Complementarity and Potentials of High Technology Trade, Technology and Skills Transfers between India-Russia

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Abstract

This paper examines complementarities and potentialities in merchandise trade in general and high technology trade in particular between India and Russia. In this context, we have also looked at the complementarities for bilateral transfer of investment, technology and skills. The analysis shows that bilateral trade flow is small even though trade complementarities in the segment of high technology as well as in merchandise trade in general exist. Inefficient trade logistics networks, absence of mutual recognition of standard, lack of bilateral technology and skill transfer and low level of connectivity between private sectors of either country are some of the factors responsible for not realising the potentials of trade. This is further confirmed by our illustrative CGE modelling exercise which suggest about half a percentage points increase in real GNP in either country if bilateral tariff barriers are abolished. In this context, governments of Russia and India need to play pro-active role to raise the level of economic engagement.

Key Words

India, Russia, High Technology, CGE model, Trade

1 Introduction

During the Cold War, India was a leader of the Non-Aligned Movement but leaned toward the Soviet Union, its primary supplier of arms. The decades-old Indo-Soviet military-supply relationship remained, but the larger political and economic ties diminished greatly, along with the collapse of the Soviet Union in 1991. For most part of the post-soviet era, annual bilateral trade between the two countries has hovered around US $ 2-3 billion a year. It has increased to US $ 8 billion in 2009-10. By contrast, trade between India and China rose to US $ 42 billion in 2009-10. This happened even though India views Russia as a time-tested, trustworthy and reliable strategic partner. Since the signing of the 'Declaration on the India Russia Strategic Partnership', in October 2000 (during the visit of then President Vladimir Putin to India), there has been a qualitative strengthening of the relationship.During the visit of President Dmitry Medvedev to India in December 2010, it was mutually decided to elevate the bilateral relationship to the level of a "Special and Privileged Strategic Partnership."

The two countries closely cooperate in diverse spheres, including defence, civil nuclear energy, space, science and technology, hydrocarbons, trade and investment, cultural and humanitarian fields, etc. A disturbing feature of the bilateral trade has been that the balance of trade is wholly in favour of Russia since 1999 which is matter of serious concern for India. By and large Russian export to India concentrates mainly on high technology (HT) products. Even then, the volume is low compared to India's other trading partners. In this context, this paper makes an attempt to analyse the complementarities and potentials of trade between India and Russia in the realm of high technology products. In this respect, the paper also investigates the scope of technology and skills transfer between the two countries. Finally, we quantify the possible gains from closed economic relationship between the two.

The paper is organised as follows. Following the introduction, section 2 analyses the complementarities of High Technology trade between India and Russia. Section 3 discusses Complementarities in Technology and Skills between India and Russia. In section 4, we quantify the complementarities and potentials of merchandise trade in general between India and Russia and gains that can accrue to both countries from closed economic relationship. Finally section 5 provides some concluding remarks

2. Complementarities of HT Trade between India and Russia

At the outset, one needs to specify what constitute HT segments of manufacturing products. The approach that is commonly used to identify technology-intensive industries and products is the product

approach. The product list is based on the calculations of R&D intensity by groups of products (R&D expenditure/total sales). Exports and imports of these products comprise high technology trade. According to European Union's definition of high technology trade, the following commodities comprise the same (see Hatzichronoglou 1997, Meri, 2008).

Table 1 High-Technology groups of Products

List of HT groups of products	***SITC Rev. 3/4***
Aerospace	7921+ 7922 + 7923 + 7924 + 7925 + 79293 + (714 – 71489 - 71499) + 87411
Computers-office machines	75113 + 75131 + 75132 + 751 34 + (752 - 7529) + 75997
Electronics-telecommunications	76381 + 76383 + (764 – 76493 - 76499) + 7722 + 77261 + 77318 + 77625 + 7763 + 7764 + 7768 + 89879
Pharmacy	5413 + 5415 + 5416 + 5421 + 5422
Scientific instruments	774 + 8711 + 8713 + 8714 + 8719 + 87211 + (874 – 87411 - 8742) + 88111 + 88121+ 88411 + 88419 + 89961 + 89963 + 89967
Electrical machinery	77862 + 77863 + 77864 + 778 65 + 7787 + 77884
Non-electrical machinery	71489 + 71499 + 71871 + 71877 + 72847 + 7311 + 73135 + 73144 + 73151+ 73153+ 73161 + 73165 + 73312 + 73314 + 73316 + 73733 + 73735
Chemicals	52222 + 52223 + 52229 + 522 69 + 525 + 57433 + 591
Armament	891

As Table 1 shows, each broad component of high technology segment is composed of several product at 3/4/5 digit SITC trade codes. The source of our data is World Bank's online WITS database. In what follows, we analyse the performance of India and Russia's trade in respect HT products in recent years focussing particularly on bilateral HT.

