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INTERNATIONAL TRADE STRUCTURE AND ANALYSIS OF COMPLEMENTARITY BETWEEN CHINA AND POLAND, THE CZECH REPUBLIC AND HUNGARY

The purpose of the article is to study the current international trade structure and complementarity between China and the three main central European countries: Poland, the Czech Republic, and Hungary. Based on the international trade structure study, trade complementarities are discussed and further development strategies are proposed. In this study some relevant international trade theories are used in the quantitative analyses and these include revealed comparative advantage index (*RCA*) and trade complementarity index (*TCI*). At the end of the article a stochastic frontier trade gravity model is used to calculate trade efficiency and potential between China and the three central European countries. It is found that complementarities of China to the three central European countries are mainly in the labour-intensive products, while complementarities of the three central European countries to China are in the resource-intensive products. However, the current structure of imported and exported products between China and the three central European countries is different from results of the complementarity analyses. At the end of the article some development strategies are proposed to optimize the international trade structure between China and the three central European countries.

Keywords: international trade, structure, complementarity, China, CEEC
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1. INTRODUCTION

As early as 2012, when Chinese Premier Li Keqiang first met leaders of Central and Eastern European countries (CEEC), he formally announced an establishment of a cooperation mechanism between China and the 16 CEEC (called "16+1" cooperation). In 2013, Chinese President Xi Jinping coined the strategic concept of the Silk Road Economic Belt and the 21st-Century Maritime Silk Road, known as the "One Belt One Road" (OBOR) initiative, thus beginning to implement and promote cooperation, trade and economic development between China and the CEEC.

In fact, the "16+1" cooperation can be regarded as one of the key OBOR projects. Among the 16 CEEC, Poland, the Czech Republic, Slovakia and

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Hungary formed a political and cultural alliance called the Visegrád Group, the Visegrád Four, or simply V4 (Visegrád Group 2018). The V4 are the main international trade partners in the Central and Eastern European (CEE) region for China given the strategic location and the total population of V4. Therefore, it is of vital importance to study the trade structure and complementarity between China and the V4. However, Slovakia was excluded from this study for the following reasons: The "China-Central and Eastern European Countries (16+1) Cooperation Five-Year Achievement Report: 2012-2017" pointed out the rapid development of trade cooperation between China and the Central and Eastern European countries in the past five years. Among those, the strategic partnership between China and the Czech Republic (2016) and Hungary (2017) has grown from nothing, and at the same time the friendly cooperation with Hungary in the same year has been upgraded to a comprehensive strategic partnership. In 2016, China and Poland improved their level of strategic cooperation from strategic partnerships to comprehensive strategic partnerships. Based on the OBOR big data report, Poland, the Czech Republic, and Hungary are the top three biggest traders for China among all the CEEC (CSIC, 2016), and are "potential growth" countries. Even in the context of weak global trade, the three countries have a large and fast growing volume of trade with China. The trade volume between China and Slovakia is significantly lower than those of the other three V4 countries, and Slovakia adopted the euro in 2009 which may affect its international trade structure and volume (see e.g. Cieślik et al. 2014; Žúdel and Melioris 2016). However, the other three V4 countries are still using their own currencies. The three Central European countries of Poland, the Czech Republic and Hungary are located in the hinterland of Central and Eastern Europe. They are important nodes in the countries included in the "16+1" cooperation and the "Belt and Road". However, most of the relevant studies do not include the Czech Republic, Poland and Hungary as separate research priorities. Therefore, it is better to group the three V4 countries for this study because they are in similar conditions and the results will be more comparable.

The first China-CEEC (16+1) five-year cooperation report for 2012-2017 points out that the cooperation between China and the CEEC has expanded significantly into different sectors including political, economic, trade, investment, finance, infrastructure, energy, cultural exchange and social development (Huang and Liu 2018). Among all the CEEC, China pays special attention to Poland, the Czech Republic, and Hungary due to their strategic location and significant role in the CEEC.

The key content in the OBOR initiative is about investment and trade between China and the related OBOR countries. International trade is one of the priorities in developing cooperation among the OBOR countries. This is particularly true for the three CEEC because Poland, the Czech Republic and Hungary are centrally located in Europe and they are the three largest traders for China for both imports and exports in the CEE region (Élteto and Szunomar 2016). Therefore, a study of international trade structure and complementarity will help establish a balanced trade relationship between China and the relevant OBOR countries.

China's trade relations with Poland, the Czech Republic and Hungary absolutely deserve attention and further development. The study of trade complementarity is particularly important, to provide insights for optimizing trade structure between China and the three CEEC.

In order to study the above issues three research questions are developed as follows. *(1) What are the current international trade structures between China and the three CEEC? (2) What are the results from the complementarity analysis between China and the three CEEC? (3) What are the corresponding strategies to optimize the trade structures between China and the three CEEC?*

To answer these questions, a few trade theories are used in this study such as the revealed comparative advantage index (*RCA*) and the trade complementarity index (*TCI*). The article is divided into six sections. First, a brief background of the study is presented and a literature review follows in the second section. Then in the third section the current trade structures between China and the three CEEC are described. The fourth section is an empirical analysis concerning trade complementarity study by adopting models of *RCA* and *TCI*. A stochastic frontier trade gravity model is used in the fifth section to find out the trade potential between China and the three CEEC. In the last section, conclusions and some trade development strategies are proposed and discussed concerning China and the three CEEC.

2. LITERATURE REVIEW

2.1. Relevant theories

In international trade research there are some traditional theories that need to be reviewed. The most fundamental theory is Smith's theory of absolute advantage (Smith 1776). The theory implies that if the labour productivity of Country A in one product is higher than that of Country B,

Country A will export this product. However, in reality, developed countries have an absolute advantage in almost all products and still trade with other countries. Under this situation, Ricardo (1817) coined the law of comparative advantage. In his opinion, even if Country A has absolute advantages in both products and Country B has absolute disadvantages, the possibility of trade would still exist if the absolute advantages are different. The comparative advantages can be determined by factor endowments, differences in labour productivity or production levels and technology characteristics.

In this research, the revealed comparative advantage (*RCA*) index is used to measure the comparative advantage of China and the three CEEC. The notion of *RCA* was proposed by Balassa (1965), which was defined as the ratio between the proportion of a particular commodity in the total exports of the country and the share of this commodity in the world total exports.

$$RCA_i^k = \left(X_i^k / X_i\right) / \left(X_w^k / X_w\right), \tag{1}$$

where: RCA_i^k – comparative advantage of export product k in country I; X_i^k – total export of product k in country I; X_w^k – total export of product k in the whole world w; X_i – total exports of country I; X_w – total exports of all countries.

This index can be regarded as an indicator for evaluating comparative advantage and international competitiveness. In general, if *RCA*<0.8, it means that this commodity has little world competitiveness; if *RCA* is between 0.8 and 1.25, it starts to enjoy a certain comparative advantage; if *RCA* is between 1.25 and 2.5, the competitiveness is considerable; if *RCA*>2.5, this kind of goods is strongly competitive.

