Synergistic development of financial agglomeration and urban resilience: A case study of the resource-based city of Yulin

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Abstract: Under the background of the transformational upgrading of resource-based cities, promoting the synergistic evolution of financial agglomeration (FA) and urban resilience (UR) is a critical pathway for achieving high-quality development. Based on panel data on Yulin from 2012 to 2024, an evaluation index system for FA and UR was constructed in this work. Entropy weight method, grey relational analysis, coupling coordination degree model, obstacle degree model, and metabolic GM(1,1) model were used, and interactive relationship, coupling coordination level, constraining factors, and future trends between these two systems were systematically evaluated. The results show that FA level in Yulin exhibits a fluctuating upward trend, characterized by rapid scale expansion coupled with relatively lagging efficiency, while UR demonstrates sustained improvement. Two systems consistently maintain a high coupling degree, with the level evolving from near disorder to high coordination. In addition, constraining factors of coupling coordination undergo a phased transition. Constraints of financial system shift from insufficient aggregate resources to deficiencies in talent and credit allocation efficiency, while those of UR shift from economic volatility to infrastructural and ecological resilience shortcomings. The forecast indicates that the coupling coordination degree will continue to rise, but the growth rate will significantly slow down. Therefore, several policy suggestions were proposed, including promoting improvements in financial quality and efficiency, fostering industrial diversification, addressing infrastructural and ecological resilience gaps, and establishing cross-sectoral collaborative governance mechanisms.

Keywords: Financial Agglomeration; Urban Resilience; Coupling Coordination; Obstacle Factors; Grey Prediction

1. Introduction

In recent years, most resource-based cities in China have been in a critical period of transforming development drivers, adjusting industrial structure, and modernizing urban governance. For the city of Yulin in Shaanxi Province, the long-term growth driven by energy economy has facilitated factor agglomeration but has also engendered challenges such as resource dependence, structural imbalance, ecological pressure, and market volatility risks. In this context, optimizing financial resource allocation to enhance its urban capacity for shock response, recovery and reconstruction, and sustainable development has become a pressing issue. Therefore, financial agglomeration (FA) and urban resilience (UR) should not be treated in isolation but rather integrated into a unified framework to explore their synergistic relationship.

National policies of China also provide a practical basis for this integration. On the one hand, finance should serve the real economy, promoting the development of technology finance, green finance, inclusive finance, and digital finance. On the other hand, urban development goals should be gradually oriented toward safety, adaptability and sustainability. For Yulin, enhancing UR depends on financial resource support, while capital absorption, information spillover, and resource integration effects of FA are key to improving UR. These two aspects do not have a one-way influence but rather form a mutually-reinforcing and coordinated relationship.

In view of this, Yulin was selected as the research subject in this work, treating FA and UR as two interrelated subsystems. Coupling relationship, coordination degree, and evolution characteristics of them were systematically analyzed, and key influencing factors during the process of coordinated development were identified. The aim is to provide a theoretical basis and policy references for local governments to optimize financial layout, enhance urban governance capacity, and strengthen resilience in transitional development.

2. Literature Review

2.1 Research on FA

Research on FA abroad began relatively early, initially framed within financial geography and international financial center theories. Pandit et al. [1] found that industrial cluster intensity significantly affects the growth of financial enterprises. Klagge and Martin [2] pointed out that financial systems exhibit obvious institutional and geographical concentration trends, while local financial networks still have unique value. Dörry [3] emphasized that international financial centers are key strategic nodes in global financial production networks. Wójcik et al. [4] found that the formation of international financial centers is closely related to labor market depth, degree of non-financial sector internationalization, and legal environment. Haberly and Wójcik [5] further noted that the spatial reorganization of offshore centers and international banking networks has changed the spatial allocation of financial risks.

In domestic research, Lin [6] found that FA has distinct regional characteristics. Liu et al. [7] pointed out that FA in urban agglomerations helps mitigate financial risks. Zhang et al. [8] demonstrated that FA contributes to enhancing the total factor productivity of cities. Wang et al. [9] confirmed that FA has both local promotion and spatial spillover effects on green technology innovation. Xiao et al. [10] found that the effect of financial resource agglomeration in central cities on peripheral cities is gradually shifting from "siphoning" to "radiation". In fact, relationships between FA and provincial-level agglomeration effects [11], urban-rural income gaps [12], and regional economic growth [13] have also received increasing attention. Moreover, domestic scholars have conducted in-depth discussions from perspectives such as regional economic resilience [14], regional economic disparity [15], high-quality economic development [16], and innovation spillovers [17].

