An Urban Composite Development Index based on China's Five Development Concepts

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Appendix A: List of Practical Indicators for the Urban Composite Development Index

1. Practical Indicators of Scale and Quality of Economic Activities (21 Indicators)							
1.1	**Economic Capacity**	**1.2**	**Openness to Trade and Services**	**1.3**	**Inflationary Pressure**	**1.4**	**Market Development**
1.1.01	Gross Regional Domestic Product (GRDP)	1.2.01	Total trade volumes	1.3.01	Consumer Price Index (CPI)	1.4.01	Government expenditures as a percentage of GRDP
1.1.02	GRDP growth rate	1.2.02	Trade surplus	1.3.02	Producer Price Index (PPI)	1.4.02	Satisfaction of business environment (Survey)
1.1.03	GRDP per capita	1.2.03	Dependency on foreign trade (Foreign trade as a share of GRDP)	1.3.03	Retail price index		
1.1.04	Per capita fixed investment	1.2.04	Foreign investment in actual use	1.3.04	Urban residents' disposable income growth rate		
1.1.05	Per capita volume of retail sales	1.2.05	Investment abroad	1.3.05	Urban residents' per capita expenditure growth rate		
1.1.06	Manufacturing sector as a percentage of GRDP			1.3.06	Residents' satisfaction with price levels (Survey)		
1.1.07	Service sector as a percentage of GRDP						
1.1.08	Urbanisation rate (percent)						
2. Practical Indicators of Financial Capacity, Labour Market Flexibility and Economic Vibrancy (26 Indicators)							

2.1	Financial Deepening and Business Efficiency	2.2	Productivity Performance	2.3	Labour Market Flexibility	2.4	Economic Vibrancy and Tripartite Relationship (Government, Employee and Employer)
2.1.01	Financial sector value-added	2.2.01	Secondary industry Total Labour Productivity	2.3.01	Number of employees	2.4.01	Growth in electricity consumption
2.1.02	Deposit balance per capita	2.2.02	Tertiary industry Total Labour Productivity	2.3.02	Newly increased number of employees	2.4.02	Growth in the number of passengers transported
2.1.03	Loan balance per capita	2.2.03	Growth rate of overall labour productivity	2.3.03	Rate of migration flow	2.4.03	Growth in the volumes of cargo transported
2.1.04	Annual loan growth rate	2.2.04	Percentage of the employed population with tertiary education	2.3.04	Workforce participation rate		
2.1.05	Insurance net income	2.2.05	Profit margin of enterprises above designated size	2.3.05	Urban registered unemployment rate		
2.1.06	Deepness of insurance (insurance income as a share of GRDP)			2.3.06	Average salary of urban employees		
2.1.07	Financed amount in stock market			2.3.07	Self-employed as a share of total employment		
				2.3.08	Proportion of workforce employed in agriculture sector		
				2.3.09	Proportion of workforce employed in service sector		

				2.3.10	Proportion of urban workers employed in state enterprises		
				2.3.11	Proportion of urban workers employed in private enterprises		

3. Practical Indicators of Good Governance, Effective Leadership and Social Stability (23 Indicators)							
3.1	**Fiscal Sustainability**	**3.2**	**Transparency and Accountability**	**3.3**	**Public Governance**	**3.4**	**Public Security and Social Stability**
3.1.01	Government fiscal revenue	3.2.01	Number of releases of government information for public viewing	3.3.01	Index for quality of e-government system (Survey)	3.4.01	Public perception of security (Survey)
3.1.02	Government fiscal revenue per capita	3.2.02	Number of responses to government issues of public interest	3.3.02	Number of public servants per 10,000 population	3.4.02	Growth rate of the number of police cases
3.1.03	Government fiscal expenditure	3.2.03	Public perception of government conduct (Survey)	3.3.03	Average public servant salary	3.4.03	Growth rate of the number of police cases solved
3.1.04	Government fiscal expenditure per capita	3.2.04	Satisfaction of the just of judiciary	3.3.04	Number of listed items under executive authority of the government	3.4.04	Fire fatality per 10,000 population
3.1.05	Tax revenue as a share of fiscal revenue	3.2.05	Number of investigations for power abuses per 10,000 population	3.3.05	Number of administration action and reconsideration cases	3.4.05	Traffic accident fatality per 10,000 population
3.1.06	Fiscal revenue growth rate					3.4.06	Satisfaction with urban management

							personnel (Survey)
						3.4.07	Satisfaction of police services (Survey)

