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Factors Affecting the Trade Dependence Relationship of Asian Countries with China: Implications for China's Belt and Road Initiative

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Abstract: China's Belt and Road Initiative (B&R) has received much doubts about its impact on Asian countries. This paper studies the B&R effect from a new perspective of the trade dependence relationship, and explores this B&R impact on the influencing factors of the degree of trade dependence. By implementing a series of grouping analyses on influencing factors, this paper analyses the impact of four national characteristics, including Asian countries' income levels, geographical location characteristics, social development levels and intimacy with China, and finally gives a robust test by combining alternative indicators of trade dependence degree based on information entropy. The empirical results show that trade dependence degree has increased after implementing the B&R, but its downward growth rate shows that the B&R has not taken over the trade dependence. The inhibiting effects of energy exports on the degree of trade dependence deny the trade binding hypothesis due to the increasing energy of export trade. Trade openness and infrastructure development had a negative effect on the degree of trade dependence, while their cross-product term weakened their respective inhibitory effects, and even more after B&R. Meanwhile, the asymmetry of trade and FDI have a significantly positive impact on the degree of trade dependence. Moreover, grouping national characteristics will bring the promoting or inhibiting effects of these influencing factors on the degree of trade dependence. The robust test presents conclusions. This paper enriches the research content on the B&R, and the findings can provide some implications on the selection of trade partners and the sustainable development of the B&R.

Keywords: China's Belt and Road Initiative; trade dependence degree; energy exports; trade openness; influencing factors

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1. Introduction

China's Belt and Road Initiative (B&R), i.e., the Silk Road Economic Belt and the 21st Century Maritime Silk Road Policy, was proposed by the Chinese government's leader in September 2013 in order to reshape the international economic and trading landscape. The Chinese National Development and Reform Commission (CNDRC), the Ministry of Foreign Affairs, and the Ministry of Commerce (MFAMC) jointly issued 'Visions and Actions for Building Silk Road Economic Belt and 21st-Century Maritime Silk Road' on 28 March 2015, which aims to build a comprehensively national economic and trade cooperation corridor based on the New Eurasian Continental Bridge, China-Mongolia-Russia and China-Central Asia-West Asia. The B&R was formed at a critical point of China's economic transformation, and China hopes to exploit a smooth transportation channel network and strengthen the relationship of cooperation with members and of China-ASEAN (Association of South-East Nations, ASEAN, Jakarta, Indonesia) with different belt-road countries. Therefore, the

Chinese government has made it a paramount national strategy, and hopes it generates a global impact.

Though it has not been a long time since the B&R was proposed, China's investment involved many industries in the process of B&R implementation. Energy and transport infrastructure were the main investment fields. During the period 2011–2016, the investment proportion in energy and transport infrastructure accounted for more than 53% of China's direct investment along the belt-road countries, and this investment proportion has reached 67.62% in 2016. International energy cooperation and transport infrastructure construction under the B&R are conducive to energy exploitation, energy exports and trade cooperation, and thus add new impetus to the sustainable development of belt-road countries' economies [1]. Therefore, the B&R provides an important platform for regional economic and trade cooperation, and undoubtedly brings unexpected opportunities for major producers in Mid Asia, West Asia and North Africa. The relevant research on economy and trade along the belt-road countries has attracted widespread attention. Gong et al. [2] analyzed the commodity structure of trade between China and countries in the B&R area, and found that China's imports have been more centralized with its increasing share of energy. Cheng [3] commented on the investment and trade from the B&R, i.e., whether the B&R was driven by market-based transactions, or if it would be a form of foreign aid that was not based on the economic calculation of gains and losses. Zhang et al. [4] pointed out that China has constructed a tight relationship with other countries, and more trade links are sustained by fewer nations along the B&R, but that trade is still correlated to geopolitics.

However, there have been various doubts related to the purpose of the B&R, whether it be viewed as China's expansionary strategy, China's geostrategic strategy, China's Marshall Plan, a global trade strategy, or merely an empty slogan. Some claim that China's B&R may aim at depriving other countries of their energy resources, aggravating their economic dependence on China in the process. Curran [5] considered that the B&R was China's Marshall Plan, which would change the strategic landscape of Asian countries by narrowing the funding gap between countries and serving to achieve China's own foreign policy goals through economic power. Based on the gap in overall economic power and military power between China and the U.S., Cheng [3] thought it would be highly questionable that China has either the ambition or the capability to pursue a grand trade and geopolitical strategy in belt-road regions that was comparable to U.S. global grand strategy. Yu [6] pointed out that the B&R goes far beyond investment cooperation and economic interests, and will advance China's strategic, political and economic interests in Asia as well as countries along this Silk Road route. Shen and Chan [7] pointed out that it may be too early to suggest that the B&R could bring outcomes similar to those of the Marshall Plan, especially in competing for the global leadership in the 21st century. Flint and Zhu [8] stated that the B&R was neither an economic nor political project, but one that transformed politics at multiple scales and simultaneously created possibilities for both global cooperation and conflict.

Therefore, we should clarify whether China is hijacking the trade dependence of countries along the belt-road. So far, there are few studies that discuss the implementation effects of B&R in terms of the trade dependence relationship and its influencing factors. Therefore, this paper intends to explore the B&R effect on the trade dependence relationship of Asian belt-road countries with China, as well as some other influencing factors. In addition, Asian countries have their own national characteristics, i.e., income levels, geographical location characteristics, social development levels and intimacy with China, which may result in different reactions to China's B&R policy. Hence, analyzing the impacts of each national characteristic on different influencing factors' effects will help to clarify the role of the B&R and the important determinants for the trade development of Asian countries. This paper expands the existing literature through innovation in several aspects. Firstly, it provides a new research perspective, in terms of trade dependence, to study the implementation effect of the B&R. Secondly, this paper compares the change in

the degree of trade dependence of Asian countries before and after the B&R was proposed, and gives the corresponding testing after controlling some influencing factors that affect trade dependence, including the microscopic energy, infrastructure development and so on. Thirdly, according to a series of grouping analysis considering national characteristics such as Asian countries' income levels, geographical location characteristics, social development levels and intimacy with China, this paper further tests the B&R effect and its changes to these different influencing factors. Finally, this paper provides a robust test of the empirical results by choosing alternative trade dependence indicators. At present, China's government is comprehensively promoting the B&R and still exploring the corresponding implementation details for it. Therefore, our research conclusions can provide some specific implications and evidence to support and promote the effective implementation of the B&R in Asia.

The rest of this paper is organized as follows. Section 2 summarizes the relevant literature. Section 3 introduces the empirical design from the perspective of the trade dependence relationship based on theoretical analysis, and states the empirical models, underlying indicator variables and data sources. In Section 4, characteristics of some important variables are compared before and after the proposal of the B&R, and the Granger causality analysis of key explanatory variables is used. Section 5 explores the influencing factors on the degree of trade dependence and analyzes the changes in the influencing effects caused by national characteristics through a series of grouping tests. Section 6 provides a test of our empirical results by integrating different indicators characterizing the trade dependence relationship. Conclusions and policy implications for China's Belt and Road initiative are provided in Section 7.

2. Literature Review

China's Belt and Road Initiative (B&R), is a vital strategic initiative for promoting economic policy coordination and realizing deep regional cooperation, and will bring new development opportunities for international trade and logistics. Since the B&R was put forward as a concept, it has become an important issue, and many studies began to analyze the impact of the B&R from different perspectives, including trade, economy, infrastructure investment, and so on.

On the one hand, some studies analyzed the impact caused by the B&R on European countries and Asian countries along the Belt and Road. For transport infrastructure, Shrestha [9], Zhai [10] and Wang and Yau [11] pointed out that the B&R would improve transport infrastructure, which could promote trade, tourism, investment and cooperation with China. For the potential risk caused by the B&R, Sarker et al. [12] explored the possible risks under the B&R associated with the oil, gas and energy sectors. For the development of economy and trade, Ferdinand [13] and Rimmer [14] found that the B&R would bring considerable benefits to the world economy in terms of welfare and trade and might potentially shape the world economy and prevent a global economic slowdown in the future. Foo et al. [15] pointed out that the B&R benefited both ASEAN countries and China in terms of increased trade flows, and could be a promising mechanism for trade facilitation in these countries. Liu et al. [16] showed that relevant cultural exchange driven by the B&R eventually assisted and enhanced unimpeded trade and deepened cooperation between countries.

On the other hand, the incentive impact caused by the B&R on Chinese industrial structure and the potential investment risks has been widely studied. For China's industrial development, Yu [6] and Ferdinand [9] stated that the B&R would help China to deal with the domestic problems of industrial overcapacity, industrial restructuring and technological upgrading. For overseas investment patterns, Du and Zhang [17] pointed out that, since the B&R was proposed, Chinese state-owned enterprises mainly invested in overseas infrastructure through mergers and acquisitions (M&A), while non-state firms played a particularly active role in non-infrastructure areas. For investment risks, Duan et al. [18], Yuan et al. [19] and Yuan et al. [20] comprehensively assessed the energy investment risks

along the belt-road countries and explored the most ideal destinations for China's energy investment. Furthermore, Huang [21] assessed the environmental risks of helping Chinese enterprises to choose suitable investment locations from the perspective of balancing the investment, environment, and resource potentials of host countries.

