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Research Article

Coordinated Development between Assistance to Tibet and Tourism Development: Spatial Patterns and Influencing Factors

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The Chinese government has provided various forms of assistance to the Tibet Autonomous Region and has substantially improved their facilities, which has had a positive influence on the development of tourism in Tibet. The present study investigated how assistance to Tibet (AT) coordinates with tourism development (TD) by exploring the patterns and influencing factors of AT and TD using statistical data from 74 prefectural units from 1991 to 2015. The findings led to several conclusions: (1) AT displayed strong and constant coupling interactions with TD, and the coupling coordination degree increased from moderately unbalanced development (MUD) to barely balanced development (BBD). However, the coupling coordination degree remains low (MUD) in most prefectural units; (2) in 2015, the degree of coupling coordination displayed a "core-periphery" spatial pattern (i.e., low in center and high in the periphery), which highly coincides with the patterns of AT (x) and TD (y), and should thus be improved further; and (3) both AT factors and TD factors have significant effects on the spatial differentiation of coupling coordination degree but not on the coupling degree. This study expands research on coupling coordination and AT and provides scientific guidance for further coordinating AT and TD.

1. Introduction

Since the reform and opening-up, China's economic growth has adopted a "two-step" strategy based on the unbalanced growth and balanced growth theories [1]. From 1978 to the early 1990s, China implemented an unbalanced development strategy that prioritized the eastern region. From the early 1990s to the beginning of the twenty-first century, China continued the unbalanced development strategy that prioritized the development of the eastern region, but also considered the central and western regions (Western development strategy, 2000; Rise of Central China Plan, 2004). After the early twenty-first century, a balanced and coordinated development strategy was implemented [2, 3]. Under the unbalanced development strategy, the regional disparity of China's economy grew in the eastern, central, and western regions [4]; therefore, promoting the coordinated development of western regions, especially the marginal areas, is crucial.

Assistance to Tibet (AT) refers to the sum of assistance received by the Tibet Autonomous Region, which is a system of economic assistance (e.g., finance and funds), projects, talent, education, and technical assistance [5]. AT is regarded as a systematic project. AT is a valuable means of macrocontrol by the Chinese government by promoting Tibet's socioeconomic development through the reallocation of assistance resources to reduce the regional gaps and promote the coordinated development of Tibet [6].

Tibet Autonomous Region, which is located in marginal China, has been in an inferior position in terms of the national economic pattern since 1951 [7]. CPC Central Committee provided various forms of assistance and held six

"Work Forum on Tibet" (WFT) [8], which promoted the socioeconomic development of Tibet. However, tourism development (TD) in Tibet has not garnered sufficient attention, and the AT prioritizes urban development and livelihood improvement projects rather than tourism [6], which caused the decoupling of TD and AT. Moreover, AT also caused regional inequalities within Tibet because of imbalances and reallocation of assistance [6, 9]. Therefore, coordinating the development of AT and TD in Tibet was addressed.

After the third WFT (1994), tourism assistance increased [10]. Tourism in Tibet became a dominant sector in the tertiary industry, accounting for 61% of tertiary industry output in 2019 (9% in 1994). A further increase in assistance was proposed in the sixth WFT (2015), which also provided the opportunity for TD. Investigating the coupling relationships between AT and TD could provide further development guidance.

Therefore, the present study focused on the coordination of AT with TD by exploring the types, spatial distributions, and influencing factors of coordinated development of AT and TD, using statistical data from 74 prefectural units in Tibet from 1991 to 2015.

Coupling is a widespread method to evaluate the interrelationships between systems or geographical features and aspects, such as economic development (ED), urbanization (UR), eco-environment (ECE), resource utilization (RU), and land use (LU), in China. In the late 1990s to early 2000s, as eco-environment topics emerged because of the rapid development of the economy and urbanization, scholars began exploring the coupling relationship between ED and ECE, as well as UR and ECE, to enable coordinated and sustainable development [11, 12]. From 2010 to 2020, the eco-environment has received increasing attention by the Chinese government, and research on the coupling coordination of ECE and ED, as well as ECE and UR, is becoming increasingly popular and crucial topics in coupling coordination research [13–16]. The coupling coordination relationship of UR and LU is also an increasingly popular and vital topic. Land-use efficiency and the intensive use of land are especially emphasized [17–19]. Moreover, the coupling relationship between RU and UR, RU and ECE, and LU and ECE are also regarded as critical topics to be discussed [20–22]. Moreover, numerous new studies have investigated the coupling coordination relationships between ED, UR, ECE, RU, and LU and geographical features (such as carbon emission, environment carrying capacity, infrastructural development, tourism development, livelihood level, and rural hollowing, respectively) [23–28].

China's socioeconomic diversification in the 2000s and 2010s led to contradictions to development that are not limited to ED, UR, ECE, RU, and LU, but also extend to the diverse geographical features, which are also extensively investigated [29–32].

For example, scholars have discussed the coordination of the population, economic, social, and spatial urbanization [33, 34], whereas others have discussed the coupling relationships between multidimensional urbanization and the service industry [35, 36]. Urbanization and economic, ecological, and transportation improvement have been demonstrated to have coupling relationships with TD. Urbanization improves several factors that are crucial in tourism, such as infrastructure, products, services, and image [37, 38]; the regional economy increases the disposable income of households and improves the tourism infrastructure by increasing investments [39, 40]; the ecological environment provides tourists with authentic tourism products [41, 42]; transportation improves tourism accessibility [43–45]. These factors promote tourism by accelerating the growth of related industries.

AT has high coupling relationships with ED and UR in Tibet. However, the coordinated development level is still low and spatially varied [5, 46]. The results indicate that AT is vital to Tibet and should be further intensified.

Previous studies are focused on "what is AT?" "why is AT important?" and "how can AT be improved?" For the first question, scholars are concerned about where AT systems originate and how they evolve [47, 48]. Scholars have concluded that AT originates from first-generation Chinese national leaders who strived for the equal development of Tibet by implementing the assistance strategy [49]. The evolution of "strategy to system" focuses on the economy, staff, education, and techniques [50] developed by five generations of national leaders [51]. For the second question, studies have determined that AT promoted the socioeconomic development of Tibet [52] and changed the industry structure [53]. Furthermore, AT strengthened the atypical dual economic structure of Tibet society [54]. For the third question, findings have emphasized that improving Tibet's self-development ability is crucial [55]. Promoting the effectiveness and reallocation of AT is also vital [6, 9]. Furthermore, tourism assistance was analyzed [56, 57]. The TD in Tibet and literature on the exploitation of tourism resources and tourism-related industries were discussed [58, 59].