For a trade complementarity study between different countries, one of the most typical methods is to use the trade complementarity index (*TCI*). Drysdale (1969) defined *TCI* as the product of the revealed comparative advantage index measured by the export of one country in a certain commodity and the revealed comparative disadvantage index measured by the import of the other country in that commodity. *TCI* can be expressed as:

$$TCI_{ij}^k = RCA_{Xi}^k \times RCA_{Mj}^k, \tag{2}$$

with

$$RCA_{Mj}^k = \left(M_j^k / M_j\right) / \left(M_w^k / M_w\right), \tag{3}$$

where: TCI_{ij}^{k} – trade complementarity index of country i and j in product k; RCA_{Xi}^{k} – comparative advantage of export product k in country I; RCA_{Mj}^{k} – comparative advantage of export product k in country j; M_{j}^{k} – total import of product k in country j; M_j – total imports of country j; M_{w}^{k} – total import of product k in the world w; M_w – total imports of the world w.

Generally speaking, if $TCI>1$, the trade complementarity is strong, otherwise it is weak. When the export commodity of one country is identical with the import commodity of the other country, *TCI* tends to be greater.

2.2. Relevant research

There has been very little research so far concerning international trade between China and the three CEEC: Poland, the Czech Republic, and Hungary. Palonka (2010) discussed the economic and trade relations between Poland and China and found that there is an imbalance of the quantity of goods traded between the two countries, and strategies for optimizing the bilateral trade are required. Yao (2017) investigated the Sino-Polish economic cooperation under the 16+1 formula and claimed that Poland is a very important participant of the 16+1 formula and OBOR initiative because of its central location and relatively big market and high GDP growth rate in recent years. Both Poland and China are export-oriented but the current trade situation does not show the expected results for both countries. Stehel and Šuleř (2016) studied the international trade structure between China and the Czech Republic and also discussed trade complementarity between both countries. Castro et al. (2017) examined the trade and investment relations between the Czech Republic and China and explored future opportunities and threats for more intensified trade and investment relations. They found that in recent years more Chinese value-added exports to the EU market went through the Czech Republic. Therefore, the Czech Republic can be as regarded a gateway to the EU for China. Fábián et al. (2014) pointed out there is a huge deficit in bilateral trade for Hungary in trading with China. Hungary imports much more than its exports to China, even in the agriculture sector.

In the literature there are some trade complementarity studies among China and countries other than the CEEC. These studies can be used as examples to study the trade structure and complementarity between China and the three CEEC. Zhou et al. (2007) examined the trade complementarity between China and Australia in the agriculture sector, with the resulting high

level complementarity and its growing trend. Lv and Xiang (2010) used the revealed comparative advantage analysis and intra-industry index to identify trade complementarity between China and the USA. According to Munemo (2011), the result of empirical research showed that trade complementarity of China to Southern African countries was much higher than that of Southern African countries to China. Vahalik (2014) analyzed the trade complementarity among the EU, China and the Association of Southeast Asian Nations (ASEAN), which implied that the EU was a bigger trading partner to ASEAN than to China. Zheng et al. (2018) studied the international trade structure and complementarity between China and the Baltic States and concluded that there is an inconsistency between the current trade structure and the results from the complementarity analysis. In order to exploit the trade potential a number of strategies can be used, for example to strengthen the transport infrastructure construction. Although these studies do not concern Sino-CEEC directly, they have some implications for the trade structure and complementarity study between China and the three CEEC. In the following section a detailed trade structure and complementarity study between China and the three CEEC will be conducted and discussed.

Previous studies are fairly few and are mainly concentrated on single and separate factors affecting trade between China and the CEEC. Unlike previous studies, in this study an integrative approach is adopted to study trade between China and the three CEEC. The current trade structure, complementarity analysis and further development strategies will be discussed in the study. *RCA*, *TCI*, and a stochastic frontier trade gravity model are combined in this study to give a comprehensive understanding of the trade situation between China and the three CEEC.

3. THE CURRENT TRADE STRUCTURE BETWEEN CHINA AND POLAND, THE CZECH REPUBLIC AND HUNGARY

In this section, trade data from 2001 to 2016 of China with Poland, the Czech Republic, and Hungary, compiled from the United Nations Commodity Trade Statistics Database (UN Comtrade Database), are used to analyze their current trade structures. In addition, the Standard Industrial Trade Classification Revision 3 (SITC Rev. 3) is used for trade classification, in which SITC0 to SITC4 are resource-intensive products, while SITC5 and SITC7 are capital-intensive products and SITC6 and SITC8 are labour-intensive products.

3.1. The current import and export structure between China and Poland

The data from 2001 to 2016 reveal that China enjoys a trade surplus with Poland. China's main export products to Poland are mainly SITC 6, 7 and 8. They account for more than 90 percent of the total export share. Among them, SITC7 has the largest share, the fastest growth rate, and the largest proportion in the past ten years. The export ratio of SITC6 has been stable at 13-15 percent. It should be noted that in these years, the three products of SITC0, 2, and 5 continue to occupy extremely low levels and maintain their levels.

China's large-scale purchase of goods from Poland are mainly SITC0, 2, 5, 6, 7, 8. The shares of these categories are distributed evenly, but the overall figure is more than 99 percent of the quota. Also, the structure of China's imports of goods from Poland is highly unstable. It is generally dominated by technology or capital-intensive goods, followed by labour-intensive goods and resource-intensive products.

3.2. The current trade structure between China and the Czech Republic

Since the beginning of this century, China's export quota to the Czech Republic has been greater than the import quota, and the gap has become bigger and bigger. The Czech Republic mainly purchases SITC6, 7, and 8 from China, accounting for more than 95 percent. Correspondingly, the share of SITC0, 2, and 5 products is only 3 percent, and the remaining categories can be ignored. The upward trend of SITC7 was the fastest. The share rose from 2001 to 2016, stabilizing at around 80 percent, accounting for the largest proportion of total exports, significantly exceeding the other categories of goods. This shows that China's exports to the Czech Republic are concentrated on technology or capital-intensive goods.

China's imports to the Czech Republic are also mainly concentrated on SITC6, SITC7 and SITC8. The share of SITC7 products from 2001 to 2016 rose, stabilizing at around 75 percent. Meanwhile, the share of SITC6 and SITC8 in total imports is about 7%, which is significantly similar to China's exports to the Czech Republic. China is also importing similar goods from the Czech Republic.

3.3. The current trade structure between China and Hungary

The export volume of international trade between China and Hungary was greater than the import volume from 2001 to 2016, but since 2009 the trade surplus has steadily declined. Hungary favours SITC7 and 8 from

China, and the export volume of SITC7 products were rising and stabilized at around 75 percent. At the same time, the share of SITC8's total exports gradually dropped and stabilized in 2004, remaining stable at around 20 percent. At the same time, SITC5 and SITC6 as secondary commodities accounted for a small proportion, averaging about 5.1 percent.

China's imports of goods from Hungary are also mainly concentrated on SITC7 and SITC8. The share of SITC7 products from 2001 to 2016 is relatively stable at around 80 percent. In the meantime, the SITC8 category shows an increasing trend in total imports, and the ratio has stabilized at around 15 percent in recent years. At the same time, SITC0, SITC5 and SITC6 account for a very small share, with an average of 8 percent. Imports and exports from China to Hungary are mainly concentrated on technology or capital-intensive products and labour-intensive products.

4. TRADE COMPLEMENTARITY ANALYSIS BETWEEN CHINA AND POLAND, THE CZECH REPUBLIC, AND HUNGARY

4.1. RCA analysis

The *RCA* for China and the three main central European countries: Poland, the Czech Republic, and Hungary can be seen in Tables 1 to4 (see Appendix).

