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Coupling Analysis of the Road-Network Spatiotemporal Distribution and the Economy in B&R Countries Based on GIS

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Abstract: The Belt and Road (B&R) is a new strategy and measure for China to extend its opening up. To explore the influence of the spatiotemporal distribution of the national road network along the B&R on economic growth, this paper adopts the subjective and objective integrated weighting method to build a regional economic evaluation model, a transportation network evaluation model, and an economy–transportation coupling coordination degree model (E-T model). We also quantitatively analyze and evaluate the coordinated development of the economy and transportation in the countries along the B&R. Our results show that: (1) There are some differences in the comprehensive scores of economic level and transportation network in different countries, and the B&R has promoted the general economic and transportation level of various countries. (2) Approximately 84% of the countries have not reached a good coordination level, and the regional differences are significant, which indicates that the overall economic and transportation coupling coordination needs to be improved. (3) In recent years, driven by the B&R, the coupling coordination of approximately 30% of the countries has improved significantly. Therefore, the B&R not only has a positive impact on the economy and transportation of countries along the belt but also plays an important role in coordinating the economic and transportation development of countries, which is of great strategic significance.

Keywords: coupling coordination degree; transportation network; national economic changes; the Belt and Road

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1. Introduction

Since 2013, China's B&R policy has brought countries in Asia, Europe, and Africa much closer, forming a community of shared futures [1]. In recent years, it has also become a new engine for economic development. However, due to reasons such as insufficient infrastructure investment and limitations in the national comprehensive power of developing countries, the economic development of some countries has been stagnant for a long time. Therefore, accelerating the building of facility connectivity is the key field and core content of the joint construction of the B&R [2]. In this context, research on the coupling and development trend between the spatial pattern of national road networks and economic development along the B&R in recent years has become the research focus of scholars across the globe.

The economy is the lifeblood of a country. In recent years, Chinese and foreign scholars have conducted research on the economy along the B&R. Zoujialing et al. analyzed the trade interdependence of countries along the B&R and concluded that the B&R has a certain positive promoting effect on the GDP growth of regions along the belt [3]. Imomnazar et al. studied the impact of the B&R on the economies of Central-Asian countries and explained that interregional trade is an important guarantee for economic development [4]. Foo et al. discussed the potential impact of the B&R policy on trade flows between ASEAN countries and China, and they believed that the B&R is an effective way for these countries to realize trade facilitation [5]. Ji et al. analyzed the impact of B&R direct investment on trade and

multilateral economic development along the route and verified its potential for regional economic development [6]. A literature review regarding economic development shows that the research perspective of the B&R and economic and trade development along the B&R is primarily from single perspectives, and there exists a general lack of correlation analysis on the transportation network, which has certain limitations.

Transportation is the bridge of the implementation of the B&R initiative. In recent years, scholars in China and abroad have conducted many studies on the development characteristics of transportation infrastructure and the impact evaluation of transportation networks. Zhang et al. analyzed the spillover effect of transportation infrastructure and relevant differences across industries and put forward unique suggestions on road construction to address the contradiction between capital and infrastructure [7]. Van Eldijk et al. developed a conceptual model of the barrier effect of transport infrastructure and its determinants and analyzed the contribution of infrastructure investment to regional accessibility [8]. Lu et al. believe that traffic impact assessment is necessary for urban development. Traffic flow is an important factor for traffic impact assessment. Many methods, such as the circle of influence method, analogy method, and OD method, can be used to calculate traffic volume [9]. Ba et al. proposed a comprehensive evaluation model of sequential preference technology based on grey relationship analysis (GRA) and similarity and ideal solution (TOPSIS) and studied the quality of traffic data in intelligent transportation systems [10]. Yang conducted research on the construction of trade and transportation hubs under the framework of the B&R and called for accelerating the construction of transportation infrastructure relying on the B&R [11]. A literature review of economic development shows that there is little research on the comprehensive influence of the transportation network, especially on the quantitative analysis and evaluation of the transportation network of the B&R.

In summary, most of the existing studies adopt a single perspective, which ignores the coupling and coordination among multiple impact factors and lacks comprehensive analysis of multi-perspective correlation within the context of the B&R. This paper analyzes the correlation between the economy and transportation infrastructure along the B&R. First, a regional economic evaluation model is constructed using the linear weighting method to classify and discuss the economic changes in various countries. Then, considering the main influencing indicators in the transportation network, the comprehensive evaluation model of the transportation network is established by using the entropy weight method and analytic hierarchy process, and the comprehensive level of the transportation network in various countries is evaluated combined with the GIS spatial analysis method. Finally, the economic and transportation models are integrated to establish an economy transportation coupling coordination degree model and study the coupling coordination degree of the distribution of transportation networks and economic development changes in countries along the B&R, to provide a new comprehensive perspective of GIS analysis and evaluation for the development demonstration of the B&R.