4. Practical Indicators of Technological Advancement and Innovation Capability (11 Indicators)					
4.1	**Research and Development Input**	**4.2**	**Technological Innovation Capability**	**4.3**	**Research and Development Output**
4.1.01	Research & Development expenditure as a share of government expenditure	4.2.01	Number of provincial-level science parks	4.3.01	Number of patents granted
4.1.02	Per capita R&D expenditure	4.2.02	Number of R&D personnel per 10,000 population	4.3.02	Number of existing patents per 10,000 population
4.1.03	Total R&D man-hour	4.2.03	Satisfaction with innovation environment (Survey)		
4.1.04	Number of science and technology personnel				
4.1.05	Total R&D expenditure of enterprises above designated size				
4.1.06	Total R&D expenditure of enterprises above designated size as a percentage of cash flow				

5. Practical Indicators of Public Service Standards and Quality of Life Improvement (33 Indicators)									
5.1	Social Security and Standard of Living	5.2	Public Health Care System	5.3	Public Education	5.4	Public Transport Infrastructure	5.5	Public Culture and Information Services
5.1.01	Proportion of the population	5.2.01	Public health and medical service	5.3.01	Ratio of public education appropriation to GRDP	5.4.01	Number of urban public transport vehicles per	5.5.01	Percentage of public expenditure

	above 60 years old		expenses as a share of GRDP				10,000 population (Standard number)		on cultural initiatives
5.1.02	Per capita annual disposable income	5.2.02	Public health and medical service expenses per capita	5.3.02	Public education appropriation per capita	5.4.02	Number of urban taxis per 10,000 population	5.5.02	Number of books in public library per capita
5.1.03	Engel's index	5.2.03	Number of doctors per 1,000 persons	5.3.03	Number of primary and secondary schools per 10,000 population	5.4.03	Number of passengers transported	5.5.03	Frequency of using the Internet for the daily convenience (Survey)
5.1.04	Number of private cars per 100 households	5.2.04	Number of beds of health care per 1,000 population	5.3.04	Ratio of teacher to student in primary and secondary schools	5.4.04	Per capita road area	5.5.04	Number of museums per 10,000 population
5.1.05	Residents' Perception of Happiness (Survey)	5.2.05	Average life expectancy	5.3.05	Number of vocational education institutions per 10,000 population	5.4.05	Satisfaction of traffic condition (Survey)	5.5.05	Mobile phone penetration rate
5.1.06	Satisfaction of income disparity (Survey)	5.2.06	Satisfaction of public health care services (Survey)	5.3.06	Average years of education received	5.4.06	Satisfaction of public transport services (Survey)	5.5.06	Internet penetration rate
		5.2.07	Cleanliness of Public Toilet (Survey)	5.3.07	Number of tertiary education attendees per 10,000 population				
				5.3.08	Satisfaction of public education system (Survey)				

6. Practical Indicators of Resource Conditions and Environmental Protection (17 Indicators)					
6.1	**Environmental Quality**	**6.2**	**Natural Resources**	**6.3**	**Environmental Management**
6.1.01	SO2 emission per RMB 10,000 GDP	6.2.01	Water consumption per 10,000 RMB GRDP	6.3.01	Forest land growth
6.1.02	COD (chemical oxygen demand) per RMB 10,000 GDP	6.2.02	Electricity consumption per 10,000 RMB GRDP	6.3.02	Environmental expenditure as a percentage of total fiscal expenditure
6.1.03	Ammoniacal nitrogen discharge per RMB 10,000 GDP	6.2.03	Forest cover	6.3.03	Green coverage ratio of built-up area
6.1.04	NO-x emissions per RMB 10,000 GDP	6.2.04	Built-up area population density	6.3.04	Wetland cover
		6.2.05	Per capita arable land	6.3.05	Urban area waste water treatment rate
		6.2.06	Per capita freshwater resource	6.3.06	Per capita park and green space acreage
				6.3.07	Area of natural reserves to administrative area (percent)

Appendix B: List of Shandong Cities

The 17 Shandong cities are listed below.