2.2 Research on UR

Most foreign scholars adopt comprehensive evaluation methods for resilience measurement. Datola et al. [18] combined multi-criteria analysis with system dynamics models to propose a comprehensive assessment framework. Dianat et al. [19] conducted a systematic review of existing assessment tools. Buzási et al. [20] carried out a comparative analysis using Hungarian cities as case studies. Oliveira and Fath [21] constructed a cross-city resilience indicator system from six dimensions. Lowe et al. [22] emphasized that resilience is a dynamic evolutionary process encompassing recovery, adaptation, and transformation.

Domestic research has mostly been conducted within the context of Chinese urban agglomerations. He et al. [23] constructed a resilience evaluation system for the Chengdu-Chongqing economic circle across five dimensions. Su et al. [24] introduced the DPSIR model for indicator system construction. Xu et al. [25] focused on economic investment, while Huang et al. [26] emphasized public services, both constructing comprehensive evaluation systems based on multiple system dimensions. In terms of influencing factors, Ma et al. [27] focused on infrastructure service levels and social-environmental carrying capacity. Wang et al. [28] found that digital economy development significantly enhances UR. Zhang et al. [29] revealed the spatiotemporal heterogeneity of factors influencing the resilience network structure of the Beijing-Tianjin-Hebei urban agglomeration. In addition, Wang and Wang [30] found that openness, digitalization level, and industrial structure have positive spillover effects on surrounding areas. Gao et al. [31] identified environmental pressure, technological innovation, industrial structure, and financial scale as main drivers of resilience in population-shrinking cities.

2.3 Research on the Relationship between FA and UR

Research directly exploring the relationship between FA and comprehensive UR is still relatively rare, but some scholars have investigated the impact of FA on urban economic resilience. Zhang and Fu [32] employed a spatial Durbin model and found that

FA exerts positive effects and spatial spillover effects on both local and regional economic resilience. Wang et al. [33] pointed out that the coupling relationship between FA and economic resilience in central cities with different levels exhibits hierarchical heterogeneity. In addition, Li [34] confirmed that FA enhances urban economic resilience by boosting innovation and entrepreneurship activity. Tan and Hai [35] validated the enhancing effect of FA on economic resilience using county-level data from Hunan Province. Zhao et al. [36] found an inverted U-shaped impact of FA on urban economic resilience based on data from 285 prefecture-level cities.

2.4 Literature Assessment

Existing literature has accumulated substantial contributions in fields of FA and UR, but there remains scope for further investigation. In terms of research perspective, most studies have focused solely on the impact of FA on economic resilience. Few studies have integrated FA with comprehensive UR, which encompasses society, ecology, and infrastructure dimensions into a unified framework for systematic analysis. In terms of research subjects, few specialized studies have targeted resource-based cities as a distinct category. For analytical depth, some studies merely focus on measuring coupling coordination degrees, without delving into the key constraining factors of coordinated development and their phased evolution. Therefore, Yulin, a typical resource-based city, was selected as the research subject in this work. Coordinated development relationship, constraining factors, and future trends between FA and UR were systematically investigated.

3. Research Design

3.1 Research Area and Data Sources

Yulin is located in northern Shaanxi Province and is a national base for the energy and chemical industries. It is rich in energy resources, with coal, petroleum, and natural gas being main industries. In 2024, its GDP ranked second in Shaanxi Province, but the secondary industry accounts for a persistently high proportion, indicating that Yulin is still in the stage of transformation and upgrading. The period 2012-2024 was selected for this study. Data are mainly sourced from the Shaanxi Provincial Statistical Yearbook, China Urban Statistical Yearbook, China Urban Construction Statistical Yearbook, and Yulin Municipal Statistical Bulletins. Minor gaps in the data were handled using interpolation.