From Table 1 (see Appendix), we can see that among the products with the code number 0 to 4, China is not dominant, even inferior to the average level, and shows a gradual decline. So it is difficult to take a greater international market share. Since the beginning of this century, SITC7 has been continuously upgraded. By 2006, it surpassed the 1.25 mark, which has brought a lot of economic benefits to China.

Poland's resource advantage is obvious shown in Table 2 (see Appendix), and the *RCA* of SITC0 to 4 is relatively high. Among them, the progress of SITC1 is the fastest, which reflects strong international competitiveness. The *RCA* of SITC0 products is showing strong comparative advantage, which means that Poland's food and other products are generally favoured by people around the world, and that the export volume is large.

From Table 3 (see Appendix) we can see that among the product types of Czech SITC0-4, there is no coordination and the level is uneven. The overall development of SITC1 is rapid, and the comprehensive level is continuously enhanced, which shows that the country has strong international competitiveness in this field, and that its market share is firm. We can see that the prospect of SITC7 is bright, and it has been steadily improving for

more than a decade, which means that the country is valued highly in this field.

In Table 4 (see Appendix), the industry with the strongest comparative advantage in Hungary is technology and capital-intensive industry. SITC7 products have the greatest advantage among them, and the *RCA* of SITC5 products is rising steadily. The second industry with a strong comparative advantage is labour-intensive industry, of which SITC8 has a significant decline, while the *RCA* of SITC6 products becomes larger. As for all the resources intensive export commodities in Hungary, the comparative advantages of SITC0 and SITC4 are better than others, achieving a strong international competitiveness.

4.2. TCL analysis

By analyzing Table 5 (see Appendix), we can see that for resource products, Poland does not rely on China's imports, and their relevance is still declining. SITC0 and SITC1 have a certain share at the beginning, exceeding 0.5, but it also shows a rapid downward trend. This means that China's complementarity with Poland on these two types of goods is getting weaker and weaker. The *TCI* index of SITC7 products has been increasing year by year, and it has been higher than 1 since 2002, which indicates that China's complementarity to Poland's machinery and transportation equipment is steadily strengthening, and the trade complementarity is strong. The *TCI* index of labour-intensive industries is still considerable, which demonstrates that Poland needs China's labour-intensive products the most, but at the same time China's comparative advantage and trade complementarity with Poland have dropped significantly, which indicates that in addition to maintaining the original strengths, it must be good at developing other industries.

We can see in Table 6 (see Appendix) that both SITC0 and SITC1 have TCL indices of more than 2, which can well meet China's demand. The *TCI* index of SITC2, SITC3 and SITC4 products continues to be less than 1, indicating Poland's complementarity with China in these types of resource-intensive products is low. SITC5 and 7 are always above 1, which means that Poland's relevant industry standards are still above China's and satisfy China's needs very well. The TCL index of SITC6 and SITC8 is on the rise, reflecting Poland's high complementarity to China in labour-intensive commodities.

In Table 7 (see Appendix), the Czech Republic is not too dependent on China's resources, and this momentum is still expanding. The changes in SITC0 are particularly evident, from the strong trade complementarity in 2001 to the weak complementarity in 2016. The *TCI* index of the other four categories has also declined over the past 16 years. This trend shows that China's complementarity with the Czech Republic on these four categories of goods is getting weaker. Although SITC7 products have declined since 2011, the *TCI* index is still greater than 1. As regards labour, China's abundant labour force is obviously required by the Czech Republic, so the complementarity index is greater than 1. China's most complementary products to Czech trade are goods of labour-intensive industries. Also, the market share of technology or capital-intensive goods is large, and has made some progress. This shows that we should continue to maintain and promote the trade development of labour-intensive industrial goods, technology and capital-intensive goods will be China's main breakthroughs in the future in the search for more profit.

Table 8 (see Appendix) shows that some resources in the Czech Republic are in short supply in China, like SITC0 and SITC1. The complementarity index is high, so the Czech Republic should continue to strengthen the export of these two types of goods to China in the future. The *TCI* index of SITC2, SITC3 and SITC4 commodities continued to be less than 1. In regard to the technology and capital-intensive commodities, the trade complementarity index of the Czech Republic has increased slightly in general. This clearly represents the extremely high level of development of the Czech Republic in this field. The product quality is higher than that of China, so the products are favoured by China. It also maintains high complementarity in the labour-intensive industries SITC6 and SITC8, and most of the commodities in this industry are also the most competitive commodity groups in the Czech Republic. It can be seen that the Czech Republic has corresponding commodity types in different industries and is highly complementary to China's trade and has international competitiveness.

In Table 9 (see Appendix), we can see clearly that China's complementarity of SITC0-5 has continued to decline from 2001 to 2016. The *TCI* index of the five categories of commodities is much less than 1, and the trade complementarity is weak. Among them, SITC0, SITC1 and SITC2 products have strong trade complementarity in 2001 and reduced to weak complementarity in 2016, while the *TCI* indices of other two types of products are also decreasing, always far less than 1, maintaining a weak

trade complementarity. In technical and capital-intensive products, the *TCI* index of SITC5 products has not changed much, and the *TCI* index of SITC7 products was increasing year after year from 2001 to 2016. China's advantageous industries, labour, and related products are all larger than 1, which means that our abundant labour is what the local market needs. This phenomenon shows that we should continue to maintain and promote the trade development of goods in labour-intensive industries, technology and capital-intensive goods should be the future development goals of China.

Table 10 (see Appendix) shows that in China's market, Hungary's technology and capital industry products are most favoured. SITC5 and SITC7 have international comparative advantages and a high *TCI* index, which is in line with Hungary's major industries and manufacturing advantages, followed by labour-intensive industries. SITC6 and SITC8 have a comparative advantage that is slightly lower than that of technology-intensive industries, and have a basically similar trade complementarity. In resource-intensive industries, SITC0 and SITC4 commodities have advantages and complementarities in the trade. In general, Hungary should continue to strengthen imports of technology, capital intensive and labour-intensive goods to China, and select SITC0 and SITC4 for resource-intensive industries to import into China.

4.3. Analysis of intra-industry trade index

From the analysis in the previous section, we can see the degree of trade complementarity between China and Poland, the Czech Republic and Hungary. At the same time, the third chapter finds an obvious intra-industry trade phenomenon when studying the trade structure between China and the three countries. Trade complementarity is usually reflected in the inter-industry complementarity and the complementarity within the industry. Therefore, in this section the intra-industry trade index between China and Poland, the Czech Republic and Hungary will be calculated varying the trade structure and complementarity to point the way for future trade.

In this section we will use the Gruber-Lloyd index (*GL*) for calculations; its formula is:

$$GL = 1 - \frac{\left|X_i - M_i\right|}{X_i + M_i}, \tag{4}$$

X_i – the export value of a country in a particular industry or category of goods; M_i – the import value of a country in a particular industry or category of goods.