	City
1	Jinan
2	Qingdao
3	Zibo
4	Zaozhuang
5	Dongying
6	Yantai
7	Weifang
8	Jining
9	Tai'an
10	Weihai
11	Rizhao
12	Laiwu
13	Linyi
14	Dezhou
15	Liaocheng
16	Binzhou
17	Heze

Source: The sequence of the cities is based on the Division Code published by The Ministry of Civil Affairs of the People's Republic of China.

Appendix C: Ranking Algorithm [3]

Following Tan, Nie, and Baek (2016), the procedure to compute the UCDI is described below for a general case of N cities, M practical indicators and C environments, with each environment comprising S sub-environments.

(1) Compute the mean value of practical indicator j ($j = 1, \ldots, M$),

$$\overline{X}_j = \frac{1}{N}\sum_{i=1}^{N} X_{ij}$$

where X_{ij} represents the value that city i ($i = 1, \ldots, N$) takes for practical indicator j.

(2) For each practical indicator j ($j = 1, \ldots, M$), calculate its standard deviation (SD),

$$SD_j = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(X_{ij} - \overline{X}_j)^2}$$

(3) Compute the standardised value of indicator (SVI) that each city i ($i = 1, \ldots, N$) takes under each of the practical indicators j ($j = 1, \ldots, M$),

$$SVI_{ij} = \frac{X_{ij} - \overline{X}_j}{SD_j}$$

(4) Compute the 'ranked' standardised value of indicator (RSVI) that each city i ($i = 1, \ldots, N$) takes under each of the practical indicators j ($j = 1, \ldots, M$):

$$RSVI_{ij} = \begin{cases} SVI_{ij}, \textit{if a higher value is better} \\ -SVI_{ij}, \textit{if a lower value is better} \end{cases}$$

(5) For each of the practical indicators j ($j = 1, \ldots, M$), a ranking can be obtained for cities: cities with a higher value of RSVI for indicator j are ranked ahead of those with a lower value.

(6) For each city i ($i = 1, \ldots, N$), calculate the RSVI for each sub-environment k ($k = 1, \ldots, S$) belonging to environment l ($l = 1, \ldots, C$),

$$Raw\_RSVI_{i,lk} = \frac{1}{y_{lk}}\sum_{p=1}^{y_{lk}} RSVI_{i,\, j_{lk,p}}$$

$$Mean\_RSVI_{lk} = \frac{1}{N}\sum_{i=1}^{N} Raw\_RSVI_{i,lk}$$

$$SD\_RSVI_{lk} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Raw\_RSVI_{i,lk} - Mean\_RSVI_{lk})^2}$$

$$RSVI_{i,lk} = \frac{Raw\_RSVI_{i,lk} - Mean\_RSVI_{lk}}{SD\_RSVI_{lk}}$$

where y_{lk} is the total number of practical indicators under sub-environment k of environment l and $(RSVI_{i,j_{lk,1}}, \ldots, RSVI_{i,j_{lk,y_{lk}}})$ are the RSVIs for city i that make up sub-environment k of environment l.

(7) For each city i ($i = 1, \ldots, N$), calculate the RSVI for each environment l ($l = 1, \ldots, C$),

$$Raw\_RSVI_{i,l} = \frac{1}{S_l}\sum_{k=1}^{S_l} RSVI_{i,\,lk}$$

$$Mean\_RSVI_l = \frac{1}{N}\sum_{i=1}^{N} Raw\_RSVI_{i,\,l}$$

$$SD\_RSVI_l = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Raw\_RSVI_{i,l} - Mean\_RSVI_l)^2}$$

$$RSVI_{i,l} = \frac{Raw\_RSVI_{i,l} - Mean\_RSVI_l}{SD\_RSVI_l}$$

where $(RSVI_{i,l1}, \ldots, RSVI_{i,lS})$ are the RSVIs for the S sub-environments under each environment l.