2. Materials and Methods

2.1. Study Area and Data Sources

The B&R goes through Asia, Europe, and Africa. It consists of 65 countries and regions including East Asia, South Asia, Southeast Asia, Central Asia, Europe, and North Africa. Linking the East Asia Pacific Economic Circle and the developed European economic circle, it is considered to be "the longest economic corridor with the most potential in the world". After the opening of the B&R Economic Zone, the number of contracted projects exceeded 3000.

The New Eurasian Continental Bridge, also named the "Second Eurasian Continental Bridge", has superior geographical and climatic conditions. As a very important linkage of the B&R economic corridor, the new Eurasian Continental Bridge has fully played its "growth pole" advantage and driven the development of economic and transportation infrastructure in the surrounding regions [12,13]. Therefore, this paper will take the new

Eurasian Continental Bridge as the main research object to analyze the development and changes in the new Eurasian Continental Bridge Economic Corridor in the B&R regarding the economy and transportation of surrounding countries and their coupling coordination degree.

The sources of traffic data and economic data obtained in this paper are shown in Table 1:

Table 1. Data and database websites.

Data	Data Source
National traffic network data	https://www.naturalearthdata.com/downloads/10m-cultural-vectors/railroads/ (accessed on 1 January 2022)
The national administrative boundary in vector data	https://gadm.org/download_world.html (accessed on 1 January 2022)
GDP data by countries	http://data.un.org (accessed on 1 January 2022)

These data include the railways and roads of countries along the route, as well as attribute data such as GDP. Only after these data are standardized and dimensionless can they participate in the calculation of the comprehensive evaluation model.

2.2. Research Methods

In this paper, the overall GDP and per-capita GDP are standardized, and then the information weight method is used to establish the regional economic evaluation model to evaluate the economic level of the regions along the line. Then, road and railway are visualized in different regions. By combining with the entropy method and subjective weighting method, the evaluation model of transportation networks, including road, node, connectivity, and other indicators, is established to evaluate the development degree of each regional traffic network more comprehensively. Finally, according to the coupling degree theory in physics, a model of economics–traffic coupling coordination degree is established to calculate the coupling coordination degree of the region along the road in recent years. The coupling coordination degree is divided into 10 levels with equal intervals, then they are compared in time and space.

2.2.1. Regional Economic Evaluation Model

GDP is the final result of the production activities of all resident units in a country (or region) in a certain period. It is also an important indicator to measure the economic situation and development level of a country or region [14]. However, the measurement of a single data indicator is likely to be one-sided, because overall GDP only takes into account the macroeconomic level of a certain region, while ignoring the contribution of the population of the region to GDP. Therefore, this paper believes that per-capita GDP should also be used as one of the indicators of the economic model.

Based on the GDP growth trends of 23 countries on the New Eurasian Continental Bridge from 2014 to 2020, this paper analyzes the impact of the B&R and other external factors on the economic situation of each country. To prevent the one-sided perspective of evaluating the national economic level with a single index [15], a regional economic evaluation model is established, using the linear weighted synthesis method in existing research for reference. The calculation formula is as follows:

$$EL = c_1 GDP_i + c_2 PC_i, \quad (1)$$

where GDP_i represents the GDP of each country, PC_i represents the per-capita GDP of each country, and c_1 represents the weight of the total GDP of each country and the weight of per-capita GDP.

2.2.2. Transportation Network Evaluation Model

The transportation network is one of the most basic projects in the infrastructure construction of the B&R, and it can measure the development status of different regions.

In the transportation network, important factors that need to be considered include roads, nodes, and network connectivity [16]. Therefore, based on these three aspects, this paper establishes a transportation network evaluation system, as shown in Table 2.

Table 2. Transportation network evaluation system.

1st Index	2nd Index	Calculation Formula	Explanation
Road condition R	Road network density D	$D_i = \frac{L_i}{S_i}$	Represents the total length of roads in an area
	Road flow Q	$Q_i = \frac{count_i}{T}$	Indicates the total number of vehicles passing over time
	Road blocking degree b_i	$b_i = \sum_{j=1}^{n} \lvert \bar{t} - t_j \rvert \cdot l_j$	Represents the j-th road in an area, and represents the traffic time per unit length
Node status N	Node density d_i	$d_i = n_i$	Represents the number of road network nodes in the area
	Node accessibility A_i	$A_i = Q_{i1} - Q_{i2}$	Indicates the flow into the node and out of the node
Connectivity $Conn_i$		$Conn_i = \frac{line_i}{n_i}$	Indicates the number of connections of all nodes in a region

For the evaluation system of the transportation network, this paper has the following description:

(1) For the road condition, this paper establishes three indices: road network density, road flow, and road congestion. The road network density and road flow describe the road traffic conditions from the perspectives of the possible and actual traffic capacity of the road, respectively. The road blocking degree can indirectly reflect the road capacity. These three indicators describe the road conditions in different aspects, so they can be included in the evaluation system.