3.2 Indicator System Construction

FA indicator system drew on the study by Wang et al. [33], comprising two dimensions, i.e., agglomeration scale and agglomeration efficiency, including 9 secondary indicators. UR indicator system drew on the study by Bai et al. [37], comprising 27 indicators across four dimensions, i.e., society, economy, ecology, and infrastructure. Specific indicators and weights were listed in Table 1.Table 1

Table 1. Specific Indicators and Weights

Indicator	Primary indicator	Secondary indicator	Calculation	Unit	Direction	Weight (%)
FA level (A)	FA scale (A1)	Loan scale	Total year-end RMB loans of financial institutions (A11)	10,000 CNY	+	8.10
		Deposit scale	Total year-end RMB deposits of financial institutions (A12)	10,000 CNY	+	14.67
		Insurance scale	Premium income (A13)	Million CNY	+	11.47
		Talent scale	Number of employees in the financial industry (A14)	10,000 persons	+	4.11
	FA efficiency (A2)	Credit depth	Total year-end deposits and loans of financial institutions / GDP (A21)	-	+	12.27
		Credit efficiency	Year-end loans/deposits of financial institutions (A22)	-	+	11.22
		Insurance depth	Premium income / GDP (A23)	%	+	8.85
		Insurance density	Premium income / total population (A24)	CNY/person	+	11.73
		Financial talent agglomeration efficiency	(Employees of financial industry in prefecture-level cities / total employees in prefecture-level cities) / (nationwide employees of financial industry / total nationwide employees) (A25)	-	+	17.57
UR level	Social	Social status	Urban population ratio (B11)	%	+	2.54

(B)	system (B1)		Employees in non-private units (B12)	10,000 persons	+	1.25
		Social security	Number of hospital beds per 10,000 persons (B13)	beds/10,000 persons	+	2.59
			Number of doctors per 10,000 persons (B14)	persons/10,000 persons	+	2.29
		Social development	Per capita disposable income of urban residents (B15)	CNY	+	3.90
			Number of industrial enterprises above designated size (B16)	-	+	3.34
			Total profits of industrial enterprises (B17)	100 million CNY	+	8.49
	Economic system (B2)	Economic strength	Per capita GDP (B21)	CNY	+	5.99
			Per capita retail sales of consumer goods (B22)	10,000 CNY/person	+	2.90

Table 1. Specific indicators and weights (continued).

Indicator	Primary indicator	Secondary indicator	Calculation	Unit	Direction	Weight (%)
UR level (B)	Economic system (B2)	Economic strength	Per capita fixed asset investment in public facilities construction (B23)	CNY/person	+	5.16
		Economic diversity	Proportion of tertiary industry GDP in total GDP (B24)	%	+	3.68
			Proportion of total exports in GDP (B25)	%	+	9.48
			Proportion of road and bridge investment in GDP (B26)	%	+	4.91
		Economic potential	Proportion of general public budget expenditure in GDP (B27)	%	+	5.46
	Ecological system (B3)	Ecological pressure	Per capita urban sewage discharge (B31)	Ton	-	2.72
			Industrial CS2 emissions per 10,000 persons (B32)	Ton	-	3.74
		Ecological status	Green coverage area of built-up areas per 10,000 persons (B33)	Hectare	+	4.33
			Per capita park green area (B34)	m2	+	2.50
		Ecological response	Volume of household waste collected and transported (B35)	10,000 tons	+	2.39
			Centralized sewage treatment rate (B36)	%	+	1.39
			Household waste treatment rate (B37)	%	+	3.70
	Infrastructure system (B4)	Early warning capacity	Per capita Mobile phone users (B41)	Subscriber	+	2.71
		Evacuation and resettlement capacity	Number of public buses per 10,000 persons (B42)	Vehicle	+	3.09
			Per capita total annual water supply (B43)	m3	+	2.86
			Length of urban drainage pipes per 10,000 persons (B44)	km	+	3.72
		Infrastructure upgrading	Gas coverage rate (B45)	%	+	2.66
			Per capita urban road area (B46)	m2	+	2.23

3.3 Research methods

3.3.1. Entropy weight method

This method was used for objective weighting to eliminate subjective bias. Firstly, original data were standardized to eliminate the influence of units. Then, the proportion of each indicator in the sample was calculated to derive information entropy and redundancy values. Finally, indicator weights were determined based on redundancy, and comprehensive evaluation indices of FA and UR were obtained by weighted summation.

3.3.2. Grey relational analysis

This method was used to measure the correlation degree between variables. Following Cui et al. [38], the correlation degree was classified into low correlation (0.00, 0.35], medium correlation (0.35, 0.65], relatively high correlation (0.65, 0.85], and high correlation (0.85, 1.00].