(8) Overall rank score of city i ($i = 1, \ldots, N$),

$$Raw\_R_i = \frac{1}{C}\sum_{l=1}^{C} RSVI_{i,l}$$

$$Mean\_R = \frac{1}{N}\sum_{i=1}^{N} Raw\_R_i$$

$$SD\_R = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Raw\_R_i - Mean\_R)^2}$$

$$R_i = \frac{Raw\_R_i - Mean\_R}{SD\_R}$$

A city with a higher R_i is ranked ahead of one with a lower value of R_i, and the city with the highest R_i is the most liveable city.

Step 5 of the ranking algorithm provides the ranking of each city for each individual practical indicator. To achieve this ranking, Step 4 of the ranking algorithm adjusts the value of the SVIs so that a lower value will lead to a better ranking in terms of urban development. Depending on the nature of the indicator in question, a higher or lower value may reflect a

more developed city. For instance, consider the practical indicators "1.1.01 Gross Regional Domestic Product (GRDP)" and "1.3.01 Consumer Price Index (CPI)". A higher "GRDP" but a lower "CPI" suggests better economic performance. In most cases, a higher value is better (e.g., GRDP). However, for indicators where the inverse is true (e.g., CPI), the SVI itself is compared between cities and a lower SVI value will lead to a better ranking. Step 4 of the ranking algorithm thus seeks to make all standardised values of all practical indicators consistent for ranking purposes.

Step 6 of the ranking algorithm determines the sub-environment rankings of each city. The average RSVI of all the indicators in the sub-environment is calculated and compared to other cities. Cities with a higher average RSVI rank better in the sub-environment. To arrive at the city ranking for each environment, the RSVIs of the sub-environments are aggregated as detailed by Step 7 of the ranking algorithm.

Finally, Step 8 of the ranking algorithm requires the RSVI values of each environment to be totalled to determine the overall ranking of the city. Although the number of sub-environments and indicators varies for each environment, the aggregate score for each main environment is given an equivalent weighting – approximately 16.7 percent of the UCDI. Identical weights are assigned to each environment as they represent equal significance to the computation of the UCDI. This method is repeated and applied consistently across all the cities to ensure precision of the rankings.

Appendix D: Telephone Survey on "Urban Composite Development Index for 17 Shandong Cities: Ranking and Simulation Analysis based on China's Five Development Concepts"

Preamble: Hello! We are conducting a survey on the satisfaction of people's livelihood in Shandong Province. Your comments are extremely important to help us improve the quality of service of the local government. Please rest assured that we will keep your answers strictly confidential. Thank you very much for your cooperation and participation.

Preamble: There are 17 questions in this survey and will require approximately 5 to 8 minutes of your time to complete.

Closing Statement (when the quota is reached): Unfortunately, your details do not fulfil our survey criteria. We extend our sincerest apologies and thank you for your participation. Have a good day!

Part 1 Background Information

P1. Respondent's gender (Judged by the interviewer)

1. Male 2. Female

P2. What is your age? If the response is below 18 years old, then the respondent does not meet the survey criteria. Respond with the closing statement.

1. Under 18 years old (terminate interview)

2. 18-29 years old

3. 30-39 years old

4.40-49 years old

5. 50-59 years old

6. Above 60 years old (control the sample size at 10-17%)

P3. Which city do you currently live in?

1.Jinan	2.Qingdao	3.Zibo	4.Zaozhuang	5.Dongying
6.Yantai	7.Weifang	8.Jining	9.Tai'an	10.Weihai

11.Rizhao 12.Laiwu 13.Linyi 14.Dezhou 15.Liaocheng
16.Binzhou 17.Heze

P3-1: (For Jinan) Which district or county of Jinan do you live in?

1.Shizhong District 2.Lixia District 3.Tianqiao District
4.Huaiyin District 5.Licheng District 6.Changqing District
7.Zhangqiu District 8.Pingyin County 9.Jiyang County
10.Shanghe County 11. High-tech Industrial Development Zone

P3-2: (For Qingdao) Which district or county of Qingdao do you live in?

1. Shinan District 2. Shibei District 3. Chengyang District
4. Licang District 5. Huangdao District 6. Laoshao District
7. Jiaozhou City 8. Pingdu City 9. Laixi City
10. Jimo District

P3-3: (For Zibo) Which district or county of Zibo do you live in?

