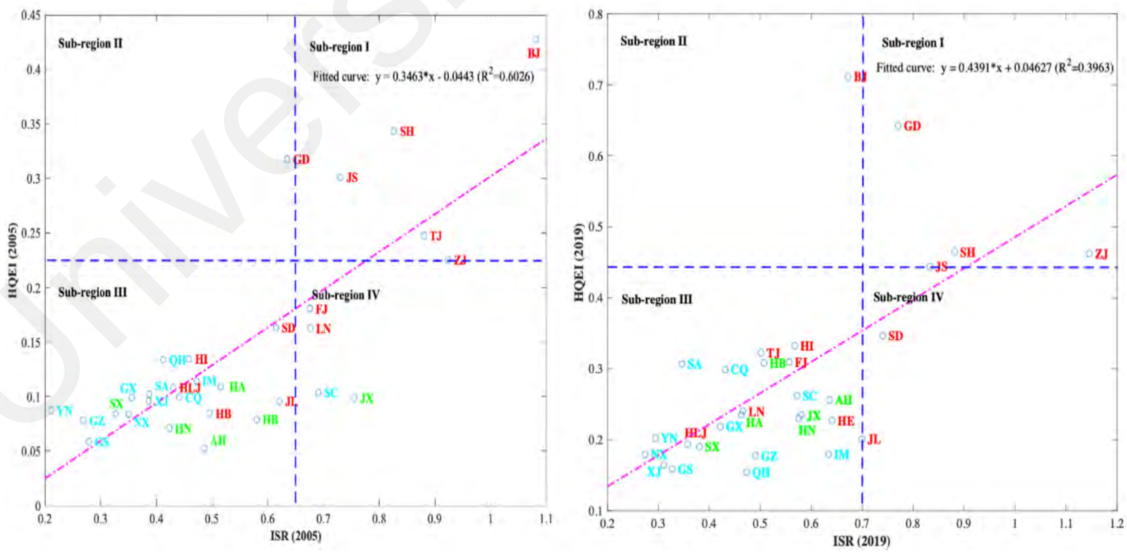

Figure 7.8: Average ISR and HQEI Distribution Characteristics of Each Province in 2005 and 2019

Source: Computed by the Author

Finally, this study discovered that China's northeastern provinces, known as the traditional northeast industrial zones, including Jilin, Liaoning and Heilongjiang, were mainly distributed in Sub-region III. This outcome suggested that the northeastern provinces have faced a pressing bottleneck of industrial structure changes, and their high-quality economic development has been hindered. There are many heavy industries in the northeastern region, for example, Anshan Iron and Steel Group Corporation. As an energy-intensive industry, heavy industry is the largest emitter of carbon dioxide (Du et al., 2011), resulting in many issues, i.e., ecological deterioration. Moreover, the extensive economic development pattern, which became the principal ideology of China's industrial economic growth, would be hard to change instantaneously. With this concern, to effectively improve HQEI, these heavy industrial bases need to support and encourage R&D activities in the traditional industrial sectors, thereby gradually eliminating backward production capacity by adopting new equipment and absorbing professional talent.

The Beidahuang Group of State Farms and Land Reclamation, a National Ecological Demonstration Zone, is located in northeast China. Heilongjiang Reclamation Area was inaugurated and constructed in 1947 and was awarded the title of "National Modern Agriculture Demonstration Area" by the Ministry of Agriculture in 2010. However, as representatives of China's advanced agricultural productivity, these groups must develop modern agriculture. For instance, such groups should vigorously construct and develop basic infrastructure in farmland and implement water project systems for flood control and irrigation by employing modern technology. Such measures will boost agricultural production, thus guiding the agricultural industry forward and ensuring the nation's food supply and security.

7.9 Chapter Summary

This chapter has systematically examined the effects of ISTU (i.e., ISU, ISR and IS) on HQD by performing the SDM. Based on the overall analysis, this study has concluded the following:

1. The regression scatter diagram determined the positive relationship between ISU, ISR and IS on HQD. Moreover, the fitted values between ISU, ISR, and IS and HQD were higher than 0.90. The results show that strongly optimising and rationalising the industrial structure was conducive to improving China's HQD. However, in some provinces, a "mismatching phenomenon" between ISTU and HQD was identified (i.e., Guangdong).
2. The SDM was performed to capture the effects of ISU, ISR and IS on HQD. Nationally, three core independent variables exhibited a strong "promoting effect". Furthermore, an examination based on the HQD five dimensions was conducted because the HQD is a comprehensive index determined based on ID, CD, GD, OD and SD. However, the effects exhibited heterogeneity, and only the negative impacts of ISU and IS on the CD were negative. Still, the estimated coefficients of Spatial ρ of Sharing development were negative in three models, highlighting that unbalanced and uncoordinated development remains a pressing issue in China.
3. This study further decomposed the total effects of ISU, ISR and IS on HQD into direct and indirect effects by adopting the partial derivatives approach. The results revealed that vigorously upgrading and rearticulating the industrial structure promoted local HQD and improved the quality of economic development in adjacent areas. The

promoting effects of ISU, ISR, and IS on HQD in adjacent areas were higher than in the local area.