4.3.1. Intra-industry trade index between China and Poland

As shown in Table 11 (see Appendix), combined with the trend and overall situation of the *GL* index from 2001 to 2016, it can be seen that the commodities with a high trade index between China and Poland are SITC0, 5, 6, 7 and SITC8, while the other five commodities are lower or do not have a stable level of intra-industry trade; this reflects the trade relationship between industries. Among them, SITC5 and SITC6 intra-industry trade index was rising, and in 2016 they rose to 0.92 and 0.87 respectively, with extremely high intra-industry complementarity. However, SITC7 has maintained a relatively high level of intra-industry trade of around 0.5 for many years, while SITC0 and SITC8 have grown significantly, from low-industry trade to higher intra-industry trade.

4.3.2. Intra-industry trade index between China and the Czech Republic

It can be seen from Table 12 (see Appendix) that in combination with the trend and overall situation of the *GL* index from 2001 to 2016, it is obvious that the commodities with a high trade index between China and the Czech Republic are SITC0, SITC2, SITC5 and SITC6, while the other six categories of commodities have a lower or unstable intra-industry trade. Among them, SITC0 developed from a low trade level of 0.21 in 2001 to a high intra-industry trade level of 0.78 in 2016, while SITC2 continued to maintain its high level of intra-industry trade. SITC5 fluctuated from 0.87 and 0.84 in 2001 but declined to 0.39 and 0.45 in 2016. Although the inter-industry trade index continued to decline, it remained above 0.5. The future trend is still promising and there may be a big rise.

4.3.3. Intra-industry trade index between China and Hungary

From Table 13 (see Appendix) we can see that in combination with the trend and overall situation of the *GL* index from 2001 to 2016, it is clear that the commodities with a high trade index between China and Hungary are SITC5, SITC6, SITC7 and SITC8, while the other six commodities have a lower or unstable intra-industry trade level. Among them, SITC5 was at the level of high intra-industry trade development, the *GL* index steadily increased from 0.68 in 2001 to 0.93 in 2016, while SITC6, SITC7 and SITC8 developed from low-industry trade to *GL* index at 0.6 – the degree of high intra-industry trade was around 0.8.

Through the above-mentioned intra-industry trade index, it can be seen that China has a relatively high level of intra-industry trade among the six categories of SITC0, SITC2, SITC5, SITC6, SITC7 and SITC7 with Poland, the Czech Republic and Hungary, especially in the latter four categories. This shows that China and the three CEEC have shown a high level of internal two-way flow in labour-intensive, technology and capital-intensive products. The findings of this study differ from previous research results (e.g. Palonka 2010; Fábián et al. 2014; Stehel and Šuleř 2016) which only pointed out the trade imbalance between countries without mentioning specific industries and products and the current nature of the intra-industry trade between China and the three CEEC.

5. TRADE POTENTIAL ANALYSIS BETWEEN CHINA AND POLAND, THE CZECH REPUBLIC, AND HUNGARY

5.1. Model construction

The trade gravity model can be used to analyze in depth and evaluate the important factors affecting bilateral trade, so as to extensively and thoroughly analyze the specific conditions of trade (Drysdale et al. 2000; Egger 2002; Sheng et al. 2010; Zhang et al. 2010; Dowd et al. 2011; Ravishankar and Stack 2014; Fan et al. 2016; Doan and Xing 2017). The trade gravity model implies that the greater import and export quotas between countries lead to higher profits, and a longer distance leads to the higher cost, so the profit margin will be compressed. This research will use the Frontier 4.1 software to estimate the stochastic frontier trade gravity model (Battese and Coelli 1992, 1995) and provide decision-making advice for future development planning by analyzing and assessing trade inefficiencies that hinder trade between China and the three CEEC.

First, based on the selection of gravity model variables, the stochastic frontier model is established as follows:

$$\begin{aligned} \ln TRADE_{it} = {} & b_0 + b_1 \ln GDP_t + b_2 \ln GDP_{it} + \\ & b_3 \ln DIS_{it} + b_4 \ln POP_{it} + \upsilon_{it} - u_{it} . \end{aligned} \tag{5}$$

Among them, β_0, β_1, β_2, β_3, and β_4, respectively, represent the intercept, the coefficient of the GDP variable of the importing country, the coefficient of the GDP variable of the exporting country, the coefficient of the

geographical distance variable, and the population coefficient of the exporting country. The random error term υ_{it} obeys the normal distribution $N(0,\sigma^2)$, and the technical inefficiency term obeys the truncated normal distribution. These two are independent of each other.

The technical inefficiency model is established as follows:

$$u_{it} = \delta_0 + \delta_1 TRA_{it} + \delta_2 M\,ON_{it} + \delta_3 TAF_{it} + \delta_4 EUN_{it} + w_{it}, \tag{6}$$

where δ_0 represents the constant to be estimated, δ_1, δ_2, δ_3, δ_4, respectively, represent the coefficient values of the four technical inefficiency variables, and Wit represents the random error, obeying the normal distribution. Technical efficiency expression for the t-th year of the i-th host country is

$$TE_{it} = \exp\left(-u_{it}\right). \tag{7}$$

Table 14

Description of model variables

	Unit	Define	Data sources
$\ln TRADE_{it}$	Ten thousand dollars	China's trade volume with the i-th trading partner in the t-year and the three CEEC	UNcomtrade
GDP_t	Ten thousand dollars	China's t-year GDP	UNCTADstat
GDP_{it}	Ten thousand dollars	GDP of the t-year of the trading partner country	UNCTADstat
DIS_{it}	Kilometre	Geographical distance between China and the i-th trading partner	French International Prediction Research Centre
POP_{it}	Thousand people	Population of the t-th year of the i-th trading partner	
EUN_{it}	Dummy variable	The i-th trading partner joined the EU in the t-th year	
$COOPER_{it}$	Dummy variable	The situation of 16+1 cooperation in the t-year of the i-th trading partner	
TRA_{it}	Scale score	Trade freedom index of the t-th year of the i-th trading partner	Index of Economic Freedom
INV_{it}	Scale score	Investment freedom index of the t-th year of the i-th trading partner country	Index of Economic Freedom
TIM_{it}	Day	Import turnover days of the t-th year for the i-th trading partner country	WDI

Source: own elaboration.

The variable description is presented in Table 14. The results of the analysis of the panel data by the model are summarized in Table 15.

Table 15

The results of the model fitting

Variable	Coefficient	Coefficient value	Standard deviation	t-value
	β_0	267.67 ***	1.135	236.68
GDP_t	β_1	0.596***	0.111	5.38
GDP_{it}	β_2	1.356***	0.154	8.79
DIS_{it}	β_3	-28.14***	0.343	-81.94
POP_{it}	β_4	-2.192***	0.118	-18.53
	δ_0	1.016***	0.684	14.86
EUN_{it}	δ_1	-0.177**	0.110	16.03
$COOPER_{it}$	δ_2	-0.038***	0.104	3.66
TRA_{it}	δ_3	-0.070***	0.008	-9.26
INV_{it}	δ_4	-0.070***	0.005	13.51
TIM_{it}	δ_5	0.016***	0.018	-8.89
	sigma-squared	14.59	0.004	3.61
	γ	0.99	0.016	61.02
log likelihood function = 33.86				
LR test of the one-sided error = 79.72				

*** 1% significance level, ** 5% significance level

Source: own calculations.