(2) For the node condition, this paper establishes two indicators: node density and node accessibility. The node density is similar to the road network density, which can reflect the average node circulation capacity in a certain area. Node accessibility is expressed by the difference between the inflow and outflow of the node. If the difference is small, it suggests that the blocking degree of the node is high. These two indicators describe the node status from the perspectives of the whole and the part and are suitable for use as evaluation indicators.

(3) For road network connectivity, the ratio of the number of roads to the number of nodes is expressed. If nodes can connect with more roads, it means that the average connectivity of nodes in the region is high.

Combined with the standardized indicators and the objective weights of indicators at all levels, the transportation network evaluation model is established as follows:

$$\begin{aligned} y &= k_1 R + k_2 N + k_3 Conn_i \\ &= k_1 (D_i + Q_i + \tfrac{1}{b_i}) + k_1 (d_i + A_i) + k_3 Conn_i \end{aligned}, \quad (2)$$

where k_1, k_2, and k_3 represent the corresponding weights of the three primary indicators; and R, N, and $Conn_i$ represent the first-level indicators mentioned in Table 2, respectively. In this paper, the subjective and objective comprehensive weighting method combining the entropy weight method and analytic hierarchy process is adopted to weight each secondary indicator, and each primary indicator is weighted by the analytic hierarchy process. The weight settings of indicators at all levels are shown in Table 3:

Table 3. Transportation network evaluation indicators and weights.

1st Index	Weight	Calculation Formula	Weight
Road condition R	0.327	Road network density D Road flow Q Road blocking degree b_i	0.1740 0.6942 0.1318
Node status N	0.327	Node density d_i Node accessibility A_i	0.1425 0.8575
Connectivity $Conn_i$	0.346		

2.2.3. Economic–Transportation Coupling Coordination Degree Model

Coupling coordination degree is a statistical concept that is often used to analyze coordinated development level [17]. This paper first takes the economic and transportation conditions of countries along the B&R as two indicators to separately analyze the performance of different regions in the system. Then, the E–T model is established to discuss the coordination of the economy and transportation.

To calculate the coupling and coordination between the two indicators of economy and transportation, first we need to calculate their coupling degree. Here, based on the coupling degree relationship in physics [18], we improve the weight coefficient of the participation index and obtain the economic and transportation coupling degree of countries along the B&R as follows:

$$C_i = \left[\frac{EL \cdot y}{(a \cdot EL + b \cdot y)^2} \right]^{\frac{1}{2}}, \tag{3}$$

where the scores of economy and transportation are independently expressed by EL and y, and a and B are their respective weights in the coupling.

Next, we calculate the coordination degree of the two indicators, and the expression of the coordination degree is as follows:

$$T_i = c \cdot EL + d \cdot y, \tag{4}$$

where c represents the weights of EL and d represents the weights of y.

Finally, the E-T model is obtained by calculating the coupling coordination degree of the two, as follows:

$$D_i = \sqrt{C_i \cdot T_i}, \tag{5}$$

where C_i and T_i represent the coupling degree and coordination degree of the economy and transportation, respectively, in different countries. Based on their practical meaning, this paper posits that the importance of these two indicators is the same, so they are given equal weights. The coupling coordination degrees are shown in Table 4:

Table 4. Classification standard of coupling coordination degree.

Coupling Coordination Degree	Coordination Level	Coupling Coordination Degree	Coupling Coordination Degree	Coordination Level	Coupling Coordination Degree
(0.0~0.1)	1	Extreme imbalance	[0.5~0.6)	6	Barely coordinated
[0.1~0.2)	2	Severe imbalance	[0.6~0.7)	7	Primary coordination
[0.2~0.3)	3	Severe disorder	[0.7~0.8)	8	Intermediate coordination
[0.3~0.4)	4	Mild disorder	[0.8~0.9)	9	Well-coordinated
[0.4~0.5)	5	On the verge of maladjustment	[0.9~1.0)	10	Quality coordination

3. Results

3.1. Results of Regional Economic Analysis

In the regional economic analysis, the *EL* values of various countries from 2014 to 2020 are calculated by using Formula (1), and polynomial regression fitting is carried out according to the data characteristics of different countries to observe the changes in *EL*. Different regression equation forms were classified, and the results are shown in Table 5.

Table 5. Classification standard of coupling coordination degree.