4. This study examined the effect of ISTU on HQD based on China's three major economic zones. Only the negative effects of ISU, ISR and IS on HQD were captured in China's western region to facilitate the regional heterogeneity comparison.
5. This study conducted robustness testing to ensure the reliability of the derived research findings. The key research findings were consistent with the former analysis after using the new proxy variables.

CHAPTER 8: RESEARCH CONCLUSIONS AND POLICY IMPLICATIONS

8.1 Introduction

This chapter concludes the study and proposes some related policy implications. At the same time, the main research limitations related to this study have also been mentioned.

8.2 Concluding Remarks

Steered by the growing interest in HQD in China's economy, this study has provided theoretical and empirical evidence to demonstrate the promoting effect of ISTU on HQD in China.

This study first conceptualised "Five new development concepts" related to HQD. Using the 19th National Congress CPC report as a cutting-off point and following current research, this study constructed a comprehensive assessment system incorporating 26 evaluation indicators to assess China's interprovincial HQD performance from 2005 to 2019. China's HQD performance was then analysed from temporal-spatial perspectives. In contrast, China's ISTU was measured by adopting two essential indicators: ISU and ISR. A comprehensive index was obtained to measure interprovincial IS levels, which aimed to fulfil the research gap. This study modelled the effects of ISTU on HQD from China's national and regional perspectives by performing SDM adopting panel data from 30 Chinese provinces from 2005 to 2019.

Specifically, the research conclusions were as follows:

1. China's regional economic development did not follow an HQD pattern, with an average growth rate of 0.219. China's economy has gradually pursued an HQD pattern with an annual average growth rate of 0.459%.

2. Development disparities across provinces and regions were extremely evident in HQD performance. Compared with eastern China, the central and western regions lagged greatly. Still, in 2019, Beijing played a leading role in national high-quality economic development, while Qinghai ranked at the bottom concerning absolute scores.
3. The Cluster Analysis results showed that the HQD status in most provinces had shown a significant mismatching phenomenon. For example, provinces had high degrees of ISU but low degrees of ISR or vice-versa.
4. The Global Moran's I test results showed China's HQEI exhibited a significant positive autocorrelation. Unfortunately, such spatial correlation decreased yearly but was still statistically significant.
5. The Geo-detector analysis showed that; TI, industrialisation, and urbanisation were crucial factors in the eastern and central regions for developing HQD. While strengthening basic infrastructure construction was conducive to realising HQD in western China.
6. The three core independent variables' distribution characteristics (i.e., ISU, ISR and IS) were analysed using the Cloud model. The results indicated that the distribution statuses of RIS and IS were better than that of ISU from a national perspective. At the same time, the distribution characteristics of the three variables mentioned above in the eastern region were better than in the central and western regions.
7. In the spatial regression analysis, ISU, ISR, and IS had significantly promoted China's HQD, designating that vigorously advancing and rationalising the industrial structure had been conducive to developing HQD nationally. As for regional heterogeneity analysis, the three variables affected HQD positively in the eastern and central regions but negatively affected the western region.

8. Based on the theoretical justification, this study also captured the effects of ISU, ISR and IS on HQD's five subsystems nationally (which can be regarded as an auxiliary analysis). The study found that ISU exerted a negative shock on GD, while ISR could moderate such a negative effect, thus improving environmental quality. In addition, China's SD was quite poor because of the negative sign of spatial ρ.
9. Finally, the robustness of the empirical results was checked using alternative variables for ISU, ISR and IS. The main results were found to be very robust.

8.3 Policy Implications

This study proposes several suggestions for formulating HQD and industrial structure re-articulation in China in light of the empirical findings.

First, from a systematic viewpoint, the Chinese central government needs to construct an assessment system based on a unified cognition of HQD. Great efforts will gradually strengthen the top-level design, forming an incentivised, integrated, and coordinated mechanism. Local governments should identify weaknesses from a national perspective while focusing on lagging provinces (i.e., Qinghai, Shaanxi) and regions (i.e., the western region) based on specific regional perspectives.

Second, sufficient funds should be provided to cultivate TI and enhance independent, innovative capabilities. Compared with some developed economies, the driving force for stimulating China's innovation has been insufficient, and its innovation environment needs further improvement. Resource-dependent regions should increase innovation investment through social capital, financial reallocation, and other mechanisms. They could use abundant innovation investment to purchase environmentally-friendly production equipment, accumulate human and material capital, and endow innovative capability, improving energy utilisation efficiency and environmental quality. Moreover, such an increase in innovation investment could be helpful to attract high-tech manufacturing sectors with the LD effect to enter resource-dependent regions, thus constituting a virtuous circle strengthening scientific and technological powers.