1. Zhangdian District 2.Linzi District 3.Zichuan District
4.Boshan District 5.Zhoucun District 6.Huantai District
7.Gaoqing District 8.Yiyuan District

P3-4: (For Zaozhuang) Which district or county of Zaozhuang do you live in?

1. Shizhong District 2.Shanting District 3.Yicheng District
4.Taierzhuang District 5.Xuecheng District 6.Tengzhou City

P3-5: (For Dongying) Which district or county of Dongying do you live in?

1. Dongying District 2. Hekou District 3. Kenli County
4. Guangrao County 5. Lijin County 6.Economic Development Zone

P3-6: (For Yantai) Which district or c county of Yantai do you live in?

1. Zhifu District 2.Hanting District 3.Muping District
4.Laishan District 5. Longkou District 6. Laiyang District
7.Laizhou District 8.Zhaoyuan City 9.Penglai City
10.Qixia City 11.Haiyang City 12.Changdao County
13. Economic Development Zone 14. High-tech Industrial Development Zone

P3-7: (For Weifang) Which district or county of Weifang do you live in?

1. Weicheng District 2.Hanting District 3.Fangzi District
4.Kuiwen District 5.Qingzhou City 6. Zhucheng City
7.Shouguang City 8.Anqiu City 9.Gaomi City
10.Changyi City 11.Changle County 12.Linqu County
13. Economic Development Zone

P3-8: (For Jining)Which district or county of Jining do you live in?

1.Rencheng County 2.Qufu City 3.Yanzhou District
4.Zoucheng City 5.Yutai County 6.Jinxiang County
7.Jiaxiang County 8.Weishan County 9.Wenshang County
10.Sishui County 11.Liangshan County
12. High-tech Industrial Development Zone

P3-9: (For Taian) Which district or county of Taian do you live in?

1. Taishan District 2.Daiyue District 3.Xintai City

4. Feicheng City 5.Ningyang County 6.Dongping County

7. High-tech Industrial Development Zone

P3-10: (For Weihai) Which district or county of Weihai do you live in?

1.Huaicui District 2.Rushan District 3.Wendeng District

4.Rongcheng City 5. High-tech Industrial Development Zone

P3-11: (For Rizhao) Which district or county of Rizhao do you live in?

1. Donggang District 2.Lanshan District 3.Wulian County

4.Ju County 5.Economic Development Zone

P3-12: (For Laiwu) Which district or county of Laiwu do you live in?

1.Laicheng District 2.Gangcheng District 3.Agricultural High-tech Zone

1.Laicheng District 2.Gangcheng District 3. Agricultural High-tech Zone

P3-13: (For Linyi) Which district or county of Linyi do you live in?

1. Lanshan District 2.Luozhuang District 3.Hedong District

4.Yinan County 5.Tancheng County 6.Yishui County

7.Fei County 8.Pingyi County 9.Junan County

10.Mengyin County 11.Lanling County 12.Linshu County

13. Economic Development Zone 14. High-tech Industrial Development Zone

P3-14: (For Dezhou) Which district or county of Dezhou do you live in?

1.Decheng District 2.Laoling City 3.Yucheng City

4.Lingcheng District 5.Ningjin County 6.Qihe County

7.Wucheng County 8.Qingyun County 9.Pingyuan County

10.Xiajin County 11.Linyi County

12. Economic Development Zone

P3-15: (For Liaocheng) Which district or county of Liaocheng do you live in?

1.Dongchangfu District 2.Linqing City 3.Gaotang County

4.Yanggu County 5.Chiping County 6.Shen County

7.Dong'e County 8.Guan County 9.Economic Development Zone

10. High-tech Industrial Development Zone

P3-16: (For Binzhou) Which district or county of Binzhou do you live in?

1.Bincheng District 2.Zouping County 3.Zhanhua County

4.Huimin County 5.Boxing County 6.Yangxin County

7.Wudi County 8. Economic Development Zone

P3-17: (For Heze) Which district or county of Heze do you live in?

1. Mudan District 2.Juancheng County 3.Shan County

4.Yuncheng County 5.Cao County 6.Dingtao County

7.Juye County 8.Dongming County 9.Chengwu County

10.Economic Development Zone

P4. Have you resided in this city for more than six months? If the response is no, then the respondent does not meet the survey criteria. Respond with the closing statement.