Countries	Polynomial Type	*EL* Change Tendency
Bulgaria	Second order	Steadily rising
Russia, Slovenia, Latvia, Romania, Albania, Bosnia and Herzegovina, Armenia, Moldova, Estonia, Serbia, Lithuania, Czech Republic, Poland, Bosnia and Herzegovina, Hungary, Slovakia, Georgia, Croatia, Ukraine, Belarus, Azerbaijan	Third order and s-type	falling–rising
Kazakhstan	Fourth order	falling–rising

Among the four types obtained by polynomial regression, one representative country is selected to visualize its economic change, and the economic change curve is obtained, as shown in Figure 1.

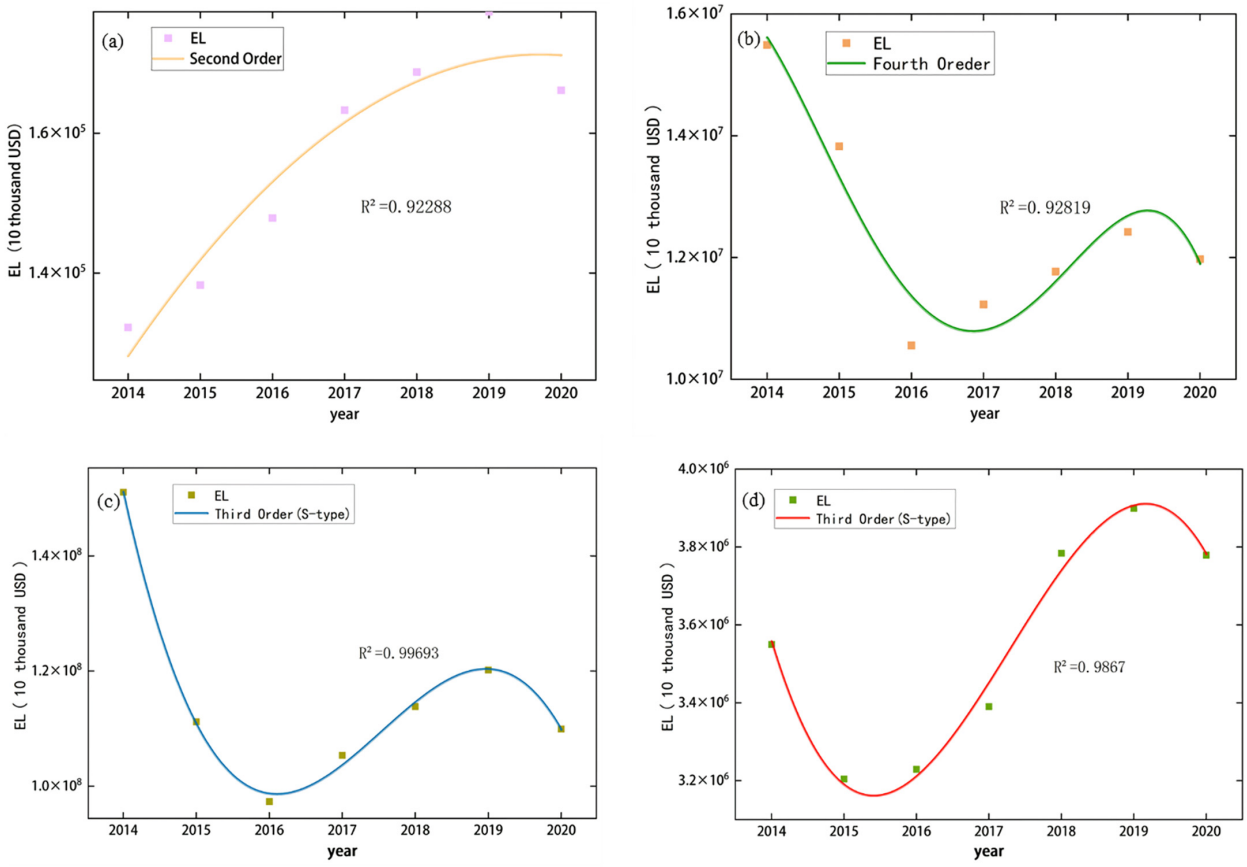

Figure 1. Eurasian Continental Bridge GDP trend forecast charts: (**a**) Bulgarian economic change curve, (**b**) Kazakhstan's economic change curve, (**c**) Russian economic change curve, and (**d**) Slovenian economic change curve.

As shown in Figure 1a, Bulgaria's *EL* changes slightly, showing a steady upward trend. The goodness of fit R^2 of the quadratic polynomial is larger than 0.9, and the model accuracy is acceptable.

As shown in Figure 1b, due to the weak stability of the economic level in Kazakhstan, there are large mutation points from 2014 to 2015, so it is reasonable to use a fourth-order polynomial to fit the curve, and its goodness of fit is acceptable.

According to the image observation, the regression with third-order polynomial fitting can be divided into two types according to whether the economic level in 2014 is greater than or less than that in 2020.