The aforementioned studies have investigated the development of AT and TD. However, the coordinated development in coupling relationships between AT and TD warrants further investigation.

To bridge the gap in knowledge, we suggested that the coupling relationship and coordinated development of AT and TD should be considered when exploring the development of AT and TD in Tibet.

The present study aims to fulfill the three objectives to reduce the economic gap: first, the temporal changes and spatial distribution characteristics of the coupling and coordination of AT and TD are assessed; second, the coupling coordination patterns of AT and TD and their distribution in space are assessed; third, the influencing factors on the spatial distribution of the coupling and coordination degree are assessed.

The findings will contribute to the theoretical knowledge on the relationships between AT and TD.

2. Study Area

Tibet has 74 prefectural units that are divided into four landform regions by several huge mountains: the Northern Tibetan plateau region (TPR), the Southern Brahmaputra river basin region (BRBR), the eastern alpine valley region (AVR), and the Himalayan mountain region (HMR).

The "Yijiangsihe" region—the Brahmaputra River, the Nianchu River, the Lhasa River, the Yalong River, and the Niyang River—is located in the BRBR, which is the center of population, economy, and culture in Tibet, and has a relatively high socioeconomic development level and numerous scenic spots. The marginal regions—the TPR, AVR, and HMR—have relatively low socioeconomic development levels and fewer scenic spots.

The scenic spots present a "core-periphery" spatial pattern (Figure 1).

3. Materials and Methods

3.1. Evaluation Index System. An AT evaluation index system, with five second-class indicators within the first-class indicators of financial assistance, infrastructure development, and public service development, was adopted based on previous studies [5, 42]. An evaluation index system of TD, with 11 second-class indicators under the first-class indicators of tourism economic environment, tourism social benefits, tourism economic benefits, and tourism development vitality, was adopted (Table 1).

3.2. Data Collection and Preprocessing. The time-series data (from 1991 to 2015) and the cross-sectional data (74 prefectural units) of AT and TD were collected separately from the Tibet County Survey, Tibet Statistical Yearbook, Tibet Yearbook, and the Fifth and Sixth Batch of AT.

To eliminate bias caused by the difference of dimension and magnitude, the min-max normalization was utilized. For positive indices, the calculation is as follows [60]:

$$X_{ij}' = \frac{X_{ij} - \min_{1\le j\le n} X_{ij}}{\max_{1\le j\le n} X_{ij} - \min_{1\le j\le n} X_{ij}}, \quad (1)$$

whereas for negative indices, the calculation is as follows:

$$X_{ij}' = \frac{\max_{1\le j\le n} X_{ij} - X_{ij}}{\max_{1\le j\le n} X_{ij} - \min_{1\le j\le n} X_{ij}}, \quad (2)$$

where X_{ij}' and x_{ij} represent the standardized value and the original value of index j in year and unit i, respectively; $\max_{1\le j\le n} X_{ij}$ and $\min_{1\le j\le n} X_{ij}$ indicate the maximum and minimum value of index j among all years and units, respectively.

If $x_1, x_2, \ldots, x_p$ represent the indices of AT and $y_1, y_2, \ldots, y_q$ represent the indices of TD, then

$$\mathrm{AT}(x) = \sum_{t=1}^{p} w_t x_t', \quad (3)$$

$$\mathrm{TD}(y) = \sum_{e=1}^{q} w_e y_e', \quad (4)$$

where AT (x) and TD (y) are the integration values of AT and TD, respectively; $\eta = \mathrm{AT}\ (x)/\mathrm{TD}\ (y)$ is the relative development degree of AT and TD [61], and AT $(x) <$ TD (y) $(0 < \eta < 0.80)$ indicates that the integration value of AT is smaller than that of TD (i.e., AT-lagged type); AT $(x) =$ TD (y) $(0.80 < \eta < 1.20)$ indicates that the integration value of AT is equal to that of TD (i.e., AT and TD synchronized type); AT $(x) <$ TD (y) $(\eta > 1.20)$ indicates that integration value of AT is larger than that of TD (i.e., TD-lagged type); x_t' and y_e' are the standardized value of x_t and y_e, respectively, which can be calculated using X_{ij}' in formulas (1) and (2); w_t and w_e are the weight of x_t and y_e, respectively, which can be calculated using information entropy weight (IEW).

IEW has been employed in studies evaluating the status uncertainty of the system [14]. The index weight can be determined by analyzing the correlation and information among the indices, which avoids bias caused by subjective preferences and guarantees objectivity. Steps are as follows [41]:

(1) Calculating the proportion of the index j in year/unit i (R_{ij})

$$R_{ij} = \frac{X_{ij}'}{\sum_{i=1}^{m} X_{ij}'}. \quad (5)$$

(2) Calculating the information entropy of the index j (e_j)

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} R_{ij} \times \ln R_{ij}. \quad (6)$$

(3) Calculating the weight of the index j (w_j)

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{n} \left(1 - e_j\right)}, \quad (7)$$

where n is the number of indexes and m is the number of years or units.

3.3. Calculating the T, C, and D of AT and TD

3.3.1. Calculating the Comprehensive Development Degree of AT and TD. To evaluate the comprehensive development degree (T) of AT and TD, the formula is as follows [41]:

$$T = \alpha \times \mathrm{AT}(x) + \beta \times \mathrm{TD}(y), \quad (8)$$

where T reflects the comprehensive development degree of AT and TD; α and β represent the contribution of AT and TD, respectively. AT is vital for the development of Tibet, and thus the values of α and β are 2/3 and 1/3, respectively [5]. The evaluation grade of T is set up into four grades [62] (Table 2).