1. Yes 2. No (terminate the interview)

P5. Are you urban resident or rural resident?

1. Urban resident 2.Rural resident

Part 2 Satisfaction Rating

Please rate your satisfaction with the livelihood services based on your personal feelings on a scale of 1 to 10, with 1 being the lowest score and 10 being the highest score. There is no right or wrong answer, please do not worrry.

Include the option: “decline to respond”. If there are more than 3 responses marked with either “refuse to respond “or “not clear”, then the survey response is considered invalid and does not meet the survey criteria.

A1. How satisfied are you with the price of daily consumables, e.g. food and clothes?

1 2 3 4 5 6 7 8 9 10

A2a. Do you currently have or planning to start a business?

1. Yes 2. No (Jump to A3)

A2b. How satisfied are you with the business environment? (If asked, the business environment includes elements such as the certificate of approval, bank credit, government tax, contract execution and investor protection, etc.)

1 2 3 4 5 6 7 8 9 10

A3. How satisfied are you with the government conduct?

1 2 3 4 5 6 7 8 9 10

A4. Are you satisfied with the just of judiciary?

1 2 3 4 5 6 7 8 9 10

A5a. Have you used a government e-service system before? (For example, internet consulting, online complaints, e-payment, document application and project permission, etc.)

1. Yes 2. No (Jump to A6)

A5b. How satisfied are you with the e-government system?

1 2 3 4 5 6 7 8 9 10

A6. How satisfied are you with the current level of public security?

1 2 3 4 5 6 7 8 9 10

A7. How satisfied are you with the urban management personnel?

1 2 3 4 5 6 7 8 9 10

A8. How satisfied are you with the services provided by the police?

1 2 3 4 5 6 7 8 9 10

A9. How satisfied are you with the government's efforts to improve the living environment by employing high-tech innovations?

1 2 3 4 5 6 7 8 9 10

A10. How satisfied are you with the current level of public healthcare services? (For example, fee for health care, quality of health care, accessibility to health care, and service attitude in health care centres, etc.)

1 2 3 4 5 6 7 8 9 10

A11. How satisfied are you with the hygiene standards in public toilets?

1 2 3 4 5 6 7 8 9 10

A12. How satisfied are you with the public education system? (For example, accessibility to public education, fairness in the public education system, costs of public education, faculty and teaching facilities, etc.)

1 2 3 4 5 6 7 8 9 10

A13. How satisfied are you with traffic conditions (for example, the quality of roads and traffic congestion)?

1 2 3 4 5 6 7 8 9 10

A14.您对本地公交车和出租车的价格、便利程度满意吗？

How satisfied are you with public transportation services (for example, the price of taxi and buses and the accessibility to public transport)?

1 2 3 4 5 6 7 8 9 10

A15-1. (For Urban Residence) How satisfied are you with the acquisition of lifestyle information through the Internet? (For example, online food ordering, mobile phone payment and DiDi Taxi, etc.)

1 2 3 4 5 6 7 8 9 10

A15-2. (For Rural Residence) How satisfied are you with the acquisition of lifestyle and production information through the Internet? (For example, online food ordering, mobile phone payment and DiDi Taxi, etc.)

1 2 3 4 5 6 7 8 9 10

A16. How satisfied are you with the current level of income inequality? (For example, minimum living standard, frequency and magnitude of salary adjustments, etc.)

1 2 3 4 5 6 7 8 9 10

A17. On a scale of 1 to 10 (where 1 is the least), how happy are you?

1 2 3 4 5 6 7 8 9 10

Part 3 Personal Information

Lastly, we would like to ask you for some personal information.

P6. What is your current education level?

1.Primary school and below 2.Secondary school 3.High school(including Specialized Secondary school) 4.University(including Diploma) 5.Master and above 6.Illiterated 7.Refuse to respond

P7. What is your current occupation:

1. Undergraduate Student

2. Enterprise/Corporate employee

3. Party and government organization/Institution/State-Owned-Enterprise/Central enterprise employee

4. Professional, i.e. Doctor, Lawyer, Scientific Researcher

5. Individual Business Operator

6. Retiree

7. Housewife

8. Freelancer

9. Active soldier

10. Others (Please specify:_____)

Concluding Remarks: Our survey ends here. Thank you once again for your support and cooperation. We are very grateful for your active participation!