In the third-order economic level curve, the representative country with a declining economic level is Russia (as shown in Figure 1c). In June 2016, Russia imposed a series of economic sanctions on Turkey, such as banning the import of food from Turkey, resulting in a depression in the Russian economy and an overall decline in the economic level. In 2020, due to the impact of factory closure and blockade measures caused by COVID-19, Russian manufacturing activities fell to a low level, which resulted in a rapid decline in the overall economic level, corresponding to our research results.

However, the economic level of most countries has shown a three-order upward trend; that is, the economy has shown a stable upward trend after declining in 2015 compared with 2014. In 2015, the B&R made direct investments in 49 countries along the belt, with an increase of 18.2% year on year. It can be reasonably speculated that the implementation of the B&R policy has promoted the development of the economic level of all involved countries; B&R countries with this characteristic of economic level change include Slovenia (as shown in Figure 1d).

3.2. Transportation Network Analysis Results

According to the road and railway data collected along the B&R, the total length of road networks in different countries was calculated. The road attribute data was combined with the vector data of the areas along the route through GIS spatial analysis methods such as spatial connection and map algebra [19], and the map was visualized to visually compare the total mileage of the road network in different countries; the results are shown in Figure 2. According to the existing research, this paper believes that the GIS spatial analysis method can combine the numerical information with the spatial expression well, and provide the basis for extended research such as proximity analysis.

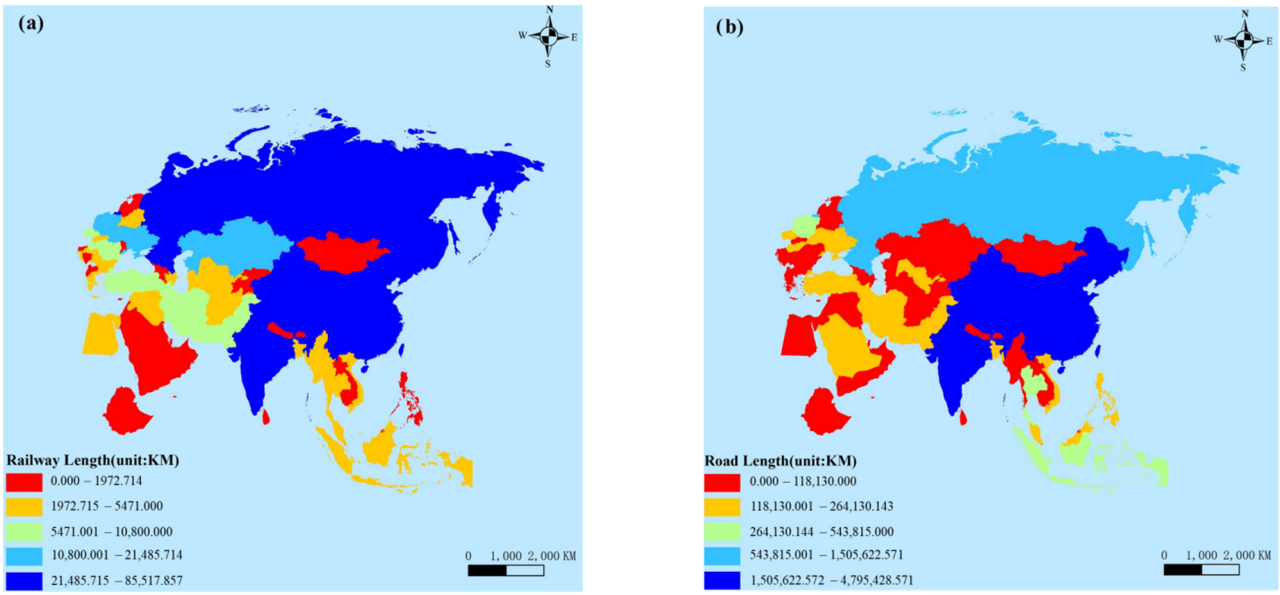

Figure 2. Length distribution of railways and highways in countries along B&R: (**a**) railway, (**b**) road.

There are obvious differences in the length of railways and roads among regions. Taking the countries of the new Eurasian Continental Bridge as an example, the total mileage of the road network in Russia and India is high, while that in some parts of the Middle East and South Asia is low. From one perspective, it can be argued that the areas with a large road network have greater demand for transportation facilities, while in the areas with a small network, the demand is relatively small. On the other hand, the areas with a large road network do not necessarily have the highest degree of transportation development because the population and the land area restrict the degree of transportation development to a certain extent.

Therefore, it is necessary to further evaluate the transportation networks in different developed areas. The comprehensive transportation scores of various countries from 2014 to 2020 were calculated as shown in Table 6.

Table 6. 2014–2020 national transportation comprehensive score.