3.3.2. Calculating the Coupling Coordination Degree. Coupling refers to the motion of the system, whereby the subsystems interact with each other. Coordination refers to

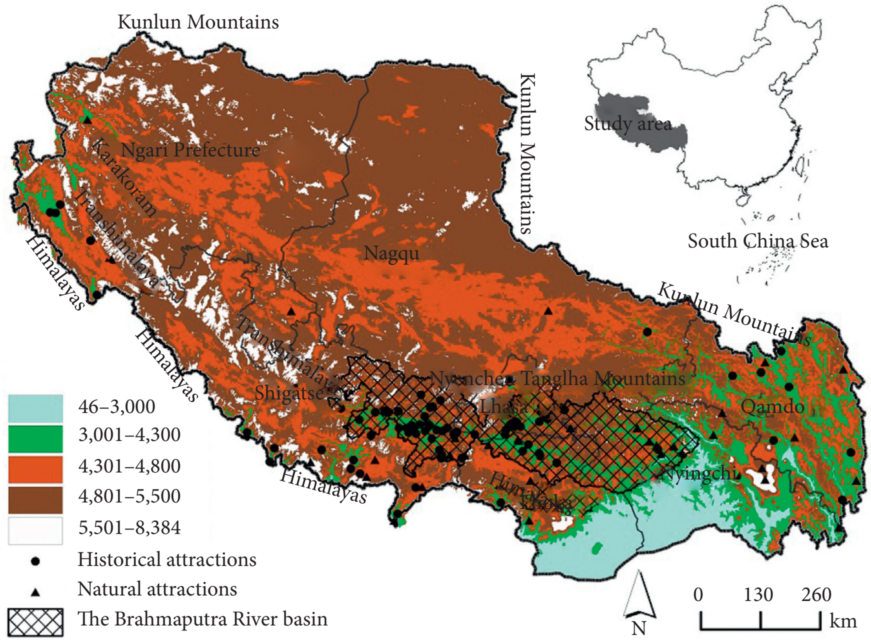

FIGURE 1: Study area.

TABLE 1: Evaluation index system of AT and TD.

Variables	First-class indicator	Second-class indicator and direction	Notation	Unit
Assistance to Tibet AT (x)	Financial assistance (FS)	Fiscal transfer payment (+) ($x1$)	FTP	10,000 million ¥
	Infrastructure development (ID)	Ratio of infrastructure investment to fixed asset investment (+) ($x2$)	RIIFAI	%
		Density of road network (+) ($x3$)	DRN	km/km^2
	Public service development (PSD)	Number of primary and secondary schools per 1,000 people (+) ($x4$)	NPSSP	Number
		Number of medical beds per 1,000 people (+) ($x5$)	NMBP	Number
Tourism development TD (y)	Tourism economic environment (TEE)	Per capita GDP (+) ($y1$)	PGDP	yuan
		Growth rate of tertiary industry output value (+) ($y2$)	GRTIOV	%
		Ratio of tertiary industry output value to GDP (+) ($y3$)	RTIOVGDP	%
	Tourism social benefit (TSB)	Tourism consumption per capita (+) ($y4$)	TCC	yuan
		Ratio of tourists to tertiary industry employees (+) ($y5$)	RTTIE	%
		Number of staffs in danwei (+) ($y6$)	NSWD	10,000 people
	Tourism economic benefit (TEB)	Contribution of tourism revenue to GDP (+) ($y7$)	CTRGDP	%
		Ratio of tourism revenue to tertiary industry (+) ($y8$)	RTRTI	%
		Retail sales of hoteling and catering trade (+) ($y9$)	RSHCT	100 million ¥
	Tourism development vitality (TDV)	Growth rate of tourists (+) ($y10$)	GRT	%
		Growth rate of tourism revenue (+) ($y11$)	GRTR	%

TABLE 2: Evaluation grade of T of AT and TD.

Value	$T < 0.25$	$0.25 < T < 0.50$	$0.50 < T < 0.75$	$T \geq 0.75$
Grade	Poor	Fair	Good	Excellent

the relationship of subsystems that work together harmoniously [63].

(1) Calculating the coupling degree (C) of AT and TD. A gray correlation method was employed [5]:

$$C = \frac{1}{m \times l} \sum_{i=1}^{m} \sum_{j=1}^{l} \xi_{ij}, \tag{9}$$

where $\xi_{ij} = \min_i \min_j |X'_i - Y'_j| + \rho \max_i \max_j |X'_i - Y'_j| / |X'_i - Y'_j| + \rho \max_i \max_j |X'_i - Y'_j|$, which represents the gray relational coefficient; $m = 5$ and $l = 11$ are the numbers of variables of AT and TD, respectively. C is the coupling degree ($0 \leq C \leq 1$), which was divided into four levels [64] (Table 3). When $C = 0$, AT and TD are irrelevant. When $0 \leq C \leq 0.3$, there is a low-coupling phase with low-level TD demand and high-level AT supply. When $0.3 \leq C \leq 0.5$, AT and TD are in the antagonistic stage, and the increase in TD demand causes disorder in the AT with a decline in AT supply. When $0.5 \leq C \leq 0.8$, AT and TD are in a running-in phase, in which the TD enhances AT, and AT, in turn, upgrades tourism facilities to further promote development. When $0.8 \leq C < 1$, there is a high-level coupling phase in which AT and TD achieve harmony benefit. If $C = 1$, a benign resonance coupling phase is achieved, and AT and TD progress toward a new ordered structure with optimal TD and balanced AT supply and demand.

(2) Calculating the coupling coordination degree (D) of AT and TD.

The coupling degree does not fully reflect the comprehensive development level of AT and TD. Therefore, the coupling coordination degree (D) was employed [64]. The formula is as follows:

$$D = \sqrt{C \times T}. \tag{10}$$

Studies have indicated that D is divided into 3 classes, 6 subclasses, and 18 types [17, 41] (Table 4).

3.3.3. Calculating the Influencing Factors of C and D. For cross-sectional data of 74 prefectural units of Tibet in 2015, a multiple linear regression model was used to identify the influencing factors of spatial differences of C and D [65, 66]:

$$y = c + \alpha_1 \times \mathrm{AT}_1 +, \cdots, \alpha_5 \times \mathrm{AT}_5 + \beta_1 \times \mathrm{TD}_1, \cdots, + \beta_{11} \times \mathrm{TD}_{11} + \varepsilon, \tag{11}$$

where y is C or D; α and β are the coefficients; $\mathrm{AT}_1 \ldots \mathrm{AT}_5$ are variables of AT (x); $\mathrm{TD}_1 \ldots \mathrm{TD}_5$ are variables of TD (y); and ε is the residual.

4. Results and Discussion

4.1. The Comprehensive Development Degree (T) of AT and TD. In the time series, T increased to the "excellent" grade (0.802 in 2015) from the "poor" grade (0.168 in 1991). AT (x) and TD (y) achieved the "good" (0.711 in 2015) and "excellent" grades (0.847 in 2015), respectively (Figure 2). T, AT (x), and TD (y) declined in 1996 and then increased in 1997.

