Empirical Analysis of Sino-India Merchandise's Trade Complementarity and Potentiality along One Belt and One Road

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Abstract: *The trade between China and India becomes the heated topic because of proposals of "One Belt and One Road" and "BCIM economic zone corridor". This paper uses Trade Intensity Index (TII), Revealed Comparative Advantage Index (RCA), Trade Complementarity Index (TCI),Trade SpecializationCoefficient (TSC) to study the complementarity of merchandise trade between India and China and applies gravity model for the trade potential calculation between China and India. The result indicates that complementarity and competitiveness co-exist in the field of trade and that actual trade value between them is far less than the estimated value, so there is broad space for India and China to explore.*

Keywords: TII; RCA; TCI; TSC; Gravity Model

1. Introduction

President Xi proposed "One Belt and One Road" during his visit to Center Asia and South-east Asia, besides, Prime Minister Li suggested to improve the relationship of "BCIM economic zone corridor". India plays a key role in "One Belt and One Road" and also a member of BRICS, so it is essential and necessary to study Sino-India trade. As the largest and the second largest country, China and India rank the second and the ninth separately in terms of GDP in the world. China has been the largest partner in goods trade of India, and India is China's ninth export market. Although bilateral trade volume is US dollars 70.579 billion between China and India, it only accounts for about 9% of India's trade value and less than 2% of China's trade value. All those imply there is extensive potential space for both to develop bilateral trade.

2. Literature Review

Bhattacharya (2007) [1] applies gravity model to analyze the impact of different preference policy to Sino-India trade benefits and the result shows the potential trade benefits of India are less than those in China in short term and that India will get more benefits because of the reduction of tariff, so it is win-win for both sides. Qureshi, Mahvash Saeed（2008）[2] uses SITC 3-digit and 4-digit production data to calculate and analyze the potentiality of Sino-India trade, and the result shows China exports more relatively higher tech goods and less labor intensive products and that India exports mainly low technological products, therefore, complementarity exists in Sino-India bilateral trade.Jayawickrama（2010）[3] finds export commodity shows strong substitutability in bilateral trade and that specialization makes different kinds of commodity to be exported in China and India export. Xinmin Zhang （2009）[4] takes RCA index and TCI index to calculate and study the commodity field of complementarity and competitiveness in China's and India's trade and suggests both sides should make full use of factor endowment and develop

intra-industry trade between China and India to enhace the core competitiveness. Rong Cheng and Huifang Cheng （2011）[5] use TSI index, RCA index and TSC to study good trade between China and India and find that complementarity and competitiveness co-exist in biteral trade and that India's true dependence on China' export goods is more than that of China on India. Hongling Yang etal.（2012） [6] use gravity model to calculate how free trade zone between China and India makes a difference to both sides and the result shows broad trade space exists in bilateral trade and free trade zone has positive effect on both sides.

This paper study Sino-India merchandise's trade complementarity and potentiality based on existing literature about Sino-India trade complementarity. Firstly, the paper uses TI index, RCA index, TSI index and TSC index to find the relationship between China and India's commodity trade. And then this paper takes gravity model to apply empirical analysis on potentiality of Sino-India trade.

3. Analysis of Sino-India Trade Complementarity

This paper uses TI index, RCA index, TCI index and TSC index to study the trade complementarity between China and India.

1) Trade indensity index analysis between China and India
Trade indensity index can be used to calculate two countries' trade dependence and it can be expressed in the following format:

$$TII_{ij} = （X_{ij}/X_i） /(M_j/M_w) \quad （1）$$

In the format (1), TII_{ij} means trade indensity index of i to j, X_{ij} means the export volume of i to j, X_i means the total export volume of i, M_j means the total import volume of j, $M_w$means the total import volume of the whole world. And i and j means the country or area in the world. If $TII_{ij}>1$, it shows i and j have a strong and close connection on trade. If

$TII_{ij}<1$, it means i and j have a loose and weak connection. Using format (1), the results show as follows:

Table 1: China and India's TII (year 2005-2014)

Year	2005	2006	2007	2008	2009
Sino-India	0.88	1.03	1.27	1.13	1.16
India-Sino	1.15	1	0.96	0.8	0.73
Year	2010	2011	2012	2013	2014
Sino-India	1.12	1.04	0.86	0.87	0.94
India-Sino	0.86	0.57	0.51	0.46	0.4