Have a nice day!

Appendix E: Rankings for Each Environment

Table E1: Scale and Quality of Economic Activities Ranking

Rank	City	Score
1	Qingdao	1.987
2	Yantai	1.687
3	Heze	1.289
4	Weifang	1.021
5	Weihai	0.849
6	Linyi	0.447
7	Dezhou	0.096
8	Tai'an	-0.321
9	Jinan	-0.364
10	Zaozhuang	-0.412
11	Binzhou	-0.573
12	Liaocheng	-0.665
13	Zibo	-0.674
14	Dongying	-0.782
15	Rizhao	-1.017
16	Jining	-1.273
17	Laiwu	-1.295

Source: Authors' calculation

Table E2: Financial Capacity, Labour Market Flexibility and Economic Vibrancy Ranking

Rank	City	Score
1	Jinan	2.264
2	Qingdao	1.932
3	Yantai	1.271
4	Weifang	0.441
5	Linyi	0.387
6	Dongying	0.293
7	Zibo	0.089
8	Weihai	0.083
9	Jining	-0.171
10	Binzhou	-0.329
11	Rizhao	-0.619
12	Heze	-0.638
13	Tai'an	-0.763
14	Zaozhuang	-0.894
15	Liaocheng	-1.021
16	Dezhou	-1.026
17	Laiwu	-1.297

Source: Authors' calculation

Table E3: Good Governance, Effective Leadership and Social Stability Ranking

Rank	City	Score
1	Dezhou	1.465
2	Weihai	1.134
3	Weifang	0.797
4	Qingdao	0.733
5	Jinan	0.532
6	Tai'an	0.498
7	Heze	0.435
8	Zibo	0.418
9	Linyi	0.321
10	Yantai	0.192
11	Dongying	0.173
12	Rizhao	0.042
13	Jining	-0.527
14	Binzhou	-0.849
15	Zaozhuang	-1.302
16	Laiwu	-1.588
17	Liaocheng	-2.473

Source: Authors' calculation

Table E4: Technological Advancement and Innovation Capability Ranking

Rank	City	Score
1	Qingdao	2.176
2	Weifang	1.417
3	Jinan	1.257
4	Yantai	1.009
5	Weihai	0.848
6	Zibo	0.492
7	Dongying	0.178
8	Jining	-0.222
9	Linyi	-0.344
10	Tai'an	-0.457
11	Dezhou	-0.517
12	Binzhou	-0.559
13	Laiwu	-0.812
14	Heze	-0.897
15	Rizhao	-1.155
16	Zaozhuang	-1.192
17	Liaocheng	-1.221

Source: Authors' calculation

Table E5: Public Service Standards and Quality of Life Improvement Ranking

Rank	City	Score
1	Dongying	1.689
2	Weihai	1.616
3	Weifang	0.920
4	Jinan	0.919
5	Zibo	0.794
6	Laiwu	0.675
7	Qingdao	0.593
8	Yantai	0.251
9	Rizhao	-0.154
10	Linyi	-0.307
11	Tai'an	-0.567
12	Heze	-0.766
13	Jining	-0.819
14	Binzhou	-0.862
15	Zaozhuang	-0.954
16	Dezhou	-1.066
17	Liaocheng	-1.964

Source: Authors' calculation

Table E6: Resource Conditions and Environmental Protection Ranking

Rank	City	Score
1	Weihai	1.632
2	Yantai	1.394
3	Dongying	1.118
4	Rizhao	0.817
5	Zibo	0.665
6	Liaocheng	0.376
7	Tai'an	0.370
8	Qingdao	0.330
9	Jinan	0.281
10	Jining	-0.112
11	Dezhou	-0.287
12	Zaozhuang	-0.393
13	Linyi	-0.512
14	Weifang	-0.814
15	Laiwu	-1.136
16	Binzhou	-1.586
17	Heze	-2.142

Source: Authors' calculation