The B&R has promoted economic development between Asian countries and strengthened the trade cooperation between Asian countries and China simultaneously. As for the improvement of facilities and the business environment, Asian countries attract more foreign direct investment due to attractive business prospects, which in turn promotes international trade of Asian countries with China and other countries. However, most of these studies have focused on the B&R's impact on investment and trade volume, while ignoring analysis on the impact of a dependent trade relationship. Trade dependence reflects the share of total imports and exports of domestic GDP, and as the trade volume increases, whether the B&R policy will enhance trade dependence of Asian countries is a topic worthy of discussion. Therefore, this paper tries to study the effect of the B&R from the perspective of the trade dependence relationships of Asian countries with China, which are essential for the sustainable implementation of the B&R.

In addition to the B&R policy, clarifying other possible influencing factors on the trade dependence relationship is helpful for a robust analysis of the effect of the B&R. However, few studies have focused on analyzing the trade dependence relationship, while many existing studies have explored the impact of infrastructure, economic scale, energy exports, FDI and trade openness on trade. In terms of infrastructure impact, Goswami [22] found that infrastructure development was the main determinant of South Asian foreign trade. Vijil and Wagner [23] and Francois and Manchin [24] argued that improvements in infrastructure will promote the development of national trade, and Li et al. [25] evaluated the contribution of infrastructure to the economic development of countries along the B&R. In terms of energy impact, Zhang et al. [4] investigated energy interdependent relations between China and the belt-road countries, and found the guaranteed degree of China's energy security was 58.42%. Zhang [26] stated that the general trade relationship between China and the belt-road countries was closely related to their oil and gas trade. Furthermore, some studies have analyzed the impact of country size, FDI, trade openness and national culture on trade. Goswami [22] found that trade openness, human capital and financial development were the main determinants of South Asian foreign trade. Alberto and Romain [27] believed that small countries can be more open to trade, and the empirical results showed that doubling their populations would reduce foreign trade dependence by 9%. According to the traditional Heckscher-Ohlin-Samuelson framework, Liu et al. [28] pointed out that FDI and international trade were alternatives. Asiedu [29] believed that FDI had a significant positive impact on trade development. Liu et al. [16] found that cultural and institutional distance would inhibit China's bilateral trade with the Belt and Road countries. Deichman et al. [30] argued that the impact of FDI might be largely due to the investment in minerals and mining production, thus stimulating trade development.

Based on this review of the literature, most studies focused on the B&R effect and on the influencing factors of trade development, while a few studies have explored the impact of the B&R on the trade dependence relationship of Asian countries and its influencing factors. Since the implementation of the Belt and Road initiative, most of the Asian belt-road countries eagerly require external forces to gradually adjust their industrial structure and export structure through international trade, which is more likely to be realized through a closer trade relationship with China formed by the large-scale investments brought by the B&R. Nevertheless, if this trade dependence relationship with China becomes too strong, Asian countries' own economic development will become vulnerable when facing external unfavorable factors. Therefore, this paper tries to figure out the impact of the B&R on the trade dependence relationship of Asian countries and explore the possible influencing factors affecting the trade dependence relationship, which should help address the aforementioned dilemma. Meanwhile, due to differences in income levels, geographical location characteristics, social development levels and intimacy with China between Asian

countries, this paper also analyzes the change in the effect of influencing factors from different national characteristics, which will be helpful for the effective implementation of the B&R for promoting trade development along the belt-road countries in the future.

3. Research Hypotheses and Empirical Design

3.1. Research Hypotheses

Before analyzing the trade dependence relationship of Asian countries with China, we first summarize some key issues according to the existing theoretical research. Most of Asian countries are emerging economies which urgently need stable trade partners and greater investment cooperation. China is undergoing an industrial transformation, there are many problems needing to be solved, such as severe industrial overcapacity and massive energy consumption. A complementary trade structure between China and Asian belt-road countries can help to solve these problems. It is conceivable that the trade dependence relationship will be affected by the B&R. Therefore, the first key issue is whether the proposal and implementation of the B&R will sharply enhance the degree of trade dependence of Asian countries with China.

The proposed B&R aims to enhance the trade connectivity between different countries through the investments in the infrastructure, which will provide the facilitation for international trade. Feng and Wu [31] pointed out that infrastructure investments could reduce the cost of economic activities and improve the social and economic environment by the multiplier effect. Meersman and Nazemzadeh [32] stated that international trade was often positively related with the degree of infrastructure facilitation, which can promote the export of advantageous industries and the introduction of complementary industries. In addition, China's energy project investment along the belt-road countries can not only satisfy China's huge energy consumption, but also bring significant economic benefits to these countries. The introduction of the technology, talent and equipment required for energy investment will in turn have a huge spillover effect and further promote the development of the energy industry and others. All of these will gradually affect the import and export structures as well as the trade dependence relationship. Therefore, the second key issue is whether energy export and the development level of infrastructure will enhance the trade dependence relationship of Asian countries with China. Meanwhile, whether this relationship will be strengthened because of the implementation of the B&R is also worth exploring.

So far, most Asian belt-road countries have many differences in economic development, geopolitical complexity, resources and multilateral trade security. All these differences may lead to different development characteristics of international trade for Asian countries. Firstly, the increase in the international trade is often accompanied by an increase in per capita income. Furthermore, when per capita income increases, people's demand for the quantity and diversification of commodities will lead to an increase in imports, thereby affecting the trade dependence relationship [33]. Secondly, the differences in resources come from oil in West Asia, minerals and rubber in Southeast Asia, and coal and iron in Central Asia, so many scholars believe that geographical differences will affect the Asian countries' approach to foreign trade. Zhang et al. [34] used different alternative indicators of trade dependence to show that geographical distance and economic scale had an important effect on the trade relationship. Finally, with the integration of the global economy, countries with high levels of social development and minimal cultural friction are often more able to participate in international trade and are favored by international capital [35]. However, the effect of these national characteristics on international trade can only be partially reflected through energy exports, FDI, trade openness, infrastructure and so on. We are more concerned with the differences in the transmission effects of influencing factors under different national characteristics. Therefore, the third key issue studied in this paper is whether the influencing effect of different factors on the trade dependence relationship will change with national characteristics, including income level, location characteristics, social development level and intimacy with China.

3.2. Sample Selection and Indicator Variables

In recent years, the B&R has involved 65 countries and regions around the world, which includes 43 Asian countries (67.19% of the total number of Asian countries). China's investment in these countries has been growing steadily from 4.69 billion dollars in 2005 to 30.59 billion dollars in 2016, where the energy and infrastructure of Asian countries are the primary investment fields. However, China's FDI among Asian countries is heterogeneous. The investment in East Asia and West Asia accounted for the vast majority of it (about 79.31%), which is mainly related to the rich energy minerals in these two regions. The implementation of the B&R is mainly achieved through investment; therefore, this paper selects the top 16 Asian countries, whose own investment ratio is more than 1% according to the rank of China's cumulative investment in the 65 belt-road countries from 2005 to 2016, as research objects. In addition, we include Turkey as an Asian country because of its geographical location (as shown in Figure 1), and China's specific investments in these Asian countries is illustrated in Table 1.

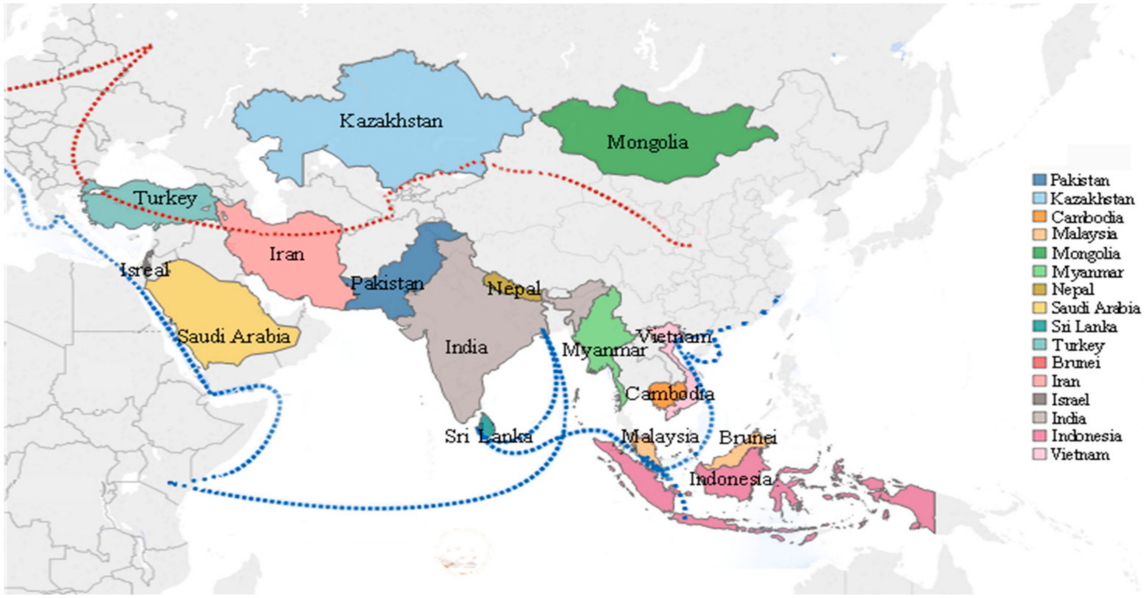


Figure 1. Geographical location map of the 16 Asian belt-road countries.