Third, local governments should avoid overemphasising ISU and try to formulate strategic plans in line with regional realities. More specifically, eastern China could continue to advance its industrial structure, especially for service-oriented sectors, based on its mature industrial development and production layout. As the current industrial structure is not reasonable in the central and western regions, deliberately concentrating more on ISU will not be able to stimulate HQD and even could curb the sustainable development of the local economy (especially in the western region). Therefore, the best way forward for the central and western regions lies in rationalising and restructuring their industrial structures, emphasising balancing the relationships among the three industries[65]. Besides, some eastern provinces (i.e., Beijing) should also emphasise rationalising their industrial structure.

Fourth, the industrial structure and TI policies should be coordinated to improve innovation efficiency for accelerating sustainable HQD in China. However, TI could lead to ISTU to a certain extent. Its asymmetric relationship could result in innovation imbalances among various industrial sectors. While mitigating such imbalances requires the corresponding ISTU. Note that the time lag in the flow of elements often causes

[65] Geng et al. (2021) contended that there were two channels regarding how to realise ISU and ISR, such as TI and production factors allocation. First, TI is an essential enabler for ISU and ISR, but not all enterprises have innovative capability at a micro level. However, it is difficult for TI for enterprises that survive by relying only on production factors input and simple imitation. Therefore, the long-term existence of these enterprises could hinder ISU and ISR especially in the central and western regions. Economics puts more emphasis on the free and full flow of production factors (or economic resources) at various levels, such as industries or enterprises (Hsieh. & Klenow, 2012). However, if the distribution or flow of economic resources always deviates from the optimal level, ISU and ISR will remain at a relatively low level. In other words, accelerating economic resource optimisation is conducive to ISU and ISR. Taking the zombie enterprises as an illustration, zombie enterprises pose great challenge to ISU in China (Geng et al., 2021). At the industry level, zombie enterprises in China are mainly located in the high-tech manufacturing sectors (i.e., special equipment manufacturing industries) and low-tech manufacturing sectors (i.e., chemical industry). Moreover, zombie emterprises are distributed in the central and western regions from a spatial perspective. Hence, it is difficult for these regions and industries to promote SSSR and enhance industry-related policies' effectiveness.

hypotheses in structural change (for example, there is a lock-in effect in the typical path of labour force distribution), leading to innovation efficiency to a certain extent. In the past economic development, China gave subsidies to those industrial sectors with lower development prospects to eliminate the disparity between the richer and the poor and to balance social income.

Consequently, R&D resources are tied up in inefficient production sectors. This outcome is because subsidies are often paid to incumbents. Simultaneously, they also support the extension and presence of enterprises at the cost of potentially superior entrants.

Besides, emerging markets (i.e., China) undergoing fast R&D input expansion are more likely to undergo resource misallocation issues. For instance, state-owned enterprises with lower innovative performance and capabilities in China consume more energy and production factors than private ones. In contrast, innovative performance and capabilities could be significantly improved once resource misallocation issues are addressed through management innovations, such as ISTU. However, when implementing ISTU as a periodic adjustment instrument, it is important to judge whether such an instrument is feasible for different levels of economic structure in different regions. That is, it must be identified whether the implemented adjustment policy can realise the same promoting effect in regions with different factor endowments and economic development levels.

Finally, all relevant parties need to strengthen regional cooperation and exchanges. More specifically, eastern China could generate spillover effects through; sharing technologies, spreading successful management experiences, and encouraging the mutual exchange of mature economic initiatives.

8.4 Future Research Recommendations

This study proposes two points for supporting future analysis based on the complete analysis.

First, theoretically, TI may play a crucial part in China's HQD. It is also believed that enterprises adopt advanced technologies to improve their production efficiency, promoting the redistribution of production factors from low-productivity industrial sectors to high-productivity ones. Therefore, such a shift will facilitate ISTU in China. Although this study has provided empirical evidence to show ISTU could contribute to HQD at a macro level, this promotion may partially depend on innovative capacity based on the interprovincial level.

Second, the fast expansion of industrial re-articulation will facilitate the reconfiguration of skilled labour because of potential wage differentials. In other words, ISTU may facilitate the urbanisation process in China. In contrast, urbanisation is an important determinant in stimulating economic growth, which existing studies have widely assessed. Therefore, urbanisation may play an intermediary role in the incentive role of ISTU to China's HQD.

8.5 Research Limitations

The main limitations of this study are twofold: First, this study has only discussed China's HQD concerning China's provinces. In contrast, the DMU's HQD levels would have likely been much worse than some advanced economies (i.e., OECD countries). Second, due to research data availability, this study did not consider all of China's provinces (i.e., Tibet) when assessing HQD levels and examining the effect of ISTU on HQD in China. As more categories of provincial statistics are released in the future, the variables and sample size employed by this study could be significantly increased to ensure more robust modelling.

8.6 Contributions of the Study

This study proposed a new concept for China's HQD based on previous literature. Using the working definition of HQD, a robust and practical assessment system was established to quantify interprovincial HQD performance based on "Five New Development Concepts". To comprehensively reveal interprovincial ISTU development characteristics, ISTU in this study was proxied by three crucial indicators: ISU, ISR, and IS. This study also modelled the effect of ISTU on HQD and captured regional heterogeneity by performing spatial econometrics, thus, providing an integrated scenario.

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