3.3.3. Coupling coordination degree model

The coupling coordination degree is derived from the capacity coupling coefficient model in physics, with calculation steps as follows:

Calculating the coupling degree C, a larger value indicates greater interaction between the two systems, with the corresponding function:

$$C=2\times\frac{\sqrt{w_1\cdot w_2}}{w_1+w_2} \tag{1}$$

where w1 is the comprehensive evaluation index of FA system, and w2 is that of UR system. Values 0.5 and 0.8 were set as thresholds to categorize the coupling degree into low, moderate, and high levels.

The coordination index T was calculated with the corresponding function:

$$T=\alpha\omega_1+\beta\omega_2 \quad (2)$$

where α and β are undetermined coefficients, both set at 0.5.

Calculating the coordination degree D, a larger value indicates a higher level of system coordination, with the corresponding function:

$$D=\sqrt{C\times T} \quad (3)$$

where 0.4, 0.6, and 0.8 were selected as thresholds to categorize the coordination degree into moderate imbalance, near imbalance, primary coordination, and high coordination.

3.3.4. Relative development degree model

Following Luo et al. [39], this model was introduced:

$$R=U_1/U_2 \quad (4)$$

where R is the relative development degree, U1 and U2 are development levels of FA and UR, respectively. When 0 < R ≤ 0.8, FA lags behind UR, and the system tends toward degradation. When 0.8 < R ≤ 1.2, FA and UR are synchronized, and the system tends toward optimization. When R > 1.2, FA outpaces UR.

3.3.5. Obstacle degree model

This model was introduced to measure the obstacle degree of each indicator, with the corresponding function:

$$O_{ij}=\frac{w_j\times(1-Z_{ij})}{\sum_{j=1}^{m} w_j\times(1-Z_{ij})}\times 100\% \quad (5)$$

where Zij is the standardized indicator value, wj is the weight of j-th indicator, Oij is the obstacle degree of j-th indicator in year i, and m is the number of indicators. A larger obstacle degree indicates a stronger constraining effect of that indicator on the coupling coordination development of FA and UR in Yulin.

3.3.6. Metabolic GM(1,1) grey prediction model

This model was introduced to predict the evolutionary trends of FA level, UR level, and their coupling coordination. Based on conventional GM(1,1) model, the successive incorporation of newly observed data and the elimination of oldest data points were adopted for rolling modeling to improve the prediction accuracy.

4. Empirical Results and Discussions

4.1 Measurement of FA and UR Levels

As listed in Table 2, FA index of Yulin rose from 0.2995 to 0.5640 over 2012-2024, showing a fluctuating upward trend and indicating a clear concentration of financial factors in the city. From a dimensional perspective, the scale index surged from 0.0631 to 0.9446. In contrast, after reaching 0.6336 in 2015, the efficiency index fluctuated and then declined, and although it has partially recovered in recent years, it still lags significantly behind the scale expansion. This reveals structural characteristics of FA in Yulin as rapid scale expansion accompanied by relatively slow efficiency improvement.

Table 2. Measurement Results of FA Level.

Year	FA index	FA scale	FA efficiency
2012	0.2995	0.0631	0.4465
2013	0.2716	0.0867	0.3866
2014	0.3177	0.1520	0.4208
2015	0.4708	0.2092	0.6336
2016	0.4657	0.2627	0.5921
2017	0.4615	0.3481	0.5320
2018	0.3388	0.2968	0.3649
2019	0.3412	0.3878	0.3122
2020	0.4286	0.4586	0.4099
2021	0.3579	0.5528	0.2367
2022	0.4182	0.7067	0.2387
2023	0.4921	0.8249	0.2850
2024	0.5640	0.9446	0.3272

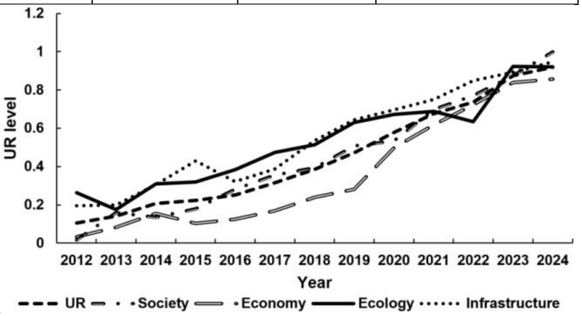

Figure 1. Measurement Results of the UR Level of Yulin.