In this model, the value of γ is 0.99, noticeably close to 1, so the model established in this study is reasonable. In addition, according to the result *LR*=79.72, we can see that this model passes the significance test and obeys the mixed chi-square distribution, indicating the existence of the technical inefficiency term. Based on the above analysis, the model has certain rationality. This means that the fluctuation of the import and export quotas of China and the other three countries can be perfectly interpreted by this equation. Conversely, by substituting the corresponding variables into the equation and reversing the push, one can get the corresponding potential calculation formula.

After calculation, the estimated model is as follows:

$$\ln TRADE_{it} = 267.67 + 0.596 \ln GDP_t + 1.356 \ln GDP_{it} - 28.14 \ln DIS_{it} - 2.192 \ln POP_{it} + \upsilon_{it} - u_{it}, \tag{8}$$

$$u_{it} = 1.016 - 0.177\, EUN_{it} - 0.038\, COOPER_{it} - 0.070\, TRA_{it} - 0.070\, INV_{it} + 0.016\, TIM_{it} + w_{it}. \tag{9}$$

We find out that the distance is inversely proportional to the import and export quota. For every 1% increase in distance, the total amount of imports and exports will be reduced by about 30%, which means that the main

objective conditions restricting the transnational trade of the four countries is spatial distance. This leads to an increase in freight costs and a longer cycle, which incurs more costs. As for the GDP factor, the impact of China's GDP is significantly lower than that of other three CEEC, which shows that China's trade structure and that of the three CEEC can have more opportunity for improvement. The population of Poland, the Czech Republic and Hungary has a significant negative impact on trade volume. It can be understood that when the population of the three countries increases, the disadvantage of labour shortage can be somewhat relieved. Whether to join the EU, whether to join the "16+1" cooperation, trade freedom and investment freedom are all significant at the 1% level, which has a positive impact on efficiency.

5.2. Trade potential and the possible development strategies

Following the calculation, the trade efficiency values of the total imports and exports volume of China and the three CEEC from 2001 to 2016 obtained are shown in Table 16. The value of trade efficiency ranges from 0 to 1. The magnitude of efficiency represents the level of trade efficiency between those countries. Higher trade efficiency will lead to the smaller trade potential, and vice versa.

Table 16

Trade potential value from 2001 to 2016

Year	Poland	The Czech Republic	Hungary
2001	0.67	0.61	0.96
2002	0.66	0.69	0.92
2003	0.78	0.81	1.00
2004	0.67	0.65	0.83
2005	0.64	0.57	0.61
2006	0.72	0.61	0.74
2007	0.75	0.70	0.76
2008	0.65	0.59	0.66
2009	0.69	0.63	0.72
2010	0.68	0.82	0.83
2011	0.61	0.72	0.69
2012	0.68	0.67	0.64
2013	0.61	0.67	0.57
2014	0.64	0.75	0.55
2015	0.74	0.84	0.57
2016	0.77	0.79	0.60
Average efficiency	0.68	0.69	0.73

Source: own calculations.

The average trade efficiency values of China and Poland, China and the Czech Republic, and China and Hungary between 2001 and 2016 were 0.68, 0.69 and 0.73 respectively, indicating that their trade potential has been tapped to some extent, but there is still room for development. As far as the comprehensive trade potential of China and these three countries is concerned, the trade efficiency values of these three countries were fluctuating from 2001 to 2016, with a little or even downward change. This means that we have not shown all the potential and have not used the value to the maximum.

Combining the equations obtained from the model, this research proposes the following methods and policies for trade between China and Poland, the Czech Republic and Hungary:

1. Initially, since the import turnover days have a negative impact on trade efficiency, the transportation network should be established to ensure the efficiency and safety factor of the transportation process. Building a fast and convenient transport system between the four countries to reduce trade costs, shortening the import and export turnover cycle and increasing the overall profit margin, it can prosper, grow faster and avoid wasting resources as well.

2. Secondly, we must combine the complementarities of each other and adjust the proportion of export products. China should focus on strengthening the production and export of labour-intensive goods, while Poland should increase exports of resource-intensive products to China and strengthen two-way trade with China in labour-intensive, technology and capital-intensive goods. The Czech Republic should further expand its market channels for labour-intensive goods in China. Accordingly, Hungary should increase its exports to China of technological and capital-intensive goods.

CONCLUSION

After a series of scientific and advanced indicators such as *RCA* and *TCI*, this research makes a detailed analysis of the trade complementarity between China and Poland, the Czech Republic and Hungary. Then, by establishing a stochastic frontier trade gravity model, the article analyzes the influence of various factors on the trade between China and the three main CEEC, and then speculates on the trade prospects between China and the three CEEC, and summarizes the results in the following four aspects:

Firstly, the total imports and exports volumes of each country show an upward trend. However, this speed is gradually decreasing and the market is saturated. China's imports and exports to and from Poland, the Czech Republic and Hungary are similar in structure. Imported goods are basically their export commodities. Among them, China's trade with Poland is more evenly concentrated on labour-intensive and technical or capital-intensive goods, while the Czech Republic and Hungary are concentrated on technical and capital-intensive products, especially SITC7.

Secondly, in general, China and the other three CEEC are highly complementary in certain industries. Some high-quality outputs are urgently needed by other countries and can be mutually beneficial.

Thirdly, intra-industry trade between China and Poland, the Czech Republic and Hungary has reached a high level, especially in labour-intensive, technology and capital-intensive industries. The strengthening of trade standards will enable more diverse products to be exported, allowing consumers to have more options and generate more revenue for the countries, thereby enhancing their international status.

Fourthly, after establishing a stochastic frontier model, we find that the biggest obstacle to the total trade between China and the three main CEEC is the space distance limitation. Therefore, a transportation network should be built to reduce transportation costs, to allow their trade to bring in more profits, and to allow all the countries to enjoy long-term and efficient development.

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APPENDIX

Table 1

RCA of China from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	0.85	0.35	0.53	0.33	0.14	0.52	1.21	0.88	2.61	0.05
2002	0.79	0.32	0.46	0.28	0.08	0.46	1.19	0.97	2.49	0.05
2003	0.70	0.25	0.38	0.26	0.06	0.43	1.14	1.10	2.32	0.05
2004	0.60	0.24	0.31	0.24	0.06	0.42	1.21	1.17	2.23	0.04
2005	0.58	0.19	0.31	0.19	0.09	0.44	1.22	1.25	2.21	0.04
2006	0.55	0.16	0.24	0.13	0.10	0.45	1.28	1.28	2.23	0.05
2007	0.50	0.15	0.21	0.13	0.06	0.47	1.25	1.28	2.22	0.04
2008	0.44	0.14	0.23	0.13	0.07	0.53	1.34	1.37	2.26	0.03
2009	0.44	0.16	0.20	0.13	0.05	0.45	1.22	1.44	2.14	0.02
2010	0.46	0.16	0.18	0.11	0.05	0.50	1.23	1.45	2.19	0.02
2011	0.47	0.16	0.18	0.10	0.05	0.56	1.30	1.47	2.29	0.02
2012	0.44	0.16	0.17	0.09	0.05	0.52	1.32	1.44	2.36	0.01
2013	0.43	0.15	0.17	0.09	0.05	0.51	1.35	1.44	2.35	0.01
2014	0.41	0.15	0.18	0.10	0.06	0.53	1.38	1.35	2.26	0.02
2015	0.41	0.17	0.18	0.12	0.06	0.51	1.37	1.28	2.02	0.02
2016	0.44	0.19	0.18	0.15	0.06	0.52	1.36	1.25	1.98	0.04

Source: UN Comtrade database and own calculations.