	2014	2015	2016	2017	2018	2019	2020
Russia	72.00	65.78	66.15	69.93	67.21	64.48	65.73
Kazakhstan	31.17	30.15	30.30	30.22	27.33	26.11	27.91
Bulgaria	39.95	38.59	42.05	41.03	41.70	39.27	38.35
Ukraine	25.92	29.13	27.83	27.27	28.88	28.26	26.34
Belarus	50.84	45.09	46.63	43.30	45.07	42.73	43.31
Georgia	17.82	17.86	17.12	18.16	16.31	17.06	16.19
Azerbaijan	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Armenia	18.72	18.23	16.95	19.19	18.42	21.99	18.34
Moldova	17.28	17.31	16.58	16.77	16.88	18.86	18.07
Poland	86.38	90.00	84.34	86.65	82.98	78.53	83.47
Lithuania	76.23	75.41	75.08	76.14	77.71	77.29	74.55
Estonia	74.69	67.50	70.59	70.12	63.29	65.42	63.50
Latvia	46.33	43.16	39.98	43.01	44.09	41.83	43.90
Czech Republic	90.00	87.64	90.00	90.00	90.00	90.00	90.00
Slovakia	73.28	73.21	74.57	74.50	70.88	67.24	71.01
Slovenia	78.8	73.84	73.64	78.73	74.4	76.54	79.76
Croatia	50.49	41.41	43.21	43.47	43.14	41.12	39.84
Bosnia and Herzegovina	24.01	25.36	23.06	23.94	24.95	26.56	26.03
Serbia	34.57	35.12	34.40	35.28	33.30	38.28	36.30
Albania	15.26	17.26	16.29	17.61	15.68	16.64	14.42
Romania	38.87	38.40	41.64	40.59	37.96	39.18	35.96
Macedonia	20.55	21.25	22.19	20.51	22.19	24.24	22.96
Hungary	65.01	64.32	67.71	62.38	67.43	65.88	64.62

Combined with the visual display and comparative analysis of comprehensive scores, the comprehensive scores of transportation in various countries vary greatly. The comprehensive scores of the Czech Republic, Poland, and other countries are generally in the forefront from 2014 to 2020, with an average score of more than 85; the transportation scores of Moldova, Albania, and other countries are generally low, with an average score of less than 20.

Located in the hinterland of central Europe, the Czech Republic is the corridor connecting Eastern and Western. Since September 2015, China has successively opened three direct routes to the Czech Republic, which has supported the Czech Republic in terms of employment, transportation infrastructure, tourism, and other aspects and greatly promoted the growth of traffic flow; Poland is an important node country in the economic corridor of the new Eurasian Continental Bridge and an influential power in Central and Eastern Europe. The country generally accepts and supports the B&R. Many railways connecting Europe and Asia pass through Poland under the B&R. Therefore, in the future, it will give full play to its node advantages and respond to the relevant strategies of B&R, which will effectively promote further improvement in its transportation level.

Due to historical reasons, Albania's transportation infrastructure has suffered a certain degree of loss. Since the country joined the B&R, China has given it some support, and its road transportation facilities have improved. However, the traffic congestion problem that comes with this improvement also needs to be solved urgently in the future. Moldova is strong in agriculture, and its transportation system has not been maintained for a long time. Although the national government has made many investments in the railway system, it is difficult to raise it to a higher level in a short time. Since joining the B&R, the comprehensive level of transportation has improved. It is believed that continuing to support relevant policies will be conducive to the gradual improvement in transportation facilities.

It is worth noting that areas with large road network lengths may not have the highest comprehensive network score, as in the case of Russia. It is preliminarily inferred that, due to its large territorial area, road network saturation will be less than that in other regions, resulting in a reduction in the comprehensive score; that is, the degree of transportation development is relatively low. Therefore, under the promotion of the B&R, all regions should also adapt transportation development measures according to their actual conditions.

3.3. Economy–Transportation Coupling Coordination Analysis Results

Based on Equation (5), the coupling coordination degree of 23 countries of the New Eurasian Continental Bridge was calculated. According to the calculated numerical distribution, the corresponding coordination level and coupling coordination degree are given. Finally, the changes in the coupling coordination degrees of 23 countries of the New Eurasian Continental Bridge from 2014 to 2020 are shown in Table 7:

Table 7. Coupling coordination degree calculation results.