From the table 1, Sino-India's TII is greater than 1. Although from the year of 2012, the TII of Sino-India is lesser than 1, the trend is going to rise, that is the result of "One Belt and One Road" proposal and recovery in global trade. General speaking, China has a steady and stable trade dependence on India's market. India-Sino TII is lesser than 1 except the index in 2005 and 2006, and it shows a decreasing trend from the year of 2005. The results demonstrates that although China is the biggest trading partner of India, India's trade deficit with China always exists and the TII is decreasing. All those means the Sino-India intra-industry trade is greater than India-Sino's and that India-Sino trade still have strong potentiality. India should take advantage of its own dominant industry and export related commodity to China so as to imporve its trade volume and its trade structure.

2) Trade Complementarity Index analysis between China and India trade.

TCI is used to calculate the bilateral trading commodity's global competitiveness and trade potentiality between both sides. The TCI is expressed as:

$$C^k_{ij}=RCA^k_{xi}\times RCA^k_{mj} \qquad (2)$$

C^k_{ij} is the commodity k's complementarity index when i exports k to j. RCA^k_{xi} means the degree of i's export comparative disadvantage of commodity k, RCA^k_{mj} means the degree of j's import comparative disadvantage of commodity k, and the equation of RCA^k_{xi} 与 RCA^k_{mj} shows as follows:

$$RCA^k_{xi}= (X^k_i/X_i)/ (X^k_w/X_w) \qquad (3)$$

$$RCA^k_{mj} = (M^k_j/M_j)/ (M^k_w/M_w) \qquad (4)$$

X^k_i and X^k_w mean the commodity k' export volume of i and the whole world, X_i and X_w mean the total export volume of i and the whole world; M^k_j and M^k_w mean the commodity k' import volume of j and the whole world, M_j and M_w mean the total import volume of j and the whole world. The result that value of C^k_{ij} is greater means both sides have strong complementarity on commodity k, namely, the commodity k what i exports is exactly what j imports. Whereas the opposite.

To make sure the data coherence and consistency, the paper uses the UN Comtrade SITC Rev.3 1-digit commodity data from the year of 2005 to 2014 and calculate China and India's RCA^k_{xi}, RCA^k_{mj} according to the equation (3) and (4). SITC 1-digit commodity 0-4 represents the primary goods

and SITC 1-digit commodity 5-9 stand for manufactured goods. Firstly, according to equation (3) and (4), China (India) as the export, we obtain relatively comparative advantage (RCA^k_{xi}) and corresponding India's (China's) relatively comparative disadvantage (RCA^k_{mj}). Then, using equation 2, we can get the complementarity index of China and India's SITC0-9 commodity (table 2 and table 3).

Table 2: China as the export country, India as the import country, C^k_{ij}

Year Commodity	2005	2006	2007	2008	2009
SITC0	0.17	0.15	0.18	0.1	0.14
SITC1	0.02	0.01	0.01	0.01	0.01
SITC2	0.45	0.41	0.33	0.28	0.24
SITC3	0.47	0.32	0.33	0.29	0.29
SITC4	0.47	0.39	0.18	0.16	0.21
SITC5	0.4	0.39	0.42	0.56	0.4
SITC6	1.5	1.17	1.22	1.25	1.46
SITC7	0.67	0.8	0.8	0.87	0.95
SITC8	0.72	0.72	0.77	0.56	0.71
SITC9	0.17	0.15	0.1	0.06	0.05
Year Commodity	2010	2011	2012	2013	2014
SITC0	0.13	0.1	0.1	0.1	0.12
SITC1	0.01	0.01	0.02	0.02	0.02
SITC2	0.2	0.19	0.21	0.21	0.24
SITC3	0.25	0.21	0.2	0.23	0.28
SITC4	0.17	0.17	0.2	0.23	0.28
SITC5	0.44	0.46	0.45	0.45	0.53
SITC6	1.53	1.57	1.31	1.48	1.56
SITC7	0.78	0.76	0.74	0.73	0.68
SITC8	0.61	0.66	0.91	0.7	0.71
SITC9	0.06	0.09	0.05	0.04	0.04