As illustrated in Figure 1, the UR level of Yulin showed a sustained upward trend from 2012 to 2024, and all four subsystems, i.e., society, economy, ecology, and infrastructure, were improved. Among them, social system resilience increased from 0.0164 to 0.9981, representing the largest improvement, indicating that supporting capacities in public services, social security, and social governance have been continuously strengthened. In addition, economic system resilience improved markedly after 2019, while ecological system resilience and infrastructure system resilience increased from 0.2638 to 0.9201 and 0.1959 to 0.9462, respectively.

4.2 Grey Relational Analysis

As shown in Table 3, relational degrees between various dimensions of these two systems range from 0.4926 to 0.8730, mainly in the relatively high association category, indicating significant interactive relationships and synergistic consistency between them. FA scale (A1) exhibits the highest associations with social (B1) and economic (B2) system resilience, while its associations with ecological (B3) and infrastructure (B4) system resilience are relatively lower. In contrast, FA efficiency (A2) shows the highest association with ecological system resilience (B3). Overall, associations between each UR dimension and FA scale are higher than those with efficiency, corroborating that current financial development remains primarily scale-driven.

Table 3. Measurement Results of Grey Correlation Degree

Reference sequence	Comparative sequence	Grey correlation degree	Ranking
A1	B1	0.7137	2
	B2	0.7205	1
	B3	0.5148	4
	B4	0.5316	3
A2	B1	0.5823	3
	B2	0.5770	4
	B3	0.6157	1
	B4	0.5855	2
B1	A1	0.8730	1
	A2	0.5473	2
B2	A1	0.8359	1
	A2	0.4926	2
B3	A1	0.7643	1
	A2	0.5972	2
B4	A1	0.7108	1
	A2	0.5222	2

4.3 Coupling Coordination Degree Analysis

As shown in Figure 2, coupling degree C consistently remained above 0.8763 with a high coupling state, implying a consistently strong interactive relationship between FA and UR. Coordination degree D rose from 0.4209 to 0.8486, undergoing an evolutionary process of near imbalance (2012-2016), fluctuating adjustment (2017-2022), and high coordination (2023-2024), marking a significant improvement in system matching.

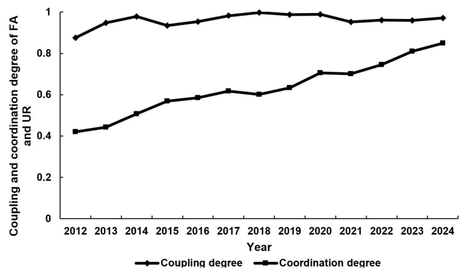

Figure 2. Coupling and Coordination Degree of FA and UR.

4.4 Relative Development Degree Analysis

As displayed in Figure 3, relative development degree R was greater than 1 in 2012-2017 with an overall fluctuating downward trend, indicating that UR lagged behind FA. After 2018, R fell below 1, implying that FA became relatively lagging. However, the gap narrowed in 2023-2024, suggesting that constraining factors for synergistic development shifted across different stages.

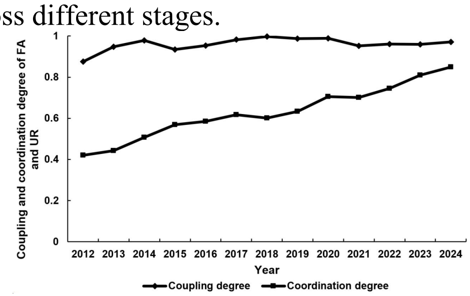

Figure 3. Relative Development Degree of FA and UR.

4.5 Obstacle Degree Analysis

The phased evolution of constraining factors is presented in Table 4. For FA system, during 2012-2016, main obstacles were deposit scale (A12), insurance density (A24), and insurance scale (A13), reflecting an insufficient accumulation of traditional financial resources. After 2017, financial talent agglomeration efficiency (A25), credit depth (A21), and credit efficiency (A22) became core obstacles, indicating that constraints had shifted from insufficient aggregate resources to low efficiency and talent scarcity.