Table 2

RCA of Poland from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	1.30	0.41	0.85	0.60	0.15	0.65	1.74	0.90	1.40	0.00
2002	1.27	0.32	0.83	0.55	0.08	0.61	1.73	0.94	1.38	0.00
2003	1.32	0.35	0.84	0.45	0.08	0.62	1.71	0.97	1.37	0.00
2004	1.47	0.55	0.83	0.53	0.17	0.61	1.66	1.00	1.28	0.00
2005	1.68	0.75	0.67	0.42	0.37	0.63	1.59	1.04	1.21	0.42
2006	1.72	0.95	0.66	0.32	0.49	0.69	1.61	1.09	1.18	0.27
2007	1.64	1.07	0.64	0.29	0.46	0.69	1.58	1.10	1.15	0.29
2008	1.57	1.22	0.61	0.26	0.38	0.74	1.56	1.20	1.18	0.38
2009	1.52	1.63	0.52	0.23	0.40	0.67	1.52	1.26	1.10	0.29
2010	1.63	1.74	0.56	0.28	0.39	0.78	1.56	1.22	1.15	0.01
2011	1.63	1.71	0.54	0.29	0.34	0.83	1.64	1.22	1.19	0.03
2012	1.80	1.74	0.57	0.30	0.39	0.86	1.71	1.16	1.13	0.08
2013	1.86	1.70	0.62	0.28	0.61	0.87	1.66	1.16	1.15	0.05
2014	1.75	1.96	0.64	0.27	0.56	0.85	1.59	1.13	1.16	0.03
2015	1.70	1.97	0.63	0.32	0.53	0.80	1.49	1.07	1.18	0.03
2016	1.65	1.70	0.57	0.29	0.51	0.82	1.49	1.03	1.29	0.04

Source: UN Comtrade database and own calculations.

Table 3

RCA of the Czech Republic from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	0.48	0.74	1.02	0.31	0.37	0.67	1.79	1.17	0.97	0.02
2002	0.40	0.90	1.04	0.44	0.18	0.76	1.53	1.24	0.88	0.05
2003	0.47	0.65	0.92	0.30	0.18	0.56	1.67	1.28	0.95	0.03
2004	0.52	0.61	0.88	0.27	0.14	0.55	1.60	1.33	0.96	0.02
2005	0.62	0.70	0.76	0.24	0.25	0.58	1.54	1.35	0.98	0.37
2006	0.58	0.65	0.73	0.20	0.24	0.57	1.46	1.43	0.97	0.39
2007	0.58	0.76	0.73	0.20	0.22	0.54	1.41	1.48	0.96	0.02
2008	0.57	0.88	0.73	0.18	0.22	0.55	1.40	1.54	1.00	0.55
2009	0.56	0.85	0.75	0.27	0.25	0.53	1.37	1.54	0.98	0.36
2010	0.52	0.84	0.72	0.25	0.32	0.57	1.31	1.57	0.98	0.48
2011	0.56	0.81	0.66	0.22	0.30	0.57	1.37	1.70	1.00	0.03
2012	0.62	0.84	0.70	0.22	0.54	0.56	1.41	1.67	1.00	0.03
2013	0.62	0.90	0.68	0.18	0.58	0.59	1.43	1.66	1.05	0.05
2014	0.59	1.03	0.64	0.29	0.63	0.54	1.26	1.53	0.96	0.05
2015	0.58	1.03	0.60	0.22	0.67	0.52	1.25	1.51	1.04	0.04
2016	0.55	1.03	0.60	0.22	0.67	0.52	1.25	1.51	1.04	0.04

Source: UN Comtrade database and own calculations.

Table 4

RCA of Hungary from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	1.24	0.36	0.58	0.16	0.42	0.64	0.75	1.41	1.02	0.62
2002	1.13	0.34	0.61	0.16	0.32	0.60	0.74	1.46	1.03	0.51
2003	1.08	0.34	0.59	0.16	0.47	0.63	0.74	1.56	0.85	0.37
2004	1.07	0.33	0.62	0.17	0.46	0.70	0.72	1.62	0.81	0.13
2005	1.05	0.30	0.54	0.21	0.56	0.74	0.71	1.61	0.76	0.71
2006	1.03	0.33	0.46	0.17	0.50	0.76	0.68	1.62	0.73	1.21
2007	1.10	0.36	0.45	0.21	0.43	0.68	0.64	1.57	0.70	1.76
2008	1.13	0.43	0.52	0.19	0.52	0.73	0.68	1.65	0.70	1.63
2009	1.07	0.30	0.50	0.18	0.58	0.74	0.72	1.68	0.69	1.00
2010	1.12	0.42	0.50	0.18	0.59	0.78	0.72	1.69	0.73	0.96
2011	1.16	0.49	0.55	0.20	0.76	0.86	0.77	1.71	0.79	0.83
2012	1.27	0.51	0.64	0.24	1.09	0.95	0.86	1.59	0.80	0.67
2013	1.21	0.64	0.56	0.22	1.39	1.00	0.88	1.61	0.82	0.54
2014	1.12	0.43	0.48	0.22	1.01	0.97	0.82	1.55	0.69	0.39
2015	1.05	0.43	0.48	0.22	1.01	0.97	0.82	1.55	0.69	0.39
2016	0.96	0.46	0.47	0.21	0.95	0.93	0.83	1.51	0.73	0.43

Source: UN Comtrade database and own calculations.

Table 5

TCL of Sino-Polish from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	0.90	0.72	0.57	0.32	0.12	0.36	0.80	0.95	3.91	1.37
2002	0.93	0.54	0.51	0.28	0.08	0.33	0.79	1.01	3.73	1.83
2003	0.89	0.73	0.43	0.29	0.07	0.32	0.74	1.10	3.48	2.53
2004	0.67	0.49	0.34	0.29	0.07	0.32	0.80	1.16	3.27	7.28
2005	0.57	0.31	0.37	0.23	0.11	0.34	0.82	1.30	3.16	0.07
2006	0.54	0.24	0.30	0.19	0.11	0.36	0.85	1.29	3.21	0.06
2007	0.49	0.20	0.29	0.18	0.07	0.40	0.85	1.31	2.91	0.04
2008	0.41	0.21	0.31	0.21	0.10	0.45	0.97	1.31	2.64	0.03
2009	0.40	0.22	0.29	0.19	0.08	0.39	0.88	1.40	2.37	0.03
2010	0.40	0.19	0.27	0.16	0.07	0.41	0.88	1.45	2.34	0.03
2011	0.41	0.21	0.26	0.14	0.06	0.45	0.91	1.51	2.40	0.04
2012	0.36	0.20	0.23	0.12	0.06	0.42	0.91	1.48	2.70	0.02
2013	0.34	0.18	0.23	0.14	0.06	0.40	0.92	1.43	2.68	0.03
2014	0.34	0.19	0.24	0.15	0.07	0.42	0.96	1.37	2.35	0.04
2015	0.35	0.19	0.22	0.18	0.08	0.43	0.97	1.29	2.00	0.06
2016	0.38	0.21	0.23	0.22	0.07	0.42	0.92	1.32	1.91	0.18

Source: UN Comtrade database and own calculations.