Table 3: India as the export country, China as the import country, Ckij (2005-2014)

Year Commodity	2005	2006	2007	2008	2009
SITC0	0.44	0.41	0.39	0.4	0.27
SITC1	0.06	0.08	0.09	0.14	0.15
SITC2	7.21	6.01	6.71	6.91	6.23
SITC3	0.62	0.84	1.02	0.97	0.92
SITC4	1.29	1.03	1.31	1.14	0.98
SITC5	1.2	1.19	1.13	1.09	0.89
SITC6	2.26	1.76	1.61	1.46	1.78
SITC7	0.34	0.36	0.38	0.48	0.55
SITC8	1.18	1.17	1.11	0.99	1.18
SITC9	0.03	0.02	0.02	0.03	0.05
Year Commodity	2010	2011	2012	2013	2014
SITC0	0.35	0.4	0.58	0.64	0.7
SITC1	0.14	0.12	0.17	0.16	0.15
SITC2	5.97	4.3	5.55	4.14	3.62
SITC3	1.08	1.09	1.14	1.28	1.56
SITC4	0.86	0.72	0.81	0.71	0.61

SITC5	0.92	0.9	1.04	1	1.01
SITC6	1.66	1.34	1.36	1.39	1.5
SITC7	0.49	0.49	0.48	0.47	0.52
SITC8	0.86	0.91	1.05	0.74	0.78
SITC9	0.13	0.67	0.2	0.62	0.21

In the field of complementarity between China and India trade, India shows greater than China and it is dominantly in primary goods, SITC2 and manufactured goods in SITC5. In the field of SITC6, both sides show complementarity and competitiveness, which means both sides have its own advantage in the specific products.

The conclusion is that both sides have its own competitive products. According to theory of comparative advantage, both sides should encourage free trade and make full use of factor endowment, which can guarantee win-win. As for the competitiveness field, according to the new international trade theory, both sides should improve quality of export products by producing differentiated product, economies of scale and technology innovation. Meanwhile, the government should publish polices to support the domestic enterprise's development. Most importantly, China and India should reach an agreement that both sides reduce tariff barriers and encourage market competence so as to improve its own products' quality and technology development.

3) Trade specialization coefficient between China and India

Trade specialization coefficient is used to measure the Sino-India trade complementarity from two aspects: inter-industry and intra-industry. TSC is expressed by the following equation:

$$TSC_{ij}= （X^{k}_{ij}-M^{k}_{ij}） / (X^{k}_{ij} +M^{k}_{ij}) \qquad (5)$$

TSC_{ij} means the commodity k's TSC of i and j, X^{k}_{ij} means commodity k's export value from i to j, means commodity k's import value from j to i. According to the literature, if $-0.25<TSC_{ij}<0.25$, intra-industry trade exists between i and j;when $TSC_{ij}\geq0.8$, it shows i has more strong competitiveness on commodity k; if $TSC_{ij}\leq-0.8$, it demonstrates that i has weaker competitiveness than j with regard to commodity k. The latter two circumstances demonstrates inter-industry trade exists between i and j. According to equation (5), we can obtain Sino-India TSC in 2014. The results shows in table 4.

Table 4: Sino-India bilateral trade TSC in 2014

SITC	SITC0	SITC1	SITC2	SITC3	SITC4
TSC	0.01	0.5	-0.77	0.56	-0.98
SITC	SITC5	SITC6	SITC7	SITC8	SITC9
TSC	0.72	0.21	0.89	0.86	-0.89

From table 4, we can draw a conclusion that SITC0 and SITC6 fall in to intra-industry trade and that China takes advantage of SITC7 and SITC8 over India and that India has comparatively advantage in SITC4 and SITC9.