Table 1. The ranking of China's cumulative investment in major Asian countries from 2005 to 2016.

Country	Cumulative Investment Million Dollars	Investment Ratio	Major Investment Fields
Kazakhstan	18,060	8.82%	Energy
Malaysia	17,230	8.42%	Energy, Metals, Real estate, Technology, Transportation
Indonesia	13,370	6.53%	Energy, Metals, Real estate, Technology, Transportation
Pakistan	10,720	5.24%	Energy, Technology, Transportation
India	7190	3.51%	Energy, Technology, Metal
Israel	6370	3.11%	Agriculture, Entertainment, Technology
Vietnam	6240	3.05%	
Myanmar	5510	2.69%	
Iran	4720	2.31%	Energy
Mongolia	4560	2.24%	
Turkey	4290	2.10%	Energy, Finance, Transportation
Saudi Arabia	3710	1.81%	
Sri Lanka	3630	1.77%	
Cambodia	3180	1.55%	
Brunei	2800	1.37%	
Nepal	1840	0.90%	

From China's investment data in Table 1, we can see that most of China's investment in Asian countries is concentrated in the energy, metal and transportation infrastructure sectors. For example, crude oil pipelines connecting China and Myanmar were officially dredged in 2017, and more than 200,000 barrels of crude oil flow from the port of Madeira to China every day. Moreover, as shown by the geographical location information of these Asian countries presented in Figure 1, the B&R connects the vibrant East Asia economic circle and encompasses countries with huge potential for economic development. Specifically, the Silk Road Economic Belt focuses on linking China with the Persian Gulf and the Mediterranean Sea through Central Asia and West Asia, and connects China with Southeast Asia, South Asia and the Indian Ocean. The 21st-Century Maritime Silk Road is designed to go from China's coast to the South Pacific and Europe through the South China Sea. Hence, the international trade between China and these Asian countries can be realized by both road and sea transport. The data sample of some countries such as Nepal, Iran and Mongolia are limited for the period of 2005–2008, so the whole sample period in this paper is 2009–2016.

Corresponding to the key issues in the research hypotheses above, we introduce the relevant variables used in the following empirical analysis. The goal of this study is to explore the changing characteristics and influencing factors of Asia countries' trade dependence relationship with China, so we choose trade dependence degree as the dependent variable. Based on the literature review, we selected the B&R dummy variable, energy export, trade openness, infrastructure and the cross-product terms of the B&R variable, trade openness and infrastructure as the key explanatory variables. Meanwhile, we selected the Hubness Measurement (HM) index, foreign direct investment (FDI) and the development level of the service industry as the control explanatory variables for ensuring the rationality of influencing factor analysis. The symbols and data sources of all these variables are shown in Table 2, and the data sources include the Wind database, the World Development Indicators (WDI) database, and the Global Competitiveness Report (For the sample data used in this paper, we would like share them with researchers interested in the research topic of this paper).

Table 2. Description of variable indicators and data sources.

Variable Indicator	Variable Name	Variable Symbol	Data Source
Dependent Variable	Trade dependence degree	TDD	Wind database
	Composite trade dependence degree	$CTDD$	Wind database
Key Explanatory Variables	B&R dummy variable	BR	The national development and reform commission of China
	Energy export	RO	WDI database
	Trade openness	TO	WDI database
	Infrastructure	INF	The Global Competitiveness Report
	Cross-product term	$TO \times INF$	
	Cross-product term	$BR \times TO \times INF$	
Control Explanatory Variables	HM index	HM	Wind database
	Foreign direct investment	FDI	Wind database
	Development level of service industry	SE	Wind database

Trade dependence degree (TDD) refers to the ratio of the import and export volume to GDP over a certain period. In this paper, we take the trade dependence degree as

the dependent variable of empirical models, and the calculation formula for the trade dependence degree of country A with country B is as follows.

$$TDD_{AB} = \frac{X_{AB} + Y_{AB}}{GDP_A} \quad (1)$$

where X_{AB} (or Y_{AB}) in Equation (1) indicates the export (or import) volume from country A to country B (or from country B to country A); GDP_A indicates the gross domestic product of country A; TDD_{AB} indicates the trade dependence degree of country A with country B. The composite trade dependence degree ($CTDD$) is constructed by the information entropy method, which will be introduced in more details in Section 6 for robust testing.

The selection of the key explanatory variables is considered from the following aspects. Firstly, the B&R was proposed at the end of the year 2013, and then the corresponding policy formulation and implementation began in 2014, so this paper designs the key explanatory variable BR as a dummy variable to explore the impact caused by the B&R on the trade dependence degree of Asian countries with China. That is, $BR = 0$ when the sample period is from 2009 to 2013, and $BR = 1$ when the sample period is from 2014 to 2016. Secondly, Wood and Mayer [36] pointed out that countries with rich natural resources often lacked export diversification, so investments in energy would increase a country's trade dependence on natural resource exports, which then affect the trade dependence relationship. Since the implementation of the B&R, China has invested heavily in the energy projects of Asian countries, and Zhang [26] pointed out that oil and gas resources were the main commodities exported to China by countries and regions possessing close trade relationships with China. Therefore, based on the export structure mentioned in Wood and Mayer [36], this paper will analyze the impact of energy exports on the degree of trade dependence. The energy exports (RO) include coal, oil and natural gas, and is defined by the following proportion.

$$RO_i = \frac{Coal\_Export_i + Oil\_Export_i + Gas\_Export_i}{Export_i} \quad (2)$$

where X_Export_i indicates the export volume of resource X (coal, oil, or gas) from country i and $Export_i$ indicates the total export volume of country i. Here, the energy export variable RO_i is logarithmically processed for stationarity. Thirdly, a favorable trade openness is conducive for attracting foreign investment and reducing trade restrictions, tariffs and non-tariff barriers, which could strengthen the trade cooperation with other economies [22]. Therefore, this paper discusses the impact of trade openness on the trade dependence relationship, which is defined as follows.

$$TO_i = \frac{Import_i + Export_i}{GDP_i} \quad (3)$$

where $Import_i$, $Export_i$ and GDP_i represent the import volume, export volume and gross domestic product of country i respectively; TO_i indicates the trade openness of country i. Finally, infrastructure construction and investment can reduce the cost of economic activities and improve the social and economic environment. By the network attributes of infrastructure, it can quickly integrate the regional economic activities at home and abroad, and show a positive spatial spillover effect. Goswami [22] pointed out that infrastructure development has a significant impact on economic growth and foreign trade. In this paper, we describe the development level of infrastructure by rank from the Global Competitiveness Report, and a higher rank indicates a better infrastructure environment. Moreover, the cross-product term of trade openness and infrastructure is very important for explaining the relationship between international trade and infrastructure [37], and we also want to investigate the change of influencing effect caused by the B&R. Therefore, the empirical model in this paper will also consider some cross-product terms among B&R, trade openness and infrastructure, and study their impacts on the degree of trade dependence.

For the control explanatory variables, we first consider the Hubness Measurement (HM) index, which reflects the asymmetry of trade relationships among economies in the Free Trade Agreement (FTA) network. The asymmetry of the dominant power in the trade cooperation relationship will lead to excessive economic dependence, and the HM index is defined as follows.

$$HM_B = \frac{X_{AB}}{X_A} \times (1 - \frac{Y_{AB}}{Y_B}) \times 100\% \quad (4)$$

where X_{AB} and Y_{AB} have the same implications in Equation (1), and X_A indicates the export volume of country A and Y_B indicates the import volume of country B. In addition, Liu et al. [28] argued that foreign direct investment could affect import and export. Therefore, this paper chooses the ratio of FDI to GDP as the second control explanatory variable.

$$FDI_i = \frac{Total\_invest\_foreign_i}{GDP_i} \quad (5)$$

where $Total\_invest\_foreign_i$ indicates the total foreign direct investment of country i. Finally, the tradability of service industry is lower than that of agriculture and industry, and the trade dependence degree of service-oriented countries is relatively low. Therefore, for the third control explanatory variable, we consider the ratio of the increase of the service industry to the increase of tertiary industries for capturing the development of the national service industry.

3.3. Empirical Design

This paper employs the following individual effect panel model for testing the impact of different factors on the trade dependence relationship.

$$Y_{it} = u_i + \beta' x_{it} + \varepsilon_{it} (i = 1, 2, \cdots, n; t = 1, 2, \cdots, T) \quad (6)$$

where x_{it} denotes the individual characteristics changing over time; u_i represents the intercept of individual heterogeneity and ε_{it} is a disturbance term. The choice of the fixed effect model or random effect model for Equation (6) can be made by the Hausman test. In the empirical analysis, the explanatory variable set x can be divided into key explanatory variable group X^{key} and control explanatory variable group $X^{control}$, and then the empirical model is constructed as follows.

$$Y_{it} = u_i + \alpha' X_{it}^{key} + \beta' X_{it}^{control} + \varepsilon_{it} (i = 1, 2, \cdots, n; t = 1, 2, \cdots, T) \quad (7)$$

where X^{key} and $X^{control}$ are shown in Table 2.