Table 6

TCL of Polish-Sino from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	3.66	2.28	0.32	0.82	0.15	0.50	1.36	0.81	2.90	0.02
2002	4.19	2.35	0.36	0.79	0.06	0.50	1.43	0.79	2.66	0.02
2003	5.38	2.77	0.35	0.65	0.04	0.57	1.50	0.79	2.19	0.05
2004	4.84	4.89	0.30	0.69	0.09	0.57	1.73	0.85	1.72	0.06
2005	6.07	5.18	0.23	0.59	0.27	0.58	1.75	0.87	1.53	4.89
2006	6.68	5.53	0.23	0.42	0.36	0.66	2.00	0.87	1.47	4.43
2007	7.01	5.73	0.21	0.37	0.24	0.66	2.06	0.92	1.39	4.32
2008	6.70	5.26	0.17	0.30	0.21	0.76	2.20	1.02	1.42	3.95
2009	6.33	7.41	0.14	0.26	0.27	0.72	1.74	1.05	1.49	4.15
2010	5.92	7.66	0.17	0.31	0.31	0.83	2.09	1.07	1.53	0.04
2011	5.63	6.10	0.16	0.32	0.31	0.91	2.40	1.09	1.66	0.05
2012	5.20	5.49	0.17	0.31	0.31	0.97	2.51	1.06	1.54	0.10
2013	5.02	5.71	0.19	0.30	0.58	1.00	2.55	1.06	1.67	0.04
2014	4.38	5.78	0.20	0.27	0.60	0.98	2.18	1.05	1.76	0.03
2015	3.51	4.73	0.20	0.31	0.58	0.92	2.26	0.97	1.75	0.03
2016	3.43	3.86	0.17	0.25	0.59	0.94	2.29	0.95	1.97	0.05

Source: UN Comtrade database and own calculations.

Table 7

TCL of Sino-Czech from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	1.26	0.63	0.62	0.36	0.19	0.48	0.80	0.82	3.31	8.11
2002	1.32	0.64	0.53	0.19	0.15	0.39	0.88	1.00	3.20	3.11
2003	1.04	0.44	0.45	0.36	0.10	0.41	0.77	0.98	2.79	6.92
2004	0.80	0.34	0.37	0.40	0.10	0.41	0.80	1.05	2.48	2.70
2005	0.67	0.25	0.40	0.39	0.18	0.44	0.82	1.16	2.44	0.04
2006	0.64	0.20	0.34	0.21	0.21	0.46	0.87	1.12	2.44	0.14
2007	0.59	0.17	0.35	0.23	0.16	0.49	0.84	1.06	2.45	3.01
2008	0.54	0.20	0.36	0.23	0.20	0.56	0.92	1.11	2.29	0.09
2009	0.51	0.20	0.35	0.20	0.10	0.49	0.87	1.20	2.14	0.06
2010	0.57	0.21	0.32	0.18	0.14	0.57	0.91	1.18	2.41	0.02
2011	0.58	0.20	0.30	0.17	0.13	0.58	0.89	1.13	2.42	0.48
2012	0.50	0.18	0.27	0.16	0.13	0.52	0.87	1.13	2.48	0.22
2013	0.47	0.16	0.27	0.17	0.11	0.50	0.87	1.16	2.38	0.20
2014	0.49	0.19	0.31	0.19	0.11	0.52	0.95	1.06	2.30	0.29
2015	0.50	0.21	0.32	0.21	0.11	0.54	0.97	1.03	2.14	0.35
2016	0.57	0.23	0.33	0.29	0.09	0.54	0.95	1.04	1.91	0.96

Source: UN Comtrade database and own calculations.

Table 8

TCL of Czech-Sino from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	1.35	4.08	0.38	0.43	0.37	0.51	1.40	1.05	2.01	0.13
2002	1.31	6.62	0.44	0.63	0.12	0.61	1.26	1.05	1.70	0.34
2003	1.90	5.07	0.38	0.43	0.10	0.52	1.46	1.05	1.51	0.34
2004	1.71	5.37	0.32	0.35	0.08	0.51	1.67	1.13	1.29	0.23
2005	2.24	4.82	0.25	0.34	0.18	0.53	1.69	1.13	1.24	4.31
2006	2.27	3.80	0.26	0.26	0.18	0.55	1.81	1.14	1.20	6.52
2007	2.47	4.06	0.24	0.26	0.12	0.52	1.83	1.23	1.16	0.27
2008	2.44	3.76	0.21	0.21	0.12	0.56	1.98	1.31	1.20	5.83
2009	2.32	3.86	0.20	0.31	0.17	0.57	1.57	1.29	1.33	5.23
2010	1.89	3.71	0.21	0.28	0.26	0.61	1.75	1.37	1.30	1.52
2011	1.93	2.89	0.19	0.24	0.27	0.63	2.00	1.53	1.39	0.04
2012	1.78	2.64	0.21	0.24	0.43	0.63	2.07	1.53	1.36	0.04
2013	1.68	3.03	0.20	0.19	0.55	0.67	2.21	1.52	1.53	0.04
2014	1.47	3.02	0.20	0.29	0.67	0.62	1.72	1.41	1.46	0.04
2015	1.20	2.48	0.19	0.21	0.74	0.60	1.89	1.37	1.54	0.04
2016	1.13	2.35	0.18	0.18	0.77	0.60	1.92	1.39	1.60	0.04

Source: UN Comtrade database and own calculations.

Table 9

TCL of Sino-Hungarian from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	1.87	1.45	1.10	0.60	0.27	0.59	1.00	0.68	3.53	0.05
2002	1.71	1.33	0.89	0.36	0.17	0.54	0.99	0.74	3.42	0.12
2003	1.48	0.95	0.72	0.48	0.16	0.49	0.96	0.82	3.14	0.06
2004	0.98	0.58	0.69	0.36	0.17	0.49	1.05	0.85	3.21	0.15
2005	0.86	0.37	0.75	0.26	0.22	0.53	1.19	0.94	3.56	0.03
2006	0.81	0.28	0.65	0.26	0.34	0.52	1.26	0.97	3.81	0.02
2007	0.75	0.25	0.66	0.19	0.18	0.59	1.25	0.94	3.69	0.02
2008	0.63	0.23	0.73	0.27	0.19	0.62	1.35	1.00	3.72	0.01
2009	0.62	0.23	0.60	0.24	0.15	0.54	1.24	1.09	3.67	0.01
2010	0.64	0.28	0.48	0.16	0.09	0.59	1.25	1.09	3.88	0.01
2011	0.64	0.25	0.43	0.14	0.10	0.59	1.25	1.10	3.84	0.01
2012	0.58	0.27	0.36	0.13	0.11	0.53	1.20	1.11	3.98	0.01
2013	0.59	0.25	0.38	0.13	0.11	0.52	1.16	1.11	3.71	0.01
2014	0.58	0.26	0.43	0.13	0.13	0.54	1.24	1.05	3.42	0.01
2015	0.59	0.28	0.39	0.17	0.15	0.50	1.23	1.01	3.08	0.02
2016	0.65	0.32	0.40	0.22	0.14	0.52	1.18	1.02	2.87	0.04

Source: UN Comtrade database and own calculations.