	2014	2015	2016	2017	2018	2019	2020
Russia	8	8	8	9	10	10	9
Kazakhstan	5	5	5	5	4	4	4
Ukraine	4	4	4	4	4	4	4
Belarus	4	4	4	4	4	4	4
Georgia	2	2	2	2	2	2	2
Azerbaijan	2	2	2	2	2	2	2
Armenia	2	2	2	2	2	3	2
Moldova	2	2	2	2	2	2	2
Poland	7	8	8	8	8	8	8
Latvia	4	5	5	5	5	5	5
Estonia	4	4	4	4	4	4	4
Latvia	4	4	4	4	4	4	4
Czech Republic	6	6	7	7	7	7	7
Slovakia	5	5	5	5	5	5	5
Slovenia	4	5	5	5	5	5	5
Croatia	4	4	4	4	4	4	4
Bosnia and Herzegovina	3	3	3	3	3	3	3
Serbia	4	4	4	4	4	4	4
Albania	2	2	2	2	2	2	2
Romania	5	5	5	5	5	5	5
Macedonia	2	3	3	2	3	3	3
Hungary	5	5	6	6	6	6	6
Bulgaria	5	5	6	6	7	7	5

To obtain a more intuitive understanding of the coupling and coordination of the economy and transportation in various countries, taking the coupling and coordination degree in 2020 for visualization, we further analyzed the overall distribution of the coordination degrees of 23 countries of the New Eurasian Continental Bridge and obtain Figure 3:

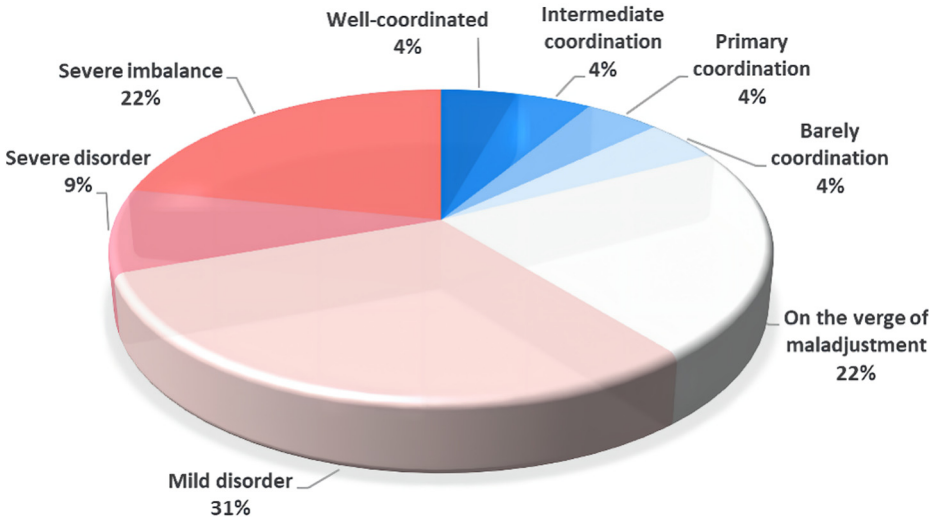

Figure 3. 3D-visualization results of coupling coordination degree.

Figure 3 shows that more than 50% of countries are on the verge of maladjustment or slightly maladjusted in coupling and coordination. In-depth analysis shows that Azerbaijan, Albania, and other countries are in these situations; Russia, Hungary, and other countries that present good coordination account for approximately 8% of the total. Coordination is closely related to the comprehensive national power of the country itself. Therefore, it is difficult to reflect the impact of the B&R on the changes in the coordinated coupling of countries along the belt based on cross-country comparison alone. Further analysis needs to be undertaken in the time dimension.

Table 7 shows that, in some of the 23 countries of the New Eurasian Continental Bridge such as Romania, Armenia, and other countries, the level of coupling coordination has not changed significantly in recent years. Therefore, this paper selects the eight countries, such as Bulgaria and Hungary, whose coupling coordination degree changed from 2014 to 2020 for further analysis. The coupling coordination degree level of these countries each year is visualized in the form of a changing column chart, as shown in Figure 4.

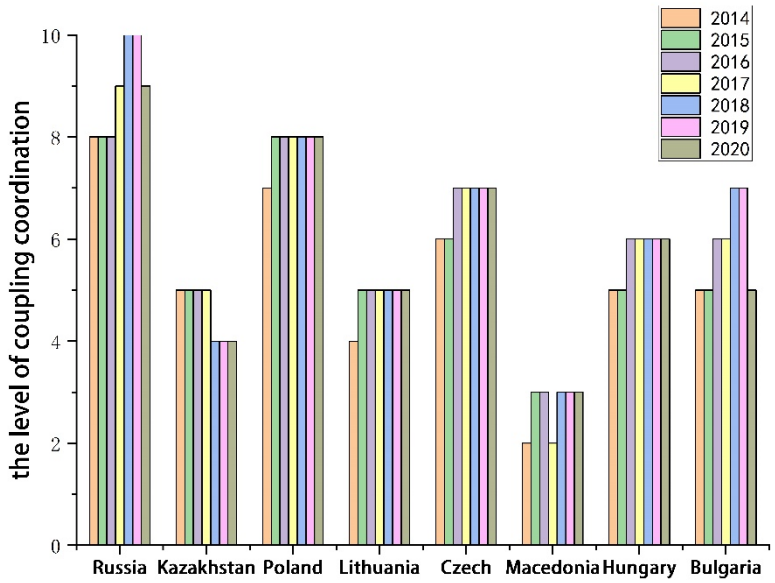

Figure 4. Coupling-coordination-level-results visualization.