Based on the grouping results in Table 3, we designed several dummy variables for income level (*INCV*), location characteristics (*LCV*), social development level (*SDLV*) and intimacy with China (*ICV*). According to the national income level in the WDI database, we set $INCV = 1$ for the high-income countries and $INCV = 0$ for the low-income countries. According to the geographical location of Asian countries, we set $LCV = 1$ for East Asian countries and $LCV = 0$ for West and Central Asian countries. By use of the social development index compiled by the United Nations Development Programme (UNDP), we design the dummy variable $SDLV$ and set $SDLV = 1$ for countries with high social development level and $SDLV = 0$ for the other countries. Similarly, according to the level of intimacy with China, we denote the countries with high level of intimacy with China by $ICV = 1$ and the other countries by $ICV = 0$.

During the empirical analysis, we use each dummy variable in the form of cross-product term with each key explanatory variable, and then combine them with the above panel data model (7) in the following form.

$$Y_{it} = u_i + \alpha'_1 X_{it}^{key} + \alpha'_2 Dummy \times X_{it}^{key} + \beta' X_{it}^{control} + \varepsilon_{it} (i = 1, 2, \cdots, n; t = 1, 2, \cdots, T) \quad (8)$$

Table 3. The grouping results of Asian countries based on different national characteristics.

Dummy Variable	Group 1	Group 2	Variable Definition
INCV	High-income: Brunei, Saudi Arabia, Israel, Malaysia, Turkey, Iran, Kazakhstan	Low-income: Nepal, Cambodia, Myanmar, Indonesia, Vietnam, Mongolia, Pakistan, Sri Lanka, India	*INCV* = 1 for Group 1 *INCV* = 0 for Group 2
LCV	East Asia: Brunei, Cambodia, Myanmar, Indonesia, Vietnam, Mongolia, Pakistan, Sri Lanka, India, Malaysia	West and Central Asia: Nepal, Saudi Arabia, Israel, Turkey, Iran, Kazakhstan	*LCV* = 1 for Group 1 *LCV* = 0 for Group 2
SDLV	High level of social development: Brunei, Israel, Vietnam, Sri Lanka, Malaysia, Kazakhstan	Low level of social development: Nepal, Saudi Arabia, Cambodia, Myanmar, Indonesia, Mongolia, Pakistan, India, Turkey, Iran	*SDLV* = 1 for Group 1 *SDLV* = 0 for Group 2
ICV	High intimacy with China: Cambodia, Vietnam, Mongolia, Pakistan, Malaysia, Kazakhstan	Low intimacy with China: Nepal, Brunei, Saudi Arabia, Indonesia, Sri Lanka, India, Turkey, Iran, Israel,	*ICV* = 1 for Group 1 *ICV* = 0 for Group 2

In Equation (8), *Dummy* can represent the dummy variables *INCV*, *LCV*, *SDLV* or *ICV* respectively. Here, we focus on the parameter vector α_2 of cross-product terms between each dummy variable and key explanatory variables. If α_2 is significant for some dummy variable, then the effect of influencing factors on trade dependence degree will change with this national characteristic, and then we can adjust the implementation strategy of trade cooperation along the belt-road countries.

4. Intuitive Analysis of Variable Characteristics

In order to understand the statistical characteristics of basic variables and the correlations between them, we provide the descriptive statistics and Pearson correlation test statistics of these basic variables in Tables 4 and 5. As analyzed in the literature review, there are some doubts on the strategic intent of the B&R. Is it to promote economic and trade development of countries along the Belt and Road through investment in infrastructure, or to loot the energy resources of other countries through infrastructureand trade? Therefore, we chose trade dependence degree, energy export and infrastructure score for detailed comparative tests and trend analysis, which helps to identify changes in important variables before and after the B&R (for details see Table 6, Figures 2–4). Furthermore, in order to better understand the subsequent results of the empirical analysis of influencing factors, we present the Granger causality testing results of key explanatory variables with trade dependence degree in Table 7.

Table 4. Descriptive statistics of basic variables.

	TDD	*RO*	*TO*	*INF*	*HM*	*FDI*	*SE*
Mean	14.028	0.320	0.784	3.761	0.143	3.773	0.798
Median	7.739	0.195	0.636	3.833	0.075	2.262	0.877
Std.Dev.	14.362	0.321	0.473	0.964	0.215	6.918	0.310
Skewness	1.653	0.786	1.055	−0.240	2.890	0.952	−2.062
Kurtosis	4.837	2.117	3.492	2.259	11.426	22.721	5.635

Table 5. Pearson correlation coefficients between basic variables.

Pearson Test	*TDD*	*RO*	*TO*	*INF*	*HM*	*FDI*	*SE*
TDD	1						
RO	−0.1201 ***	1					
TO	0.7580 ***	−0.0090	1				
INF	−0.3019 ***	0.2371 **	0.1489	1			
HM	0.7671 ***	0.0255	0.2745 **	−0.4587 ***	1		
FDI	0.4167 ***	−0.0026	0.2021 **	−0.1665 *	0.3264 ***	1	
SE	−0.6648 ***	0.2241 **	−0.1899 *	0.6340 ***	−0.8218 ***	−0.3069 **	1

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Table 6. Mean test of trade dependence degree and its growth rate before and after the B&R.

	Null Hypothesis	Alternative Hypothesis	*p*-Value
Trade dependence degree	mean (T-diff) = 0	mean (T-diff) > 0	0.0695
Growth rate of trade dependence degree	mean (G-diff) = 0	mean (G-diff) < 0	0.0092

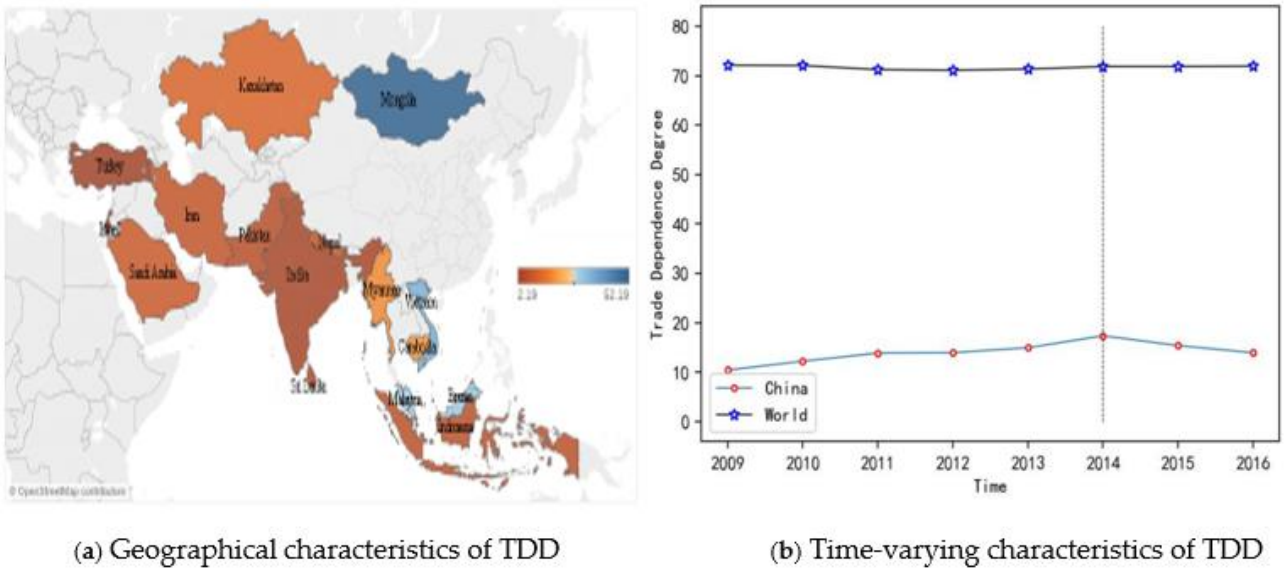


Figure 2. Geographical and time-varying characteristics of trade dependence degree in Asian countries.