Table 10

TCL of Hungarian-Sino from 2001 to 2016

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	3.51	1.98	0.22	0.23	0.42	0.49	0.59	1.27	2.11	3.46
2002	3.74	2.47	0.26	0.23	0.21	0.49	0.61	1.23	1.99	3.46
2003	4.38	2.64	0.24	0.23	0.27	0.58	0.65	1.27	1.36	4.43
2004	3.55	2.92	0.23	0.23	0.25	0.65	0.75	1.37	1.09	1.82
2005	3.79	2.10	0.18	0.30	0.41	0.69	0.79	1.34	0.96	8.36
2006	4.00	1.94	0.16	0.22	0.37	0.73	0.84	1.30	0.91	20.17
2007	4.71	1.92	0.15	0.27	0.23	0.66	0.83	1.31	0.84	25.93
2008	4.83	1.86	0.15	0.22	0.29	0.74	0.97	1.41	0.84	17.20
2009	4.46	1.37	0.14	0.21	0.39	0.78	0.82	1.41	0.93	14.54
2010	4.09	1.83	0.15	0.20	0.48	0.83	0.97	1.47	0.97	3.03
2011	4.00	1.74	0.16	0.23	0.68	0.94	1.12	1.53	1.10	1.14
2012	3.65	1.59	0.19	0.25	0.86	1.06	1.26	1.46	1.10	0.80
2013	3.26	2.16	0.17	0.23	1.31	1.14	1.35	1.47	1.19	0.48
2014	2.79	1.27	0.15	0.23	1.07	1.12	1.12	1.43	1.05	0.36
2015	2.17	1.03	0.15	0.21	1.11	1.13	1.25	1.40	1.03	0.35
2016	2.00	1.05	0.14	0.18	1.08	1.06	1.27	1.39	1.13	0.45

Source: UN Comtrade database and own calculations.

Table 11

Intra-industry trade index between China and Poland (2001-2016)

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	0.30	0.29	0.79	0.00	0.00	0.75	0.31	0.56	0.03	0.00
2002	0.06	0.20	0.41	0.53	0.00	0.59	0.54	0.49	0.04	0.00
2003	0.15	0.31	0.40	0.02	0.00	0.63	0.82	0.50	0.05	0.00
2004	0.14	0.56	0.83	0.00	0.74	0.98	0.69	0.57	0.11	0.00
2005	0.07	0.44	0.70	0.06	0.00	0.89	0.64	0.37	0.15	0.00
2006	0.07	0.90	0.65	0.19	0.00	0.78	0.52	0.37	0.17	0.00
2007	0.29	0.40	0.48	0.06	0.00	0.95	0.65	0.35	0.10	0.00
2008	0.23	0.90	0.79	0.00	0.02	0.99	0.62	0.31	0.12	0.00
2009	0.23	0.77	0.51	0.02	0.00	0.73	0.86	0.34	0.19	0.00
2010	0.31	0.66	0.22	0.00	0.00	0.83	0.82	0.33	0.22	0.00
2011	0.56	0.29	0.36	0.00	0.00	0.97	0.85	0.40	0.38	0.00
2012	0.77	0.20	0.27	0.00	0.00	0.99	0.82	0.50	0.51	0.00
2013	0.64	0.24	0.23	0.00	0.00	0.95	0.86	0.50	0.51	0.00
2014	0.60	0.39	0.22	0.13	0.00	0.93	0.84	0.50	0.46	0.00
2015	0.51	0.33	0.18	0.30	0.00	0.93	0.86	0.45	0.51	0.20
2016	0.61	0.19	0.31	0.76	0.01	0.92	0.87	0.49	0.51	0.23

Source: UN Comtrade database and own calculations.

Table 12

Intra-industry trade index between China and the Czech Republic (2001-2016)

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	0.21	0.00	0.95	0.46	0.00	0.87	0.84	0.42	0.02	0.00
2002	0.14	0.00	0.48	0.17	0.07	0.98	0.70	0.36	0.03	0.00
2003	0.09	0.00	0.12	0.00	0.00	0.79	0.80	0.39	0.05	0.00
2004	0.18	0.00	0.23	0.58	0.01	0.86	0.74	0.37	0.07	0.00
2005	0.15	0.70	0.42	0.00	0.01	0.80	0.59	0.21	0.09	0.00
2006	0.33	0.58	0.48	0.01	0.02	0.98	0.54	0.16	0.07	0.81
2007	0.17	0.80	0.92	0.00	0.07	0.97	0.50	0.15	0.08	0.87
2008	0.15	0.31	0.63	0.00	0.00	0.77	0.62	0.15	0.09	0.03
2009	0.17	0.26	0.89	0.84	0.05	0.94	0.84	0.18	0.12	0.00
2010	0.19	0.11	0.92	0.57	0.02	0.91	0.70	0.20	0.09	0.00
2011	0.24	0.22	0.91	0.92	0.00	0.70	0.68	0.20	0.11	0.00
2012	0.45	0.20	0.78	0.02	0.02	0.69	0.60	0.18	0.09	0.09
2013	0.92	0.22	0.60	0.32	0.09	0.51	0.59	0.21	0.10	0.20
2014	0.94	0.23	0.68	0.07	0.00	0.42	0.61	0.28	0.12	0.00
2015	0.90	0.20	0.78	0.35	0.00	0.47	0.59	0.29	0.11	0.00
2016	0.78	0.35	0.80	0.69	0.05	0.39	0.45	0.29	0.13	0.35

Source: UN Comtrade database and own calculations.

Table 13

Intra-industry trade index between China and Hungary (2001-2016)

Year	SITC0	SITC1	SITC2	SITC3	SITC4	SITC5	SITC6	SITC7	SITC8	SITC9
2001	0.98	0.60	0.45	0.17	0.00	0.68	0.22	0.37	0.02	0.00
2002	0.65	0.35	0.63	0.00	0.00	0.85	0.18	0.32	0.02	0.00
2003	0.31	0.46	0.61	0.64	0.00	0.64	0.17	0.31	0.03	0.00
2004	0.12	0.03	0.39	0.00	0.00	0.65	0.23	0.35	0.05	0.00
2005	0.14	0.96	0.19	0.05	0.00	0.80	0.19	0.27	0.10	0.00
2006	0.26	0.40	0.19	0.72	0.00	0.63	0.19	0.39	0.12	0.00
2007	0.07	0.20	0.46	0.30	0.15	0.83	0.32	0.43	0.12	0.16
2008	0.23	0.00	0.93	0.09	0.00	0.95	0.37	0.41	0.12	0.00
2009	0.22	0.00	0.71	0.77	0.00	0.98	0.54	0.47	0.16	0.00
2010	0.27	0.01	0.36	0.41	0.04	0.99	0.60	0.54	0.25	0.00
2011	0.19	0.04	0.14	0.04	0.00	0.74	0.54	0.56	0.33	0.00
2012	0.25	0.10	0.12	0.08	0.30	0.87	0.51	0.61	0.39	0.00
2013	0.26	0.10	0.13	0.08	0.71	0.98	0.70	0.64	0.56	0.00
2014	0.74	0.02	0.29	0.24	0.02	0.91	0.78	0.72	0.65	0.00
2015	0.45	0.01	0.29	0.34	0.26	0.96	0.76	0.72	0.55	0.00
2016	0.32	0.03	0.35	0.32	0.14	0.93	0.70	0.79	0.65	0.28

Source: UN Comtrade database and own calculations.