Before 1996, AT (x) was larger than TD (y); however, TD (y) surpassed AT (x) after 1996. Correspondingly, the relative development degree was $\eta > 1.20$ from 1991 to 1996, $0.80\eta < 1.20$ from 1997 to 2008, and $0\eta < 0.80$ from 2009 to 2015. These results indicated that AT and TD changed from TD-lagged to AT-lagged and then to AT and TD synchronized (Figure 2).

The spatial distribution minimum, maximum, mean, median, and standard deviation of AT (x) in 2015 were 0.055, 0.600, 0.269, 0.268, and 0.096, respectively. The areas with larger AT (x) than the mean were distributed in marginal Tibet, whereas areas with smaller AT (x) than the mean were mainly concentrated in central Tibet (Figure 3(a)).

The minimum, maximum, mean, median, and standard deviation of TD (y) in 2015 were 0.126, 0.521, 0.231, 0.203, and 0.083, respectively. The areas with higher TD (y) than the mean were distributed in marginal Tibet, whereas the areas with smaller TD (y) than the mean were distributed in central Tibet (Figure 3(b)).

AT (x) and TD (y) displayed a "core-periphery" spatial pattern, and both are lower in the center.

Because both AT (x) and TD (y) are relatively low in central regions and high in marginal regions, T is also low in central and high in marginal Tibet (Figure 3(c)). Compared with TD (y), AT (x) is smaller in central regions and larger in marginal ones. Therefore, η is low in central Tibet and high in marginal Tibet (Figure 3(d)).

4.2. Results of Coupling Coordination Degree of AT and TD. In terms of time series, from 1991 to 2015, C was always in the "running-in phase," whereas D increased to the "favorably balanced development" (FBD, 0.754 in 2015) from the "moderately unbalanced development" (MUD, 0.343 in 1991) (Figure 4). These results indicated that the coupling interactions of AT and TD were strong, and the coordinated development of AT and TD improved substantially.

The spatial pattern minimum, maximum, mean, median, and standard deviation values of C in 2015 were 0.590, 0.773, 0.661, 0.653, and 0.035, respectively. The coupling level was generally high (running-in phase) across the 74 units. The areas with larger values of C than the mean were distributed in central Tibet, whereas areas with smaller values of C than the mean were distributed in marginal Tibet (Figure 5(a)).

The minimum, maximum, mean, median, and standard deviation values of D in 2015 were 0.285, 0.548, 0.397, 0.383, and 0.054, respectively. The coordination level was relatively low (MUD) across the 74 units. Areas with larger values of D than the mean were concentrated in marginal Tibet, whereas areas with smaller values of D than the mean were distributed in central Tibet (Figure 5(b)).

The coupling coordination level was classified into the MUD, SUD, and BBD (Figure 5(c)). The MUD (0.285–0.400) had 45 units, which were mainly concentrated in the Qamdo, "Yijiangsihe" region, and Ngari Prefecture. The SUD (0.401–0.500) had 25 units, which were mainly concentrated in Nyingchi-Lhoka region, Nagqu-Shigatse region, and western Ngari Prefecture. The BBD (0.501–0.548) had four units, which are the capitals of Lhasa Prefecture, Nyingchi Prefecture, and Ngari Prefecture.

Both C and D display a "core-periphery" spatial pattern. However, C was higher in the center and D was higher in the periphery.

Central Tibet displayed relatively bigger external effects from the assistance which caused small differentiations in

Table 3: Evaluation grade of the C of AT and TD.

Value	$0 < C \leq 0.30$	$0.30 < C \leq 0.50$	$0.50 < C \leq 0.80$	$0.80 < C < 1.00$
Coupling level	Low-coupling phase	Antagonistic stage	Running-in phase	High-level coupling phase

Table 4: Coordinated development types of AT and TD.

Classes		Subclasses	Types		Characteristic
Unbalanced development	$0.0 < D \leq 0.2$	Seriously unbalanced development (SeUD)	AT (x) < TD (y)	I-A	Seriously unbalanced development with AT-hindered
			AT (x) = TD (y)	I-B	Seriously unbalanced development with AT and TD synchronized
			AT (x) > TD (y)	I-C	Seriously unbalanced development with TD-hindered
	$0.2 < D \leq 0.4$	Moderately unbalanced development (MUD)	AT (x) < TD (y)	II-A	Moderately unbalanced development with AT-hindered
			AT (x) = TD (y)	II-B	Moderately unbalanced development with AT and TD synchronized
			AT (x) > TD (y)	II-C	Moderately unbalanced development with TD-hindered
Transitional development	$0.4 < D \leq 0.5$	Slightly unbalanced development (SUD)	AT (x) < TD (y)	III A	Slightly unbalanced development with AT-hindered
			AT (x) = TD (y)	III-B	Slightly unbalanced development with AT and TD synchronized
			AT (x) > TD (y)	III-C	Slightly unbalanced development with TD-hindered
	$0.5 < D \leq 0.6$	Barely balanced development (BBD)	AT (x) < TD (y)	IV-A	Barely balanced development with AT-lagged
			AT (x) = TD (y)	IV-B	Barely balanced development with AT and TD synchronized
			AT (x) > TD (y)	IV-C	Barely balanced development with TD-lagged
Balanced development	$0.6 < D \leq 0.8$	Favorably balanced development (FBD)	AT (x) < TD (y)	V-A	Favorably balanced development with AT-lagged
			AT (x) = TD (y)	V-B	Favorably balanced development with AT and TD synchronized
			AT (x) > TD (y)	V-C	Favorably balanced development with TD-lagged
	$0.8 < D \leq 1$	Superiorly balanced development (SBD)	AT (x) < TD (y)	VI-A	Superiorly balanced development with AT-lagged
			AT (x) = TD (y)	VI-B	Superiorly balanced development with AT and TD synchronized
			AT (x) > TD (y)	VI-C	Superiorly balanced development with TD-lagged