Table 4. Key Indicators of Main Obstacles and Obstacle Degree Rankings of FA and UR Systems

Year	FA system			UR system		
	First obstacle indicator (Obstacle degree %)	Second obstacle indicator (Obstacle degree %)	Third obstacle indicator (Obstacle degree %)	First obstacle indicator (Obstacle degree %)	Second obstacle indicator (Obstacle degree %)	Third obstacle indicator (Obstacle degree %)
2012	A12 (9.1974)	A21 (7.4737)	A24 (7.3541)	B25 (5.8440)	B17 (5.0542)	B21 (3.5761)
2013	A12 (8.9963)	A24 (7.2954)	A13 (7.1188)	B25 (5.8758)	B17 (5.1645)	B21 (3.5013)
2014	A12 (9.3980)	A24 (7.5017)	A13 (7.2987)	B25 (6.3336)	B17 (5.4377)	B21 (3.6525)
2015	A12 (10.3057)	A24 (8.2692)	A13 (8.0130)	B25 (7.2604)	B17 (6.4793)	B21 (4.5876)
2016	A12 (10.0832)	A24 (7.1833)	A13 (6.9885)	B25 (7.0335)	B17 (6.4856)	B21 (4.4351)

2017	A12 (9.8846)	A25 (7.8443)	A21 (6.0844)	B25 (6.8753)	B17 (6.0658)	B21 (4.1140)
2018	A25 (12.3444)	A12 (8.6951)	A21 (7.6320)	B25 (6.7186)	B17 (5.8329)	B21 (3.4668)
2019	A25 (13.7627)	A21 (8.8948)	A12 (8.7241)	B25 (6.8813)	B17 (6.1775)	B26 (4.0173)
2020	A25 (16.8280)	A12 (9.3763)	A22 (7.5715)	B25 (8.1763)	B17 (7.4670)	B21 (4.1019)
2021	A25 (17.1119)	A21 (12.6980)	A22 (8.8838)	B25 (6.8147)	B17 (4.6258)	B33 (3.0080)
2022	A25 (19.9924)	A22 (13.0452)	A21 (12.5442)	B25 (5.3092)	B17 (3.5300)	B33 (3.3655)
2023	A25 (27.1842)	A22 (17.4590)	A21 (15.9281)	B23 (3.2738)	B17 (2.3523)	B26 (2.2242)
2024	A25 (34.0082)	A22 (21.7296)	A21 (16.2611)	B23 (6.0240)	B26 (3.4587)	B34 (2.2713)

For UR system, from 2012 to 2022, main obstacles were concentrated in the economic dimension, such as proportion of total exports in GDP (B25), industrial profits (B17), and per capita GDP (B21), which exposed the vulnerability of resource-based economy. This is closely related to the industrial structure of Yulin, which is dominated by energy industry. In 2023-2024, obstacles shifted to per capita fixed asset investment in public facilities construction (B23), proportion of road and bridge investment in GDP (B26), and per capita park green area (B34), with infrastructure and ecological resilience becoming the new weaknesses.

4.6 Trend Prediction

As shown in Table 5 and Figure 4, the metabolic GM(1,1) model was used to forecast trends for 2025-2028. Accuracy tests indicate that average relative residuals of three metabolic models are all below 5%, with P values of 1.0000 and C values below 0.35, confirming that the prediction accuracy exceeds the acceptable level and forecasts are reliable.

Projections indicate that FA index will increase from 0.5652 to 0.5944 over 2025-2028 with an average annual growth rate of 1.3%, maintaining a generally steady upward trajectory. UR index will rise from 0.9344 to 0.9685 with an average annual growth rate of 1.3%, though the growth rate will notably decelerate compared with the sample period. The coupling coordination degree will increase from 0.8533 to 0.8736, with an average annual growth rate of 0.7%, still showing steady improvement. As both systems progressively enter higher-level ranges, subsequent enhancements will depend more on internal structural optimization and quality improvements.

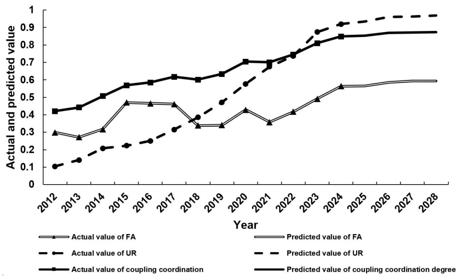

Figure 4. FA, UR, and Coupling Coordination Degree Prediction.