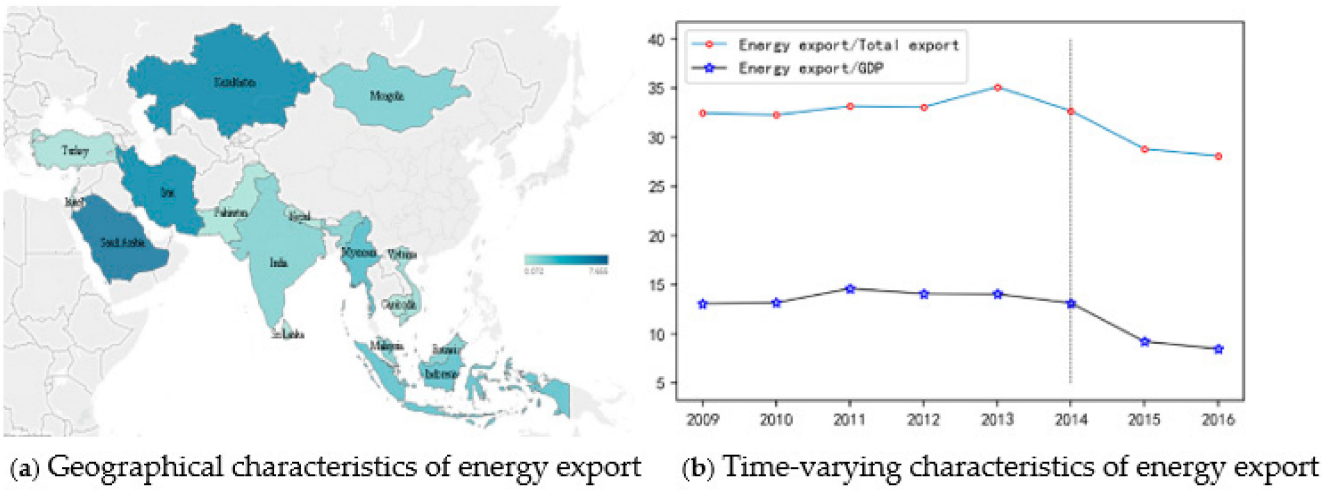
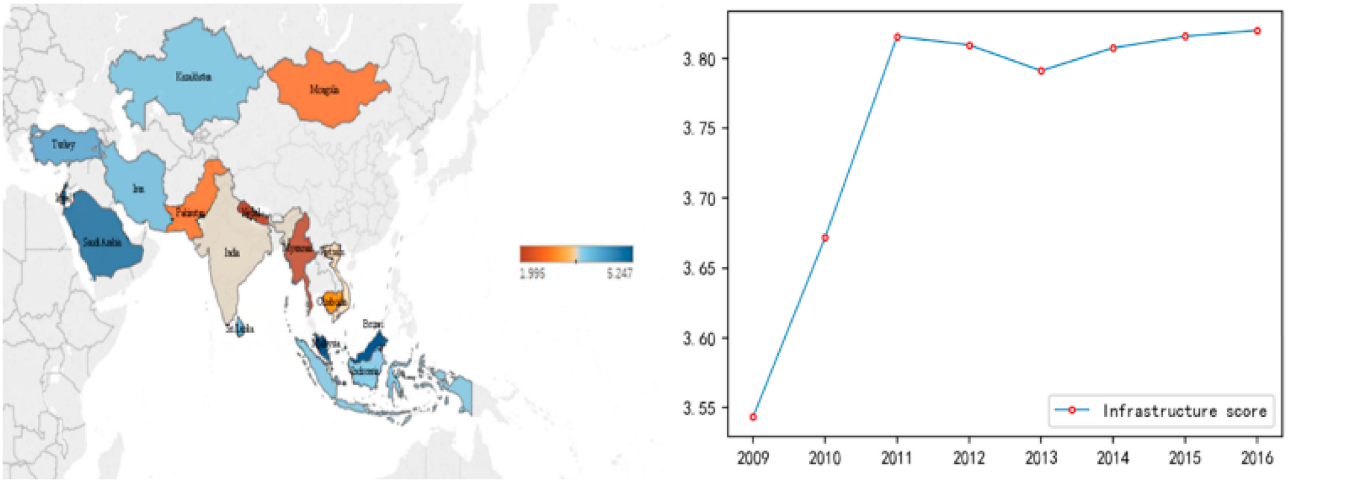


Figure 3. Geographical and time-varying characteristics of energy export in Asian countries.

Table 4 shows that these basic variables have significant differences among Asian countries. The medians of most variables are smaller than the means, and the standard deviations are significantly larger, indicating the unbalanced development situation of Asian countries. From the correlation results in Table 5, the variables *TO*, *HM*, *FDI* and *TDD* have significantly positive correlations among them, which is consistent with the research conclusions in Goswami [22]. Moreover, the B&R aims to explore new development and cooperation opportunities. As pointed out in Du and Zhang [17], the B&R boosted foreign direct investment inflow from China, and the massive investment in infrastructure would improve the quality and availability of logistics facilities for the belt-road countries. The B&R investment in energy will strengthen the development of energy, trade, and related industries. It is worth noting that *TDD* is negatively correlated with *RO*, *INF* and *SE*.

Therefore, the B&R will have some potential impact on the trade dependence relationship of Asian countries with China. The specific geographical and time-varying characteristics of the degree of trade dependence are shown in Figure 2.



(a) Geographical characteristics of infrastructure score (b) Time-varying characteristics of infrastructure score

Figure 4. Geographical and time-varying characteristics of infrastructure score in Asian countries.

Table 7. Granger causality testing results of key explanatory variables.

	Panel Granger Causality			Cross Section Granger Causality
Variables	**Z Statistics**	***p*-Value**	**Results**	**Wald Test: With Causality**
BR	4.6574 ***	0.0000	Yes	Nepal, Saudi Arabia, Indonesia, Mongolia
RO	5.6703 ***	0.0000	Yes	Brunei, Myanmar, Cambodia, Indonesia, Malaysia, Kazakhstan
TO	5.9194 ***	0.0000	Yes	Brunei, Saudi Arabia, Indonesia
INF	5.8514 ***	0.0000	Yes	Nepal, Cambodia, Indonesia, India, Kazakhstan
$TO \times INF$	2.0125 **	0.0442	Yes	Nepal, Saudi Arabia
$BR \times TO \times INF$	4.1974 ***	0.0000	Yes	Nepal, Saudi Arabia, Indonesia, Mongolia

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

The geographical characteristics of the trade dependence degree (TDD) in Figure 2a show that Mongolia has the strongest trade dependence relationship with China, followed by Vietnam, Malaysia and Brunei in Southeast Asia. India, Turkey and Israel's trade dependence relationship with China is relatively weak. Asian countries adjacent to China have a higher degree of trade dependence than other countries. From the time-varying trend of the average degree of trade dependence in Figure 2b, we find that after the launch of the B&R in 2013, the degree of trade dependence grew in 2014, but this growth trend was not maintained during the period of 2015–2016. Although China has greatly increased the total amount of foreign investment after the B&R, this has not aggravated the burden of trade dependence for Asian countries. In addition, the volatility of Asian countries' degree of trade dependence with the world is slight, while the degree of trade dependence with China fluctuated fiercely, especially before and after the B&R was proposed. Meanwhile, we can find that after the implementation of the B&R, except for Israel, Cambodia, Sri Lanka, Kazakhstan and Pakistan, the degree of trade dependence of the remaining eleven Asian countries with China has a downward trend. But for the degree of trade dependence with the world, only seven countries have experienced a similar decline. Therefore, the B&R promotes foreign investment and trade integration, but not at the cost of the trade dependence relationship with other countries. Furthermore, we verify the variation characteristics of trade dependence degree before and after the B&R was proposed by the mean test in Table 6.

From the testing results in Table 6, there were obvious differences in the trade dependence degree before and after the B&R was proposed. Although the trade dependence degree presented a high value after the B&R was proposed, this difference was not very large, and it is only significant at the 10% significance level according to the alternative hypothesis 'mean (T-diff) > 0'. The growth rate of trade dependence degree was significantly reduced when the B&R was implemented. Therefore, there is no direct evidence for judging that the purpose of the B&R is to take advantage of the trade dependence of Asian countries.

Currently, global energy consumption has begun to shift towards the developing countries, and more energy trading entities are in the Asia-Pacific region. Energy investment is a key link in the B&R for building the economic corridor based on oil and gas pipeline networks along the belt-road countries, which is bound to affect the energy export trade. Hence, it is necessary to understand the geographical and time-varying characteristics of energy export in Asian countries, as shown in Figure 3.

Figure 3a shows that the landlocked countries in Central Asia and West Asia have more energy exports than other regions. The countries with larger energy exports are Kazakhstan, Iran and Saudi Arabia, which also have abundant energy resources such as coal, oil and natural gas. Meanwhile, the types of energy products exported from Asian countries are based on their own energy resources. For example, Southeast Asian countries (Brunei, Cambodia, Vietnam, Malaysia and so on) are short of mineral resources, so their export products are mainly natural rubber and oil palm, commodities related their natural climate. From the time-varying characteristics of energy export in Figure 3b, we find that energy exports (ratio to total export or GDP) in Asian countries declined around 2014. Although China has increased its amount of energy imports due to economic development in recent years, the energy investment in Asian countries not only stabilizes China's energy needs, but also accelerates the economic development of Asian countries through the spillover effect. Therefore, the influence of energy export from Asian countries on the degree of trade dependence is worth discussing.

Infrastructure, as the fundamental condition for economic and social development, needs to be constantly improved. This is crucial for the construction of the interconnected Internet of Things and information networks in the B&R, and can help to facilitate trade and reduce trade barriers. We use the infrastructure score provided by the Global Competitiveness Report to represent the level of infrastructure development, and the corresponding geographical and time-varying characteristics are shown in Figure 4.

The geographical characteristics of infrastructure score in Figure 4a show that the countries with relatively high infrastructure scores are Saudi Arabia, Malaysia and Brunei, while Nepal, Pakistan and Mongolia have lower infrastructure scores. Overall, Southeast Asia and West Asia have better infrastructure conditions than Central Asia. The level of infrastructure development is constrained by many factors such as economic development, laws, property rights, government size, monetary systems and so on. Some Asian countries' infrastructure is poor, mainly due to the lack of stable financial support and an unstable political environment. For example, Mongolia is in the interior of Asia, and its economy is not developed. Although mineral resources are abundant there, it has difficulty in attracting foreign investment because of its own political problems. However, infrastructure construction needs to rely on long-term, significant capital investments. Nepal is also a landlocked country dominated by agriculture and it is one of the least developed countries in the world. Its economic problems are the main factors restricting the development of infrastructure, and it is difficult to attract foreign investment due to resource shortages. The Pakistani economy is also relatively backward, and its political situation is not stable, which has caused great obstacles to the development of its own infrastructure. In addition, Figure 4b shows those Asian countries that have steadily improved their development levels of infrastructure. Especially after the B&R was proposed, the overall level of infrastructure in Asian countries still maintains a stable but slow uptrend, which may be owing to the long construction cycle of infrastructure. Therefore, the foreign trade of Asian countries

will have a better diversified development based on the gradually improving infrastructure, and whether it will strengthen its trade dependence on China is worth exploring.