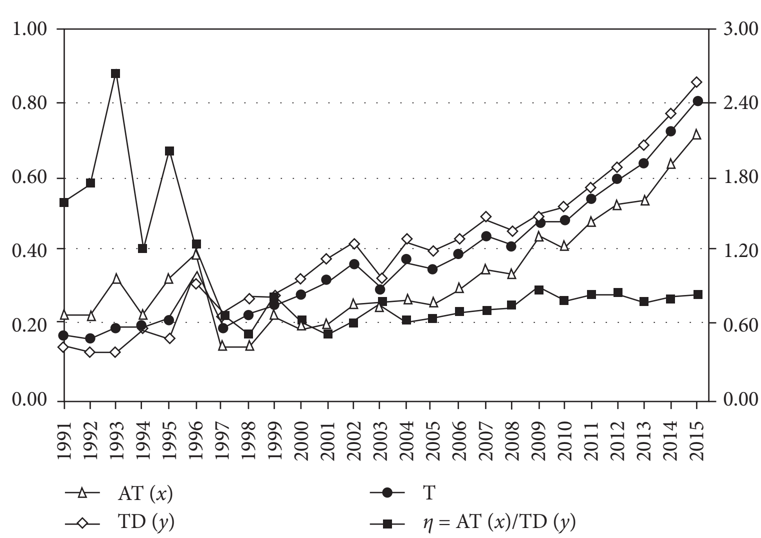

Figure 2: Changes of AT (x), TD (y), T, and η from 1991 to 2015.

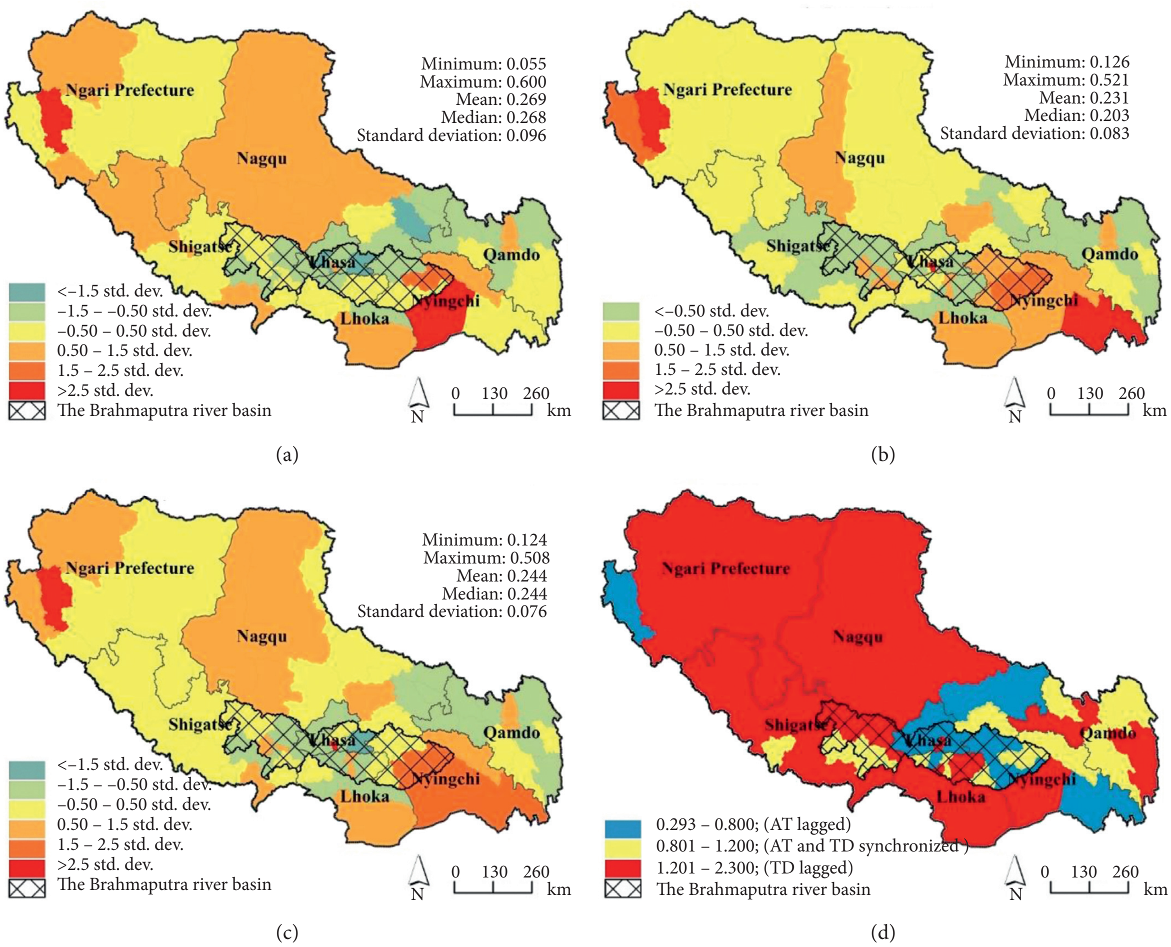

Figure 3: The spatial pattern of AT (x), TD (y), T, and η in 2015. (a) Integration value of AT (b) Integration value of TD (c) Comprehensive development of degree (T) of AT and TD (d) Relative development degree (η) of AT and TD.

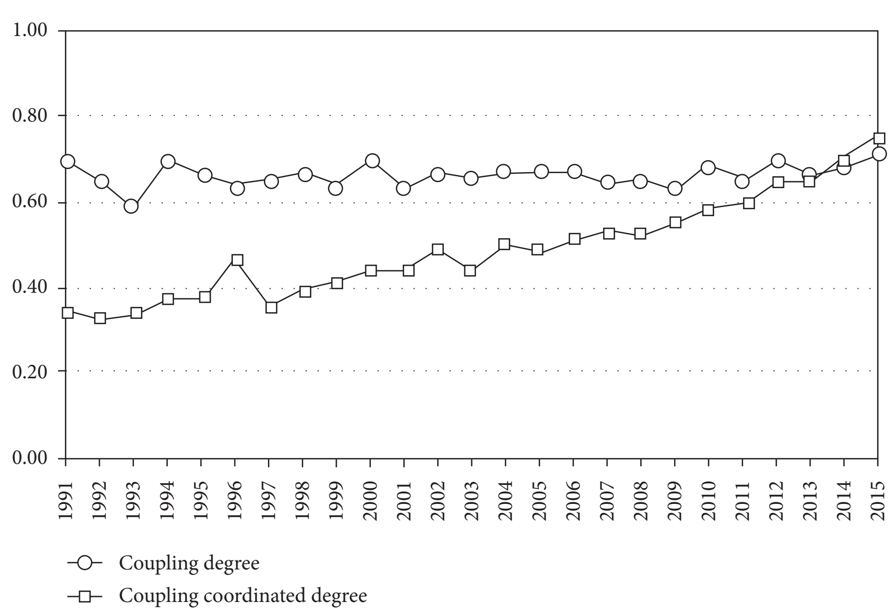

Figure 4: Time-series changes of coupling degree and coupling coordination degree of AT and TD (1991–2015).