Table 5. Accuracy test results of metabolic GM(1,1) model.

Prediction object	Model	Average relative residual	Probability of small error P	Posterior difference ratio C	Accuracy level
FA	Basic model	0.0497	1.0000	0.3997	Qualified (level 2)
	First metabolism	0.0429	1.0000	0.3433	Good (level 1)
	Second metabolism	0.0387	1.0000	0.2992	Good (level 1)
	Third metabolism	0.0154	1.0000	0.1593	Good (level 1)
UR	Basic model	0.0318	1.0000	0.3093	Good (level 1)
	First metabolism	0.0439	1.0000	0.3747	Qualified (level 2)
	Second metabolism	0.0234	1.0000	0.1577	Good (level 1)
	Third metabolism	0.0133	1.0000	0.2383	Good (level 1)
Coupling coordination degree	Basic model	0.0500	1.0000	0.3548	Qualified (level 2)
	First metabolism	0.0341	1.0000	0.3362	Good (level 1)
	Second metabolism	0.0168	1.0000	0.2254	Good (level 1)
	Third metabolism	0.0080	1.0000	0.1843	Good (level 1)

Accuracy levels are classified according to the posterior error test standard of grey prediction model. If $P > 0.95$ and $C < 0.35$, it is considered good (level 1). If $P > 0.80$ and $C < 0.50$, it is considered qualified (level 2). If $P > 0.70$ and $C < 0.65$, it is considered barely qualified (level 3). The rest are considered unqualified (level 4).

5. Conclusions and Policy Recommendations

5.1 Conclusions

FA level of Yulin exhibited a fluctuating upward trend over the sample period, with the core issue being the structural imbalance between rapid scale expansion and lagging efficiency improvement. Meanwhile, UR level continued to rise, and four subsystems showed varying degrees of improvement. These two systems remained in a consistently high coupling state, with the coupling coordination degree evolving from near imbalance through fluctuating adjustment to high coordination. Moreover, associations between FA scale and various dimensions of UR are uniformly stronger than those between agglomeration efficiency and resilience dimensions, suggesting that the current support of financial development for UR remains primarily scale-driven. Principal obstacles to the coordinated development exhibit marked phased characteristics, i.e., constraints within the financial system shift from an aggregate financial insufficiency to talent shortages and inefficient credit allocation, while UR constraints shift from economic volatility and industrial unicity to inadequate infrastructure carrying capacity and relatively lagging ecological governance. Based on projections, the coupling coordination degree will continue its upward trajectory during 2025-2028, albeit at a significantly decelerating pace. This indicates that the synergistic development is transitioning from a phase of relatively rapid advancement to one of high-level steady development, with subsequent improvements depending more on internal structural optimization and quality enhancement.

5.2 Policy Recommendations

5.2.1. Promoting the transition of finance from scale expansion to quality enhancement

Credit allocation should be optimized to increase support for advanced manufacturing and green industries. The diversified financial service system should be improved, and the introduction and cultivation of financial talent should be strengthened to address the efficiency bottleneck.

5.2.2. Enhancing urban economic resilience and promote industrial diversification

The energy industry chain should be extended to improve the risk resilience capacity of resource-based industries. Non-resource industries such as equipment manufacturing, digital economy, and modern logistics should be vigorously cultivated to strengthen the adaptability and recoverability of economic system.

5.2.3. Addressing infrastructural and ecological resilience shortcomings

Investment in public facilities, transportation networks, and emergency support systems should be increased. Ecological restoration and green space development should be reinforced, and green finance should be leveraged to support these efforts, thereby consolidating the foundation for synergistic development of these two systems.

5.2.4. Establishing synergistic promotion and dynamic monitoring mechanisms

Policy coordination across finance, industry, urban development, and environmental protection should be promoted. Cross-departmental collaborative governance mechanisms should be established, and a dynamic monitoring and early warning system should be built to precisely identify key obstacles and potential risks.

5.2.5. Adopting classified and phased implementation approaches

The policy emphasis for financial system should shift from scale expansion to quality enhancement, while UR policy focus should shift from economic stabilization to infrastructure strengthening, ecological optimization, and governance improvement, thereby advancing these two systems toward a higher-quality and more sustainable stage of synergistic development.

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