To make it clear that specific products' TSC, in this paper, we use SITC 2-digits commodity to measure TSC and filter

the commodity of TSC≤-0.8(China's weak competitiveness, and India's strong competitiveness), TSC≥0.8 (China's strong competitiveness, and India's weak competitiveness) and -0.25＜TSC＜0.25 (intra-industry between China and India) (shown in table 5)

Table 5: Sino-India bilateral trade TSC in 2014(2 digits)

SITC3	Commodity	TSC	Total trade value（Million）
Intra-industry complementarity			
8	Animal Feed Stuff	0.16	33.77
24	Cork And Wood	0.13	6.779
29	Crude Animal, Veg.Materl.	0.21	141.383
33	Petroleum,Petrol.Product	0.19	552.28
43	Animal,Veg.Fats,Oils,Nes	0.1	2.557
			736.7 (10.44%)
Commodity Of China's Stronger Competitiveness			
2	Dairy Products,Bird Eggs	0.97	0.006
6	Sugar,Sugr.Preptns,Honey	0.83	23.383
9	Misc.Edible Products Etc	0.94	16.185
25	Pulp And Waste Paper	0.99	1.773
32	Coal, Coke, Briquettes	1	454.203
52	Inorganic Chemicals	0.93	674.627
54	Medicinal,Pharm.Products	0.9	1491.887
56	Fertilizer,Except Grp272	1	2337.129
58	Plastic,Non-Primary Form	0.87	549.27
62	Rubber Manufactures, Nes	0.87	285.725
63	Cork, Wood Manufactures	0.95	194.545
64	Paper,Paperboard,Etc.	0.99	498.025
67	Iron And Steel	0.86	3381.421
69	Metals Manufactures,Nes	0.93	1772.218
72	Special.Indust.Machinery	0.92	1891.058
73	Metalworking Machinery	0.91	451.528
74	General Industl.Mach.Nes	0.81	3981.871
75	Office Machines,Adp Mach	0.98	3537.075
76	Telecomm.Sound Equip Etc	0.97	5527.971
77	Elec Mch Appar,Parts,Nes	0.86	5154.943
78	Road Vehicles	0.88	1312.884
79	Othr.Transport Equipment	0.99	91.282
81	Prefab Buildgs,Fttng Etc	0.99	894.943
82	Furniture,Bedding,Etc.	0.97	744.884
83	Travel Goods,Handbgs Etc	0.92	411.397
85	Footwear	0.9	581.947
87	Scientific Equipment Nes	0.93	1152.354
88	Photo.Apparat.Nes;Clocks	0.92	343.918
			37758.45 (53.50%)
Commodity of India's stronger competitiveness			
3	Fish,Crustaceans,Mollusc	-0.98	111.086
22	Oil Seed,Oleaginus Fruit	-0.82	56.958
27	Crude Fertilizer,Mineral	-0.81	1164.063
28	Metalliferous Ore,Scrap	-0.94	1461.846

42	Fixed Veg. Fats And Oils	-0.99	269.931
61	Leather, Leather Goods	-0.84	471.685
93	Spec.Transact.Not Classd	-0.89	1.146
			3536.72 (5.01%)

From the table above, we can find intra-industry trade value between China and India is USD 736.74 million, 10.44% of Sino-India total trade value. Primary goods such as energy and labor intensive goods are transitioned in intra-industry.

In Sino-India's inter-industry trade, China's stronger competitive goods value is USD 37758.45 million, 53.50% of bilateral trade value, and all those goods are manufactured goods. Among those, the largest value belong to SITC7 equipment and machine and SITC8, and trade value of SITC54 and SITC56 ranks second. The result shows that China exports capital and technology intensive products to India. India's stronger competitive goods value in inter-industry trade is USD 3536.72 million (5.01%), and main export goods are resource and labor intensive products.

4. China's Bilateral Trade Potentiality Analysis

Gravity model is a tool to measure two countries' bilateral potentiality. Based on Linnemann's (1966) [7] research, using China and top 51 trade partners' [51 partners include: US,HK China, Japan, South Korea, Taiwan China, Germany, Australia, Malaysia, Russia, Brazil, Vietnam, UK, Singapore, Netherlands, Thailand, India, Saudi Arabia, Indonesia, South Africa, France, Canada, UAE, Italy, Philippine, Switzerland, Mexico, Angola, Chile, Iraq, Spain, Belgium, Oman, Myanmar, Turkey, Kazakhstan, Nigeria, Poland, Venezuela, Pakistan, Columbia, Peru, New Zealand, Sweden, Kuwait, Argentina, Bangladesh, Egypt, Czech, Israel, Denmark] cross sectional data in 2014, we put GDP, population, gap in GDP per capita, distance and APEC as variables into gravity model to test China's trade potentiality. And the model is as follows:

$$\log(BT_{ij}) = \beta_0 + \beta_1 \log(GDP_j) + \beta_2 \log(POP_{ij})$$
$$+ \beta_3 \log(D_{ij}) + \beta_4 \log(DG_{ij}) + \beta_5 APEC + u_{ij} \quad (1)$$