For the Granger causality testing, we use the Dumitrescu-Hurlin testing method for heterogeneous panel data proposed in Dumitrescu and Hurlin [38], which has very good small sample properties, even in the presence of cross-sectional dependence. Table 7 presents the detailed testing results on panel Granger causality and cross section Granger causality.

In Table 7, the Z-Statistics is used for panel data Granger causality, and the null hypothesis H_0 is testing variable does not Granger-cause *TDD*, while the alternative hypothesis H_1 is testing variable does Granger-cause *TDD* for at least one panel-variable (i.e, Country). The Wald test is used for cross section Granger causality analysis, and the test objects are similar to Z-Statistics. We test each key explanatory variable in Table 2, and present the testing results in Table 7. The testing results show that each key explanatory variable does Granger-cause *TDD* at the panel data level, while different key explanatory variables do Granger-cause *TDD* corresponding to different countries at the cross-section level, especially involving some Southeast Asian countries. On the whole, the key explanatory variables have the causality relationships with degree of trade dependence, which is useful in helping make a critical analysis in the following influencing factor analysis.

5. Empirical Analysis on the Factors Affecting the Trade Dependence Relationship

Based on the preliminary analysis of variable characteristics and the Granger causality relationship, we first examine further the influencing factors of the trade dependence relationship for Asian belt-road countries, including the implementation of B&R, energy export, infrastructure construction and so on, and then explore the differences in their influencing effect due to different national characteristics by a series of grouping tests.

5.1. Influencing Factors of Trade Dependence Relationship for Asian Belt-Road Countries

For testing the influencing factors of trade dependence degree for Asian belt-road countries, we have estimated the empirical models in Equation (7). For accurately capturing the impact of key variables and obtaining robust parameter estimation results, we gradually added the explanatory variables in the empirical models during the estimation process. For estimating the panel data model, we should confirm the random effect or fixed effect model structure because of its own different parameter estimation methods. Through the Hausman test for panel data model, we selected the fixed effect model in this paper, and we used the generalized least-squares estimator and robust variance estimator based on conventional panel data assumptions. Since the estimation results are similar, only robust variance estimation results are reported in this paper. Specifically, the parameter estimation results for the influencing factor model of trade dependence degree by Equation (7) are given in Table 8.

From the parameter estimation results in Table 8, we can find that except for the weak significance level of energy export, all the other key and control explanatory variables have a significant impact on the trade dependence degree. Especially for the infrastructure variable INF and its associated cross-product terms $TO \times INF$ and $BR \times TO \times INF$, there is a very stable significance level. In the following, we will give some detailed analysis according to each influencing factor.

First, the significantly positive coefficient of BR indicates that the trade dependence degree of Asian countries has indeed increased after implementing the B&R, which is consistent with Granger causality testing results in Table 7. At present, Asian countries have become a new impetus for global economic development, so the trade dependence degree of Asian countries with China and the world has been rising since 2009. The trade dependence degree of Asian countries with China had a significant rise in 2014. However, trade volumes have increased after proposing B&R, but the degree of trade dependence and its growth rate have declined since 2014, as shown in Figure 2. On the whole, it is premature to assert B&R will control the trade dependence degree of Asian countries

to achieve any political strategy, which is not consistent with the research findings in Cheng [3] and Curran [5].

Table 8. The parameter estimation results for the influencing factor model of trade dependence degree.

Variables	The Dependent Variable *TDD*								
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
BR	2.0835 ***			1.9085 ***	1.7340 ***	−1.1736			0.0020
Ln_RO		−1.3105 **		−0.6208			−0.5381		−0.5109
TO			−12.2007 **	−14.6911	−19.9488 *			−10.3934	−4.7361
INF			−6.2442 ***	−7.8770 ***	−9.4612 ***		−6.0436 ***	−8.1065 ***	−6.8012 **
$TO \times INF$			8.9928 ***	9.1316 ***	10.8843 ***	4.2558 ***	4.9999 ***	7.9598 ***	6.1208 *
$BR \times TO \times INF$						0.6324 **	0.6362 ***	0.5700 ***	0.6302 **
HM	25.1633 ***	25.9628 ***	21.4898 ***	19.9786 ***	20.6243 ***	21.4036 ***	20.8136 ***	21.2643 ***	20.7860 ***
FDI	0.2248 ***	0.1716 ***	0.2422 ***	0.2548 ***	0.2599 ***	0.2665 ***	0.2676 ***	0.2678 ***	0.2638 ***
SE	−26.5262 **	−34.0818 ***	−18.0304 *	−19.2942 **	−17.1534 *	−16.3921 *	−27.2270 ***	−23.5032 **	−26.2307 ***
Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.5052	0.5281	0.6993	0.7567	0.7268	0.6969	0.7742	0.7419	0.7745

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Second, the estimated coefficient of energy import is negative but not always significant, which indicates that energy export has a weak negative effect on the trade dependence relationship. As stated in Feng et al. [39], energy investment from the B&R can not only effectively ensure the stable energy supply for China, but also promotes the economic development of Asian countries through the spillover effect of energy investment on capital, knowledge and technology. In addition, some southeast Asian countries have abundant natural resources, such as Cambodia and Myanmar, which has increased the trade dependence through energy exports, which is consistent with the cross-section Granger causality test. Although the proportion of energy exports of Asian countries is falling, the spillover effect of energy industry drives the rapid development of other industries and production networks. This, in turn, increases the trade share of final products with China, which possibly strengthens trade dependence through trade reciprocity. Therefore, the viewpoint that the B&R binds trade dependence by energy export does not make sense, and, actually, interdependence relations exist between China and the Asian belt-road countries in terms of energy cooperation, as stated in Zhao et al. [40].

Third, countries with higher degree of trade openness, such as Saudi Arabia and Indonesia (see the Granger causality analysis in Table 7), tend to have lower trade barriers and allow other international capital to enter the domestic market. Therefore, enhancing trade with other countries will relatively reduce the trade dependence with China, and the negative coefficient of TO confirms our analysis. In addition, the negative coefficient of INF shows that China's infrastructure investment contributes more to the GDP of Asian countries and further relieves the severity of trade dependence of Asian countries with China. As the assessment analysis of Asian infrastructure investment showed in Yang et al. [41], the benefits of investing in infrastructure are lowering the costs of production and transactions, expanding new export markets, improving market services and the investment environment, and thereby promoting the improvement of productivity. However, the cross-product term of infrastructure and trade openness is positive, which has an inhibitory effect on the aforementioned two variables. According to the current situation in Asian countries, the investment and construction of infrastructure projects are mainly led by China, and China will also participate in the operation and maintenance of infrastructure in the future. Meanwhile, China is the main trading partner for each country, and is an important player in the international trade of the belt-road countries (e.g., energy trade for Saudi Arabia). Therefore, the consolidated trade patterns for countries with high trade openness found in Yang et al. [41] will increase the degree of trade dependence. Furthermore, the significantly positive coefficient of $BR \times TO \times INF$ shows that Asian countries with higher levels of trade openness and infrastructure scores are more inclined to establish trade relationships with China since implementing the B&R.

Finally, the coefficients of control variables FDI and HM are significantly positive, similar to the findings of Zhang et al. [34] and Yi and Zuo [42]. In addition, the larger coefficient of the HM index means that if there is a big asymmetry in import and export between

the trading countries, the weaker side will rely heavily on the other side. Meanwhile, the significantly negative coefficient of SE indicates that countries dominated by services tend to have a low degree of trade dependence for the lower export attribution of the service industry, which is consistent with the conclusions in Yi and Zuo [42].

5.2. Analysis on the Influencing Factors from Different National Characteristics by Grouping Tests

We have stated in the research hypotheses that the national characteristics, including income level, geographical location, social development level and intimacy with China may lead to a change in the effect of influencing factors on the degree of trade dependence. Furthermore, this paper will give the corresponding empirical evidence supported by the grouping tests based on some dummy variables such as $INCV$, LCV, $SDLV$ and ICV, as proposed in Table 3. Based on the formation of the cross-product terms between each dummy variable and the key explanatory variables, we study how these national characteristics affect the influencing factors' effect on the trade dependence degree, and the relevant grouping test results are presented in Tables 9–12.

Table 9. The grouping test results based on the national characteristic of income level.