As shown in Figure 4, the ordinate represents the coordination level, the abscissa represents the change in the coupling coordination level of each country in the last seven

years, and different colors indicate different years. The general coordination level of Russia, Poland, the Czech Republic, and other countries is high. Macedonia's accession to the B&R was relatively late, its early economic foundation is relatively weak, and its economic and transportation coupling has not improved in the initial implementation stage of the strategy. However, with the promotion of the strategy and the improvement in the domestic and foreign environment, its coordination degree has gradually increased. China and Kazakhstan first established friendly and cooperative relations in 2013. Given the limited export commodities of Kazakhstan and fewer economic exchanges between China and Kazakhstan, the trade volume between China and Kazakhstan increased by 32.9%. However, the pace of economic development and transportation construction later deviated, resulting in a decline in the coordination between transportation and the economy. By analyzing the changes in the coordination level of most countries, it is found that the overall trend from 2014 to 2019 is increasing, indicating that the B&R has improved the economic and transport coordination level of most countries along the belt. Although most countries experienced a decrease in coordination in 2020, perhaps because of COVID-19, they still presented higher values than the original minimum value. However, due to the promotion of the B&R, the overall level will remain relatively stable.

4. Conclusions

Taking the areas along the B&R as the research object, this paper focuses on the 23 countries of the new Eurasian Continental Bridge. Through the construction of the regional economic evaluation model, transportation network evaluation model, and economic transportation coupling coordination degree model, the economy and transportation of these countries and regions were comprehensively evaluated and analyzed, and the following conclusions are shown:

(1) From the comprehensive level of economic development since China started implementing the B&R policy in 2013, it can be seen that the economic level of the countries of the new Eurasian Continental Bridge has been continuously improving, and the initial effect may not be very significant [20]. However, after China increased its export investment in 2015, it can be clearly seen that the economic level of all countries has rapidly improved the growth rates of all countries differently, and the growth rates of countries with good economic foundations are obvious. From 2019 to 2020, due to the COVID-19 pandemic, all countries experienced a great economic decline. However, in general, we can see that the B&R policy has played an important role in the economic level of various participating countries.

(2) From the comprehensive situation of the transportation networks, the comprehensive transportation scores differ across countries. The comprehensive scores of the Czech Republic, Poland, and other countries in 2014–2020 are generally at the forefront, while the transportation scores of Moldova, Albania, and other countries are generally low. Moreover, the comprehensive score of some areas with high total road mileage is not the highest, which is closely related to their land area and population [21]. The comprehensive score is closely related to the actual local situation, and the B&R policy has generally improved the transportation infrastructure of various regions to a certain extent. Therefore, in terms of improving the degree of transportation development, specific transportation facilities should be deployed according to the geographical conditions of different regions to comprehensively improve the transportation strength of countries along the B&R.

(3) According to the changes in the coordination degree of economic and transportation coupling in the last seven years, the overall coupling and coordination level of about 80% of the countries of the new Eurasian Continental Bridge still needs to be improved [22]. At the same time, it cannot be ignored that, driven by China's B&R policy, the national economies and interregional transportation have improved by one-third year on year; this improvement is closely related to the time when countries joined the B&R strategy. In particular, the earlier countries joined the B&R, the greater

the increase in their coupling coordination. The B&R strategy and the development of countries are shown to have the more positive impact of mutual promotion and coordination, which shows that the B&R plays a good role in promoting the economy, transportation, and coordinated development of countries along the line and is a very meaningful strategy.

For the three models proposed in this paper and the corresponding conclusions, we verified them according to the facts. The conclusions given in the paper are accompanied by corresponding factual explanations, which can reflect the reliability of our research from that perspective.

The conclusions drawn from the research on economy, transportation and coupling coordination degree all show a common feature: the B&R has a promoting effect on the comprehensive development of the regions along the route. This has also been mentioned in previous studies, such as studies that have concluded that the transportation and tourism industries in the areas related to the Silk Road Economic Belt are on the rise [23]. The difference is that this paper focuses on analyzing the coupling coordination degree of economy and traffic along the New Eurasian Continental Bridge, which is innovative compared to related research, and the conclusions drawn also have certain reference value for future research.

In future research, we will also consider introducing related algorithms in the field of artificial intelligence, such as applying self-organizing feature maps [24] to traffic network clustering analysis to explore the characteristics of traffic networks in various regions; or introducing spatiotemporal attention into a multi-dimensional traffic network evaluation system deep network [25] to predict important parameters such as road traffic flow at different times.

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