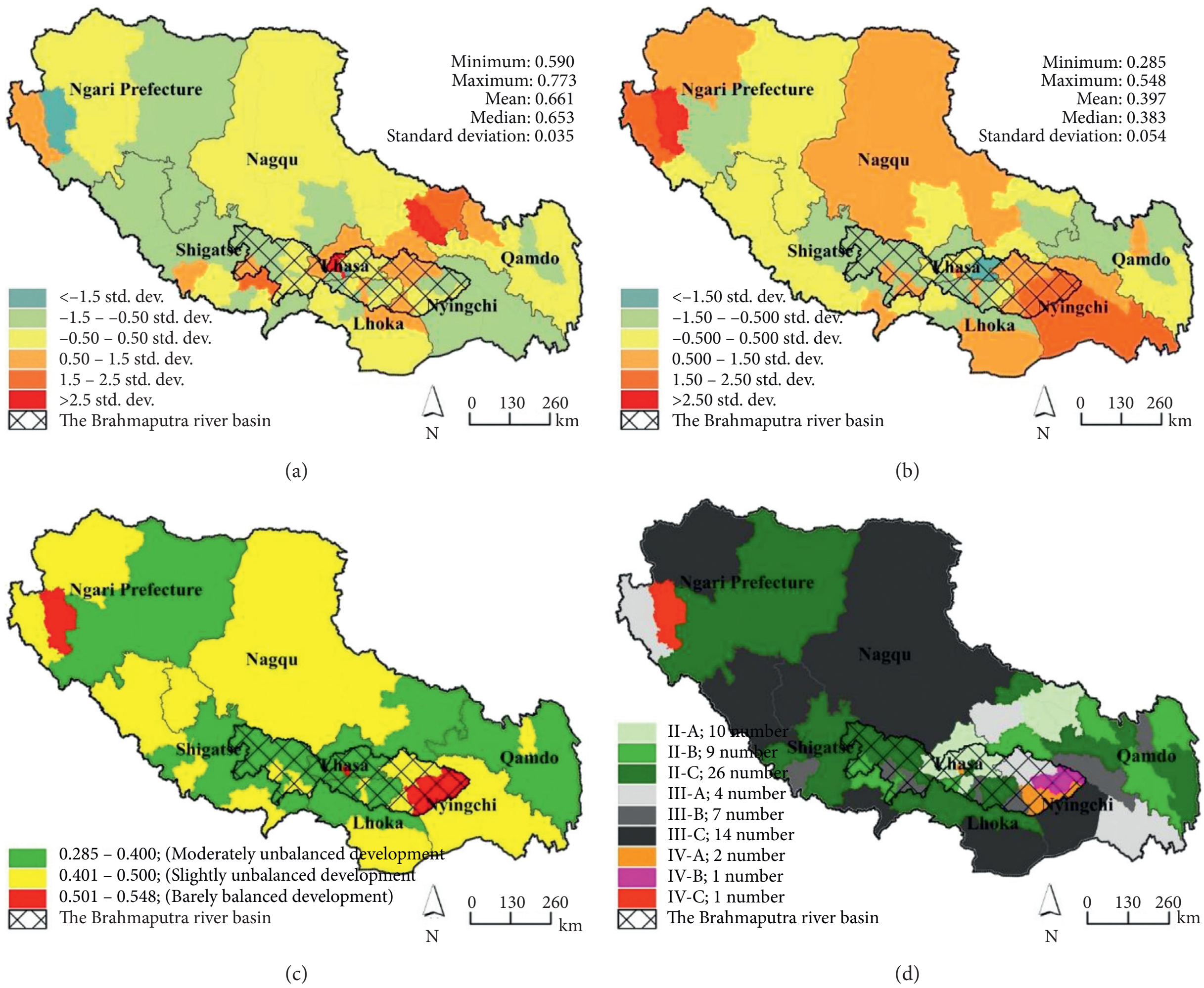

FIGURE 5: Spatial distribution of C and D, coupling coordination level, and coordinated development types of AT and TD in 2015. (a) Coupling degree (C). (b) Coupling coordination degree (D). (c) Coupling coordination level. (d) Coupling development types.

socioeconomic development, which led to a higher coupling relationship between AT and TD. However, central Tibet is low-lying ground of assistance, and the AT (x), TD (y), and D were relatively low.

Marginal Tibet obtained small external effects from assistance, which led to a lower coupling relationship between AT and TD. However, marginal Tibet was in the highlands of assistance, and the AT (x), TD (y), and D were relatively high.

Therefore, differentiated strategies should be adopted to improve the coordinated development level of AT and TD.

4.3. Types of Coordinated Development of AT and TD. As illustrated in Table 4, coordinated development types were identified (Figure 5(d)).

Type II-A (10 units) is the MUD with AT-hindered type, which is characterized by a relatively small T ($\overline{T}_{\text{II-A}} = 0.178$) and an AT ($x$) that is smaller than TD (y). This type is mainly concentrated in Lhasa and eastern Nagqu (i.e., Biru-Suoxian-Baqing region). Type II-B (9 units) is the MUD with AT and TD synchronized type, which is characterized by a relatively small T ($\overline{T}_{\text{II-B}} = 0.191$) and an AT ($x$) that is approximately equal to TD (y). This type is scattered in Qamdo, Nagqu, Lhoka, and Shigatse. Type II-C (26 units) is the MUD with TD-hindered type, which is characterized by a relatively small T ($\overline{T}_{\text{II-C}} = 0.204$) and an AT ($x$) that is larger than TD (y). This type is concentrated in the western Ngari Prefecture (i.e., Gaize-Geji-Pulan region) and the Shigatse-Lhoka region and scattered in Qamdo.