Cause variables related to China are constant, so the model can be simplified:

$$\log(BT_{ij}) = \beta_0 + \beta_1 \log(GDP_j) + \beta_2 \log(POP_{ij})$$
$$+ \beta_3 \log(D_{ij}) + \beta_4 \log(DG_{ij}) + \beta_5 APEC + u_{ij} \quad (2)$$

BT_{ij} means trade value based on SITC Rev.3 1-digit goods of China with partner j's bilateral trade. GDP_j means j'GDP per captia, POP_j means j's population, D_{ij} means the distance from China to j, DG_{ij} means the GDP per capita difference between China and j, APEC is a dummy variable(if yes, APEC=1,or, APEC=0)

Using Eviews6 to measure, the table 6 shows the results:

Table 6: Gravity Model Estimated Equation

Explanatory variable	Basic model	Extensive model 1	Extensive model 2	Extensive model 3
Constant	8.691227***	8.606613***	6.594078***	7.358037***
	-6.1	-5.53	-5.03	-5.24
$\log(GDP_j)$	0.641813***	0.903027***	0.630083***	0.774471 ***
	-6.5	-6.11	-7.15	-5.78
$\log(POP_j)$	-0.204902**	-0.289580**	-0.084676	-0.214254*
	(-2.26)	(-2.19)	(-1.14)	（-1.83）
$\log(D_{ij})$	-0.722267***	-0.911823***	-0.635048***	-0.740395***
	(-4.73)	(-5.42)	(-4.63)	(-4.79)
$\log(DG_{ij})$		-0.224359*		-0.149109
		(-1.91)		(-1.42)
APEC			0.712759***	0.664486***
			-4.04	-3.74
R^2	0.603008	0.637973	0.715289	0.728291
Adjusted R^2	0.567979	0.604297	0.688805	0.695944
F	17.21465	18.94396	27.00763	22.51539

value in parenthesis is t-statistic，***/**/*/respectively stands for 1%，5%，10% significance.
From table 9, we can obtain the final model:
$$\log(BT_{ij}) = 7.36 + 0.77\log(GDP_j) - 0.21\log(POP_{ij})$$
$$- 0.74\log(D_{ij}) - 0.15\log(DG_{ij}) + 0.66APEC + u_{ij}$$

From the result, we can see that the coefficient is GDP_j plays the most important role in the bilateral trade. The second significant factor is distance, and it has a negative effect on bilateral trade, so China and its partners should take measures to reduce the transportation costs, make capital and information spread fast. The distance between China and India is a positive factor for both sides to develop bilateral trade, hence, both sides should reduce the relevant tariff and encourage communication. The dummy variable APEC can promote China's bilateral trade, so APEC community should regulate and coordinate inner problems and appeal to more partners to join to enjoy benefits of trade convenience.

Further more, we compare the theory bilateral trade value with real trade value to measure trade potentiality. According to Qingfeng Liu and Shuzhu Jiang（2002）[8] research, if actual trade value/theory value>=1.2, it means "Excessive Trade", both sides should explore other fields to increase trade value; If 0.8<= actual trade value/theory value<1.2, it means"moderate trade", both sides can expand its trade based on previous products and can find new fields as well; if actual trade value/theory value<0.8, it means"inadequate trade", bilateral trade has huge potential in both sides.Both sides should positively eliminate obstacles and find chances to cooperate. Therefore, we use the above equation results and the real trade value to measure trade potentiality and the results shows Sino-US bilateral trade is inadequate trade, so both sides should find ways to develop intra-industry and inter-industry trade;

Sino-India bilateral trade is inadequate trade as well, so both sides should take advantage of distance and reduce the tariff, regulation and friction to explore market and obtain win-win.

5. Conclusion

Complementarity and competitiveness co-exist and huge potential exists in the field of Sino-India trade, so both sides should make joint efforts to improve trade value in intra-industry and inter-industry.

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