	The Dependent Variable *TDD*				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BR	1.3406 *	2.0017 ***	1.0108 *	1.6583 ***	1.3296 **
Ln_RO	–	–	–	–	–
TO	−18.2135	−19.0205	−16.8297	−15.2603	−23.4145 **
INF	−9.6612 ***	−9.2424 ***	−11.1325 ***	−12.3701 ***	−9.1390 ***
$TO \times INF$	10.7071 ***	10.3180 ***	11.2906 ***	10.4340 ***	12.0546 ***
$INCV \times BR$	0.8419				
$INCV \times Ln\_RO$		−0.0090			
$INCV \times TO$			−27.9340 ***		
$INCV \times INF$				5.0592 *	
$INCV \times TO \times INF$					−4.0149 **
HM	20.9115 ***	20.1372 ***	20.4373 ***	20.8969 ***	20.3133 ***
FDI	0.2567 ***	0.2590 ***	0.2616 ***	0.2635 ***	0.2576 ***
SE	−18.1307 *	−18.2865 *	−18.3035 **	−20.6297 **	−14.6166
Fixed Effect	Yes	Yes	Yes	Yes	Yes
R^2	0.7283	0.7496	0.7591	0.7354	0.7427

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Table 10. The grouping test results based on the national characteristic of geographical location.

	The Dependent Variable *TDD*				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BR	1.1174	1.9656 ***	1.5216 ***	1.7348 ***	1.5430 **
Ln_RO					
TO	−17.5929	−12.8337	−33.2152 **	−20.3743 *	−18.7053
INF	−8.6776 ***	−7.7765 ***	−9.1289 ***	−9.3046 ***	−8.4302 ***
$TO \times INF$	10.0919 ***	8.6142 **	10.2767 ***	11.0452 ***	8.1134 **
$LCV \times BR$	1.0861				
$LCV \times Ln\_RO$		−0.8473			
$LCV \times TO$			17.0918 *		
$LCV \times INF$				−0.5779	
$LCV \times TO \times INF$					2.5172
©HM	20.3283 ***	19.8966 ***	20.5649 ***	20.6451 ***	20.5019 ***
FDI	0.2669 ***	0.2529 ***	0.2646 ***	0.2598 ***	0.2604 ***
SE	−17.7057 *	−20.6426 **	−17.3962 *	−17.1529 *	−16.5902 *
Fixed Effect	Yes	Yes	Yes	Yes	Yes
R^2	0.7298	0.7585	0.7368	0.7269	0.7313

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Table 11. The grouping test results based on the national characteristic of social development level.

	The Dependent Variable *TDD*				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BR	1.2247	1.6801 ***	1.4831 **	1.7110 ***	1.3765 **
Ln_RO	−0.8485 **	−1.4530	−0.5900	−0.7654 *	−0.5293
TO					
INF	−5.6413 ***	−5.1844 ***	−2.3255	−7.0250 ***	−3.6864 **
TO × *INF*	5.4819 ***	5.7621 ***	2.6517 *	5.5342 ***	2.3209 *
SDLV × *BR*	1.4633				
SDLV × *Ln_RO*		0.8711			
SDLV × *TO*			15.8282 **		
SDLV × *INF*				3.7580	
SDLV × *TO* × *INF*					3.9589 ***
©*HM*	20.4799 ***	19.8785 ***	20.0387 ***	20.4167 ***	20.3608 ***
FDI	0.2504 ***	0.2559 ***	0.2317 ***	0.2561 ***	0.2219 ***
SE	−24.3252 ***	−21.0742 ***	−19.7419 **	−19.4417 **	−15.0231 **
Fixed Effect	Yes	Yes	Yes	Yes	Yes
R^2	0.7586	0.7546	0.7703	0.7602	0.7788

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Table 12. The grouping test results based on the national characteristic of intimacy with China.

	The Dependent Variable *TDD*				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BR	1.4018 *	1.5463 **	1.4737 **	1.7398 ***	1.5390 **
Ln_RO					
TO	−18.6148	−7.8907	−32.5755 **	−23.5466 *	−18.8879
INF	−9.4167 ***	−6.1077 *	−8.8889 ***	−9.1630 ***	−8.7891 ***
TO × *INF*	10.2817 ***	7.0236 *	10.1164 ***	11.7583 ***	8.2385 **
ICV × *BR*	0.8192				
ICV × *Ln_RO*		−2.2861 **			
ICV × *TO*			17.2748 **		
ICV × *INF*				−1.9129	
ICV × *TO* × *INF*					2.4608
©*HM*	29.2435 ***	22.7983 **	23.2679 **	29.0729 ***	25.6316 **
FDI	0.2567 ***	0.2273 ***	0.2620 ***	0.2472 ***	0.2553 ***
SE	−18.5530 *	−16.7698 *	−17.5862 *	−16.8341 *	−16.3076 *
Fixed Effect	Yes	Yes	Yes	Yes	Yes
R^2	0.6896	0.7204	0.7023	0.6895	0.6939

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Table 9 shows that the cross-product terms $INCV \times TO$, $INCV \times INF$ and $INCV \times TO \times INF$ are significant at the 10% level, which demonstrates the serious difference in national income level for the B&R countries found in Liu et al. [43] does affect some of the influencing factors of the trade dependence degree. Meanwhile, Wang and Zhang [44] pointed out that the influences of free trade on different income levels are heterogeneous. Although the trade openness and infrastructure of Asian countries will weaken the trade dependence relationship, this weakening effect is different between high-income countries and low-income countries. In addition, the strengthening effect of $TO \times INF$ on the trade dependence degree is more obvious for the low-income countries. Most of the low-income countries are located in east and southeast Asia, and generally have more rigid financial constraints, so greater openness is urgently needed to attract investment. Since the implementation of the B&R, Chen et al. [45] showed that investment facilitation in in east and southeast Asia is higher than other regions, so China provides a huge investment

in low-income Asian countries and plays a role as an investor and builder, which will inevitably strengthen the trade dependence relationship of these countries with China.

The estimation results in Table 10 show that only the cross-product term $LCV \times TO$ is significant at the 10% level, which indicates that the geographical location characteristic of Asian countries will affect trade openness on the trade dependence relationship. The increased trade openness could weaken the trade dependence relationship highlighted in Table 8, but this effect for East Asian countries is weaker than for Central and West Asian countries. Central and West Asian countries such as Saudi Arabia, Iran and Kazakhstan have more energy resources than East Asian countries. Once a new trade link has been established for East Asian countries with China through trade openness, they prefer to maintain such stable trade relationships. Furthermore, according to the grouping results of Asian countries in Table 3, we find that, except for Nepal, nearly all Central and West countries are high-income countries, so this result on trade openness presented in Table 10 is consistent with that in Table 9. Trade openness in Central and West Asian countries will have more spillover effects for accelerating economic development, which in turn is more conducive to weakening the trade dependence relationship. Therefore, the national location characteristic can partly explain the geographical distribution of the degree of trade dependence, which verifies the findings shown in Figure 2.

The significant cross-product terms $SDLV \times TO$ and $SDLV \times TO \times INF$ in Table 11 indicate that social development level characteristics of Asian countries will influence the effect of some influencing factors. For the countries with high social development levels, trade openness and its relationship with infrastructure will be more likely to strengthen the trade dependence relationship of Asian countries. The development of those countries has been promoted by the spillover effect of commercial exchange with China, so it inevitably strengthens those countries' trade dependence relationship with China, which is in line with the common prosperity put forward by China in the B&R. Moreover, for countries with high social development levels, the increase in trade openness will deepen economic exchange and economic dependence between the two sides. The trade dependence degree of Asian countries with China is significantly higher than that with the entire world, so China is a very important trading entity, especially for countries with high social development level. The common advantages of trade openness and infrastructure have a great effect on strengthening bilateral trade for countries with high social development levels. Based on Table 1 and Figure 4, most countries with low social development levels tend to have vulnerable infrastructure, while countries with high social development levels often receive more Chinese investment. These further indicate that China's efforts to strengthen infrastructure have been fruitful in recent years, not only promoting the socio-economic development of Asian countries, but also facilitating closer economic exchanges.

The significant cross-product terms of $ICV \times Ln\_RO$ and $ICV \times TO$ in Table 12 show that Asian countries' intimacy with China has an important impact on the influencing factors of the degree of trade dependence. For the countries with high levels of intimacy with China, the increased energy exports will not constrain the trade structure, while the trade openness will further strengthen the trade dependence relationship. This is because countries with high levels of intimacy with China have a long-term stable energy export trade relationship with China. Meanwhile, these countries are easier to bring in investment from China and establish trade, which inevitably strengthens the trade dependence relationship and develops in the direction of a virtuous cycle. Meanwhile, Asian countries with high levels of intimacy with China are more inclined to shorten cultural distance and reduce political friction, which is conducive to reducing transaction costs and promoting trade cooperation [35,46].

6. Robust Tests Based on the Composite Trade Dependence Degree

The trade dependence degree of country A with country B used above is the ratio of total trade (of country A with country B) to gross domestic product (GDP) in country A. But there may be some overlap between imports and exports due to the exchange of

goods or production factors, which means that the trade dependence degree computed from Equation (1) may not accurately reflect the position and effect of foreign trade in the national economy. Therefore, an alternative to calculate the trade dependence degree is the ratio of total trade (of country A with country B) to the total trade value in country A, and its corresponding formula is as follows.

$$TTD_{AB} = \frac{X_{AB} + Y_{AB}}{X_A + Y_A} \tag{9}$$

where X_{AB}(or Y_{AB}) represents the export (or import) amount of country A to country B; X_A (or Y_A) represents the total export (or import) amount of country A. Although this calculation method in Equation (9) can avoid the overlapping problems between imports and exports in Equation (1), it seems to lack a judgment on the role of foreign trade in the domestic economy. Therefore, this paper will synthesize these two alternative indictors to construct a composite trade dependence degree denoted by $CTTD$. The weights of different trade dependence indicators are calculated by the information entropy method, and then linearly generate the composite trade dependence degree $CTTD$. By entropy weights' calculation, we calculated the weights for trade dependence indicators by Equations (1) and (9) to be 0.6467 and 0.3533, respectively.