Type III-A (4 units) is the SUD with AT-hindered type, which is characterized by a median T ($\overline{T}_{\text{III-A}} = 0.333$) and an AT ($x$) that is larger than TD (y). This type is scattered in the units of Nyingchi, Nagqu, and Ngari Prefecture. Type III-B (7 units) is the SUD with AT and TD synchronized type, which is characterized by a median T ($\overline{T}_{\text{III-B}} = 0.297$) and an AT ($x$) that is approximately equal to TD (y). This type is scattered in Qamdo, Nagqu, Lhoka, and Shigatse. Type III-C (14 units) is the SUD with TD-hindered type, which is characterized by median T ($\overline{T}_{\text{III-C}} = 0.288$) and an AT ($x$) that is larger than TD (y). This type is mainly located in the western Ngari Prefecture, Nagqu-Shigatse region, southern Shigatse, and Nyingchi-Lhoka region.

Type -A (2 units) is the BBD with AT-lagged type, which is characterized by a relatively high T ($\overline{T}_{\text{IV-A}} = 0.430$) and an AT ($x$) that is larger than TD (y). This type is located in Milin

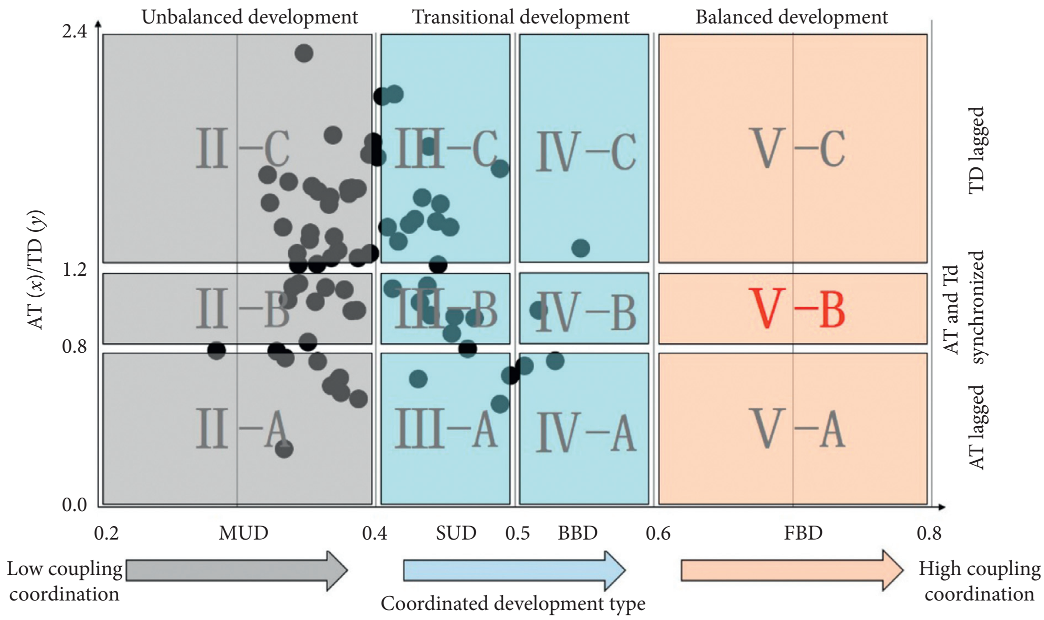

FIGURE 6: Evolution of the coordinated development types of ATTD. Note: $\overline{T}_{\text{II-A}} = 0.178$, $\overline{T}_{\text{II-B}} = 0.191$, $\overline{T}_{\text{II-C}} = 0.204$; $\overline{T}_{\text{III-A}} = 0.333$, $\overline{T}_{\text{III-B}} = 0.297$, $\overline{T}_{\text{III-C}} = 0.288$; $\overline{T}_{\text{IV-A}} = 0.430$, $\overline{T}_{\text{IV-B}} = 0.430$, and $\overline{T}_{\text{IV-C}} = 0.508$.

TABLE 5: Results of OLS method of the MLR model.

Variables	*C* Coefficient	*C* Std. error	*C* *T* statistic	*D* Coefficient	*D* Std. error	*D* *T* statistic
Constant	0.679	0.019	34.878***	0.199	0.006	33.487***
X1_FTP	−0.039	0.036	−1.093	0.004	0.011	0.401
X2_RIIFAI	−0.079	0.017	−4.578***	0.026	0.005	4.910***
X3_DRN	−0.032	0.026	−1.247	0.027	0.008	3.396***
X4_NPSSP	−0.078	0.017	−4.498***	0.068	0.005	12.750***
X5_NMBP	−0.041	0.038	−1.092	0.041	0.012	3.575***
Y1_PGDP	−0.014	0.035	−0.405	0.051	0.011	4.683***
Y2_GRTIOV	−0.011	0.029	−0.370	0.034	0.009	3.808***
Y3_RTIOVGDP	0.047	0.016	2.922***	0.109	0.005	22.240***
Y4_TCC	0.010	0.023	0.459	0.083	0.007	11.890***
Y5_RTTIE	0.008	0.016	0.523	0.027	0.005	5.359***
Y6_NSWD	0.039	0.076	0.510	0.011	0.023	0.483
Y7_CTRGDP	0.131	0.033	4.006***	0.122	0.010	12.231***
Y8_RTRTI	−0.037	0.040	−0.933	−0.007	0.012	−0.601
Y9_RSHCT	−0.102	0.076	−1.331	0.033	0.023	1.409
Y10_GRT	−0.042	0.063	−0.668	0.025	0.019	1.314
Y11_GRTR	−0.033	0.086	−0.384	0.031	0.026	1.192
R2	0.676			0.987		
Adj. R2	0.585			0.984		
S.E. of regression	0.023			0.007		
F statistic	7.434			277.035		
Obs ∗ R2	0.849			0.614		

Note: "***" represents significant at 1% level.

County and in Chengguan District, the capital of Lhasa. Type IV-B (1 unit) is the BBD with AT and TD synchronized type, which is characterized by a relatively high T ($\overline{T}_{\text{IV-B}} = 0.430$) and an AT ($x$) that is approximately equal to TD (y). This type is concentrated in Bayi District, the capital of Nyingchi. Type IV-C (1 unit) is the BBD with TD-lagged type, which is characterized by a relatively high T ($\overline{T}_{\text{IV-C}} = 0.508$) and an AT ($x$) that is smaller than TD (y). This type is located in Gaer County, the capital of Ngari Prefecture.

Increasing AT (x) and TD (y) and balancing them to higher coordination levels is generally a challenge (V–B) (Figure 6).

4.4. Influencing Factors of the Spatial Differentiation of C and D. By employing the multicollinearity test and heteroscedasticity test, we estimate the MLR model. The results are presented in Table 5.

For the spatial differentiation of C, the OLS method indicated that the RIIFAI and NPSSP (AT factors) had

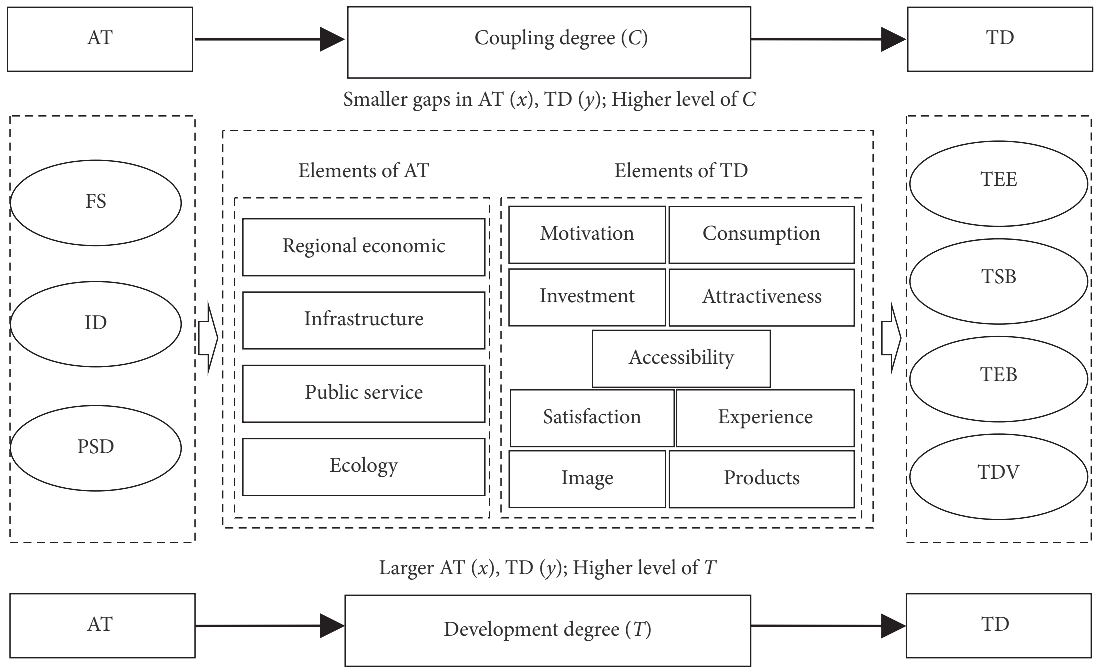

Figure 7: Dynamics of the coordinated development of AT and TD.

significant positive effects at a 1% significant level, whereas RTIOVGDP and CTRGDP (TD factors) had significant negative effects.

For the spatial differentiation of D, the OLS method indicated that both AT and TD displayed significant effects. The RIIFAI, DRN, NPSSP, and NMBP AT factors had significant positive effects at a significance level of 1%, whereas the effects of FTP were not significant at the 1% level; the PGDP, GRTIOV, RTIOVGDP, TCC, RTTIE, and CTRGDP TD factors had significant positive effects at a 1% significance level, whereas the effects of NSWD, RTRTI, RSHCT, GRT, and GRTR are not significant at 1% level.

These results indicate that AT factors of ID and PD have significant effects on the spatial differentiation of D, whereas the effects of FA were not significant. The TD factors of TEE, TSB, and TEB had significant effects on the spatial differentiation of D, whereas the effects of TDV were not significant.

The results indicated that the improvement of socioeconomic conditions and tourism facilities promoted tourism in Tibet. These improvements were rooted in the financial assistance, infrastructure construction, and public service investments.

The assistance established a basic framework for socioeconomic development in Tibet, which provided the socioeconomic conditions for tourism, such as economic, infrastructural, service, and environmental improvements.

However, the socioeconomic conditions forced Tibet tourism to promote its image, products, attractiveness, and accessibility to enhance tourism, which aggrandized the tourism scale, quality, and benefits, both directly and indirectly. For instance, tourist, employee, tourism revenue, and tourism-related industries developed.

Assistance increased and tourism improved, which promoted AT (x) and TD (y). If AT (x) and TD (y) improve, then T flourishes; otherwise, it declines. If differences between AT (x) and TD (y) decrease, then C increases; otherwise, it decreases. The coordinated development of AT and TD was the unification of C and T (Figure 7).

5. Conclusions

The analysis of spatiotemporal dynamics and influencing factors of coordinated development of AT and TD led to the following conclusions:

(1) AT had strong, continuous coupling interactions with TD. The coordination degree increased (BBD) under this interaction. However, the level remained relatively low (MUD) across Tibet.

(2) The lower-level coordinated development types were predominant in central Tibet, whereas the higher-level ones were predominant in marginal Tibet. The spatial pattern highly coincides with the patterns of AT (x) and TD (y) (i.e., low in center and high in the periphery).

(3) AT and TD factors had significant positive effects on the spatial pattern of the degree of coupling coordination, but not on the spatial pattern of the coupling degree, especially the ID, PSD, TEE, TSB, and TEB.

To improve the coordinated development level in central and marginal Tibet, the following suggestions are provided.

(1) Further intensifying the AT. The analysis indicated that AT has high coupling interactions with TD, but the

degree of coordination remains low for most units in Tibet. Therefore, assistance should be further increased to improve tourism in Tibet. (2) Adopting policies that suit local idiosyncrasies. The analysis demonstrated that the coupling coordination degree was low in the center and high in the periphery. Therefore, the focus for central and marginal Tibet should be improving the comprehensive development level (T) and coupling degree (C), respectively. (3) Ensuring the accuracy of the AT. The analysis indicated that ID and PSD could effectively promote the coordination of AT and TD. Furthermore, AT (x) and TD (y) are low in center and high in the periphery.

The limitation of this study was the difficulty of obtaining the most recent data from 74 prefectural units of the Tibet Autonomous Region, which may have caused an underestimation of the coordinated development level of AT and TD in the current period. However, our empirical results are beneficial for understanding the coordinated development of AT and TD and can thus help improve AT (x), TD (y), and narrow regional differences.

Data Availability

The data used in this study are available from the first author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

Acknowledgments

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