Based on the composite trade dependence indicators, similar panel regression models in Equations (7) and (8) are performed to test the robustness of the empirical results obtained above. The detailed estimation results are shown in Tables 13 and 14. We find that most of the testing results are generally consistent with the conclusions in Section 5, and a little difference is reflected in the significance of the cross-product term $INCV \times TO \times INF$. Overall, the symbol and significance of the main variables are the same, which indicates that the research conclusions in this paper are robust for the choice of dependent variables.

Table 13. The robust testing results for the influencing factors of composite trade dependence degree.

Variables	The Dependent Variable *CTDD*								
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
BR	2.3876 ***			2.6123 ***	2.3922 ***	−0.0182			1.6755 *
Ln_RO		−1.0967 **		−0.4920			−0.4696		−0.4379
TO			−15.5257	−20.6804 *	−26.2148 **			−13.5263	−15.7885
INF			−5.5299 **	−8.1744 ***	−9.9680 ***		−4.7414 ***	−7.5900 ***	−7.6458 ***
TO × *INF*			8.0741 **	8.7407 ***	10.6836 ***	2.8307 ***	3.0934 ***	6.9313 **	7.2612 **
BR × *TO* × *INF*						0.4657 *	0.6895 ***	0.6306 ***	0.3097
HM	34.0674 ***	35.2551 ***	31.6635 ***	29.5305 ***	30.4694 ***	31.1102 ***	30.6616 ***	31.4140 ***	29.9272 ***
FDI	0.1523 ***	0.0961 **	0.1446 ***	0.1649 ***	0.1691 ***	0.1791 ***	0.1746 ***	0.1729 ***	0.1693 ***
SE	−22.9396 **	−30.5441 ***	−17.0292	−17.6116 **	−15.8193	−15.9404	−26.9314 ***	−23.0835 **	−21.0201 **
Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.6475	0.6840	0.6559	0.7969	0.7068	0.6691	0.7905	0.7068	0.8014

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

Table 14. The robust testing results for different dimension characteristics based on composite trade dependence degree.

	CTDD							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
BR	1.8141 ***	2.3050 ***	2.0888 ***	2.1382 ***	2.1290 ***	2.0524 ***	2.1954 ***	2.1917 ***
Ln_RO					−0.4884	−0.4377		
TO	−23.7215 **	−20.8181 *	−28.8144 **	−42.0853 ***			−9.8162	−37.7877 ***
INF	−11.3040 ***	−13.3163 ***	−9.7263 ***	−9.5704 ***	−1.3150	−2.9485 *	−5.5076 *	−9.7755 ***
TO × *INF*	11.0084 ***	10.1653 ***	11.5615 ***	9.9567 ***	0.5605	0.4803	5.5218	10.0726 ***
INCV × *TO*	−22.3296 **							
INCV × *INF*		5.8234 *						
INCV × *TO* × *INF*			−3.0116					
LCV × *TO*				20.4469 **				
SDLV × *TO*					17.3349 ***			
SDLV × *TO* × *INF*						4.0019 ***		
ICV × *Ln_RO*							−2.6419 ***	
ICV × *TO*								14.9072 *
HM	30.3200 ***	30.7832 ***	30.2362 ***	30.3983 ***	29.6283 ***	29.9575 ***	35.5749 ***	40.8506 ***
FDI	0.1704 ***	0.1731 ***	0.1673 ***	0.1746 ***	0.1428 ***	0.1357 ***	0.1307 ***	0.1619 ***
SE	−16.7386 *	−19.8207 **	−13.9164	−16.1098 *	−19.0086 **	−14.4456 *	−15.3169 *	−16.0654 *
Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.7270	0.7181	0.7156	0.7209	0.8109	0.8167	0.7089	0.6117

Note: "*", "**", "***" represent their significance levels of 10%, 5% and 1% respectively.

7. Conclusions and Implications for China's B&R

China's B&R as a national strategy aims to promote international economic integration, which has had an important impact on the trade dependence relationship of Asian countries with China in recent years. In this study, we focused on the trade dependence degree of Asian countries and examined their changing characteristics in response to the implementation of the B&R as well as the possible influencing factors. Meanwhile, we provided further analysis of influencing factors considering country characteristics based on a series of group tests and a robust analysis for the alternative measure of the degree of trade dependence. The detailed results of this research reveal a series of important findings.

Firstly, the trade dependence degree of Asian countries with China has increased after implementing the B&R, but their growth rates have no persistent rising tendency. There is no evidence to assert that the B&R will lead to Asian countries relying more heavily on China for trade. Secondly, the energy exports of Asian countries has no significant impact on the trade dependence relationship, so the B&R does not bind the trade dependence of Asian countries by energy export. Thirdly, our empirical results show that the trade openness and infrastructure development will relieve the severity of trade dependence of Asian countries with China. However, the cross-product term of infrastructure and trade openness has an inhibitory effect, and Asian countries with higher trade openness and infrastructure score will be more inclined to establish trade relationships with China. Finally, the grouping analysis for the influencing factors shows that four national characteristics have different promoting or inhibiting effects on the influencing factors of the trade dependence relationship. The robust test, by combining alternative trade dependence indicators based on the information entropy method reveals similar conclusions. For the control explanatory variables, we have some consistent findings with the existing research.

Based on the results presented in this paper, we have provided some empirical evidence on the controversy with regard to the strategic intention of China's B&R. Since the B&R was put forward, there have been many doubts from other countries. Many countries worry about whether the huge investment from the B&R is designed to help China better deprive their energy resources of other countries. Asian belt-road countries possess abundant energy resources; hence they worry about whether massive energy exports to China will cause the domestic economy to become overly dependent on energy resources. Meanwhile, Asian belt-road countries also worry about whether the excessive trade contacts will generate strong trade dependence with China. However, our analysis results show that such worries are misplaced. The investment in the energy and infrastructure fields from the B&R not only provides a stable energy supply for China, but also improves the market services, investment environment and the economic development of Asian countries through the spillover effect on capital, knowledge and technology. Although trade exchange between China and Asian countries is becoming more frequent, the trade dependence degree of Asian countries with China has not kept increasing. Therefore, China's B&R policy doesn't impose a huge energy and trade burden for Asian countries, but instead has promoted the common development of trade and economic relations between China and Asian countries. This provides strong incentive to continue with the implementation of the Belt and Road initiative.

For the effective implementation of China's B&R in the future, we have some policy implications for China's government, which are as follows. Firstly, the implementation intensity of the B&R at the earlier stage is feasible. Although Chinese economic growth slows continuously at present, the B&R is helpful for reconfiguring China's international trade relationship with belt-road countries. From the existing implementation effect of the B&R, the trade dependence relationship of Asian countries with China does not strengthen drastically under China's current large investment, which does not cause concern on behalf of the Asian countries for the trade burden and is conducive to better implementation of the B&R policy. Secondly, the B&R has the potential of changing the foreign trade structure of Asian countries, so China's government should make some complementary strategies according to the trade products and distribution of energy resources. For example,

concerning the Southeast Asian countries (Brunei, Cambodia, Vietnam, Malaysia and so on), we can encourage domestic enterprises to invest and cooperate for industrial chain upgrading and product diversification of natural rubber and oil palm. For the Central and West Asian countries, we can strengthen energy investment to promote production capacity cooperation. Thirdly, some specific national characteristics of Asian countries such as income level, geographical position, social development level and intimacy with China may need to be considered more in the process of forming China's overseas investment strategy along the belt-road countries. Different national characteristics have different promoting or inhibiting effects on trade implementation; therefore the Chinese government should carry out targeted trade cooperation strategies and choose preferred partners, and then gradually realize the goal of common prosperity. Asian countries with stable social development environments and less cultural differences with China can be prioritized as investment opportunities of the B&R. Fourthly, the Chinese government should deepen its trade coordination mechanisms and investment strategies based on equality and reciprocal principles so as to enhance the effectiveness of the B&R policy. From the conclusions in this study, we find that energy export, trade openness and infrastructure are very important for Asian countries to maintain a stable trade dependence relationship with China. Therefore, trade and investment should consider the urgent needs of Asian countries. Meanwhile, the implementation process of the B&R policy tries to avoid conflict. Finally, the belt-road countries should take advantage of the B&R opportunities and make more of an effort to strengthen international cooperation. Asian countries should consider their own advantages and adopt a more positive attitude to become China's investment and trade targets.

Although this study provides a comprehensive analysis of the trade dependence relationship of Asian countries with China and explores the influencing factors from multiple dimensions, it still has some limitations. The trade dependence indicator can be refined to specific product types based on detailed trade data; this would ensure that the results of the analysis will be more relevant Although Asian countries have closer trade relationships with China because of their proximity, the studied sample can be extended to all belt-road countries, and then we can comprehensively compare and identify the effects of B&R on the degree of trade dependence. All of this is planned for future research.

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