Aggregate Trend Analysis

The aggregate performance of India and Russia in respect of HT trade is shown in Table 2. As this table shows, India's overall HT exports has risen from US $ 1.2 billion in 1996 to US $ 1.6 billion in 2000 and further to US $ 11.2 billion in 2009. During the same time frame, Russia's HT exports has increased from US $ 2.2 billion in 1996 to US $ 4.4 billion in 2000 and subsequently to US $ 4.8 billion in 2009. By contrast, China's HT exports rose from US $ 15.3 billion in 1996 to US $ 348.3 billion in 2006. The dismal performance of India, Russia is also reflected in other summary indicators such as share of HT trade in respective country's GNP, or in manufactured exports (true for India only) or the share of country's HT trade in world HT trade. As Table 2 indicates, the share of Russia or India in world's HT trade is less than half a percentage barring imports in case Russia. This compares poorly vis-

a-vis China's share of about 19 percentage point of HT exports in world HT exports. Russia compares favourably with respect to China only in respect of the share of HT exports in manufactured exports—23% for Russia against 31% for China. However, comparison across time in respect of the share of world trade, we find that Russia's share of HT exports has declined from 0.4 percentage points in 2000 to 0.27 percentage points in 2008. By contrast, India's share has increased marginally in the last decade.

Table 2 Aggregate Exports /Imports of HT products by India, Russia, China, USA

Item	Year	India		Russia		China		USA	
		Export	Import	Export	Import	Export	Import	Export	Import
Absolute (US $ Million)	1996	1239		2162		15295		140250	
	2000	1569	3590	4390	3511	40837		196698	
	2005	3382	13361	4126	11096	214246		190864	
	2009	11215	27916	4756	19140	348295	25968.5*	141519	265470.3*
Share of Manufactured Exports (%)	1996	5.1		9.4		12.0		31.2	
	2000	4.8		17.2		18.6		33.7	
	2005	4.7		8.1		30.6		29.9	
	2009	4.7		23.0		31.0		23.0	
Share of World Trade (%)	1996								
	2000	0.3		0.4		3.6		17.1	
	2005	0.2		0.3		13.6		12.1	
	2009	0.36*	0.33*	0.27*	1.25*	18.57*	0.47*	14.63*	13.54*
Share of GNP (%)	1996	0.10		0.27		0.77		1.80	
	2000	0.05	0.23	0.45	0.36	1.38		1.95	
	2005	0.06	0.53	0.25	0.67	3.98		1.50	
	2009	0.12	0.74	0.18	0.74	3.81	6.68*	1.01	21.68*

* Corresponds to 2008 data
Source: Author's estimate from www.wits.worldbank.org

Importing HT items is usually a process adopted by countries for technological upgradation. Here, we find from Table 2 that Russia is way ahead of China or India.

Trade Engagement in HT Products between India & Russia

We have seen that India's and Russia are small players in the global space of HT exports. The question arises whether complementarities in HT trade exists between the two. To be specific given the closed relationship between the two governments over long years, one would expect synergies in trade in general and high technology in particular to exist between the two countries.

The data on economic engagement in the realm of HT trade is shown in Tables 3-4. As Table 3 shows, Russia's share in India's HT exports in most of the product category is 1% or below except pharmacy product where the share is 3%. Moreover, we find that Russia's position as trading partner has

continuously declined over the years. China, USA, several European countries are more important trading partner for India in respect of HT exports (see Pohit, 2011). By contrast, India seems to be an important trading partner of Russia (Table 4), with share in the range of 30-40% in 3 product categories. Moreover, we find that India's position as a trading partner of Russia has improved between the years 2000 to 2009. The three product categories where Russia dominates are aerospace items, computer office machines, electrical machinery and electronic telecommunication items.

Table 3 Product-wise India's HT exports

Products	India's HT Exports					
	2000		2005		2009	
	Total	Share of Russia	Total	Share of Russia	Total	Share of Russia
	(1000 US $)	%	(1000 US $)	%	(1000 US $)	%
Aerospace	3166	2%	11658	0%	237958	0%
Computers office machines	166010	1%	282679	0%	411334	0%
Electronics-telecommunication	473966	1%	589000	1%	4828792	0%
Pharmacy	465060	5%	970665	5%	2204013	3%
Scientific Instruments	166349	6%	440824	0%	827558	0%
Electrical Machinery	6014	1%	35767	8%	100725	0%
Chemicals	278161	1%	966967	1%	2246943	1%
Non-electrical Machinery	8316	0%	83906	0%	313447	0%
Armaments	1461	0%	929	0%	44313	1%

Source: Author's estimate from www.wits.worldbank.org

Table 4 Product-wise Russia's HT Exports

Products	Russia's HT Exports					
	2000		2005		2009	
	Total	Share of India	Total	Share of India	Total	Share of India
	(1000 US $)	%	(1000 US $)	%	(1000 US $)	%
Aerospace	819305	9%	1647624	8%	1119096	40%
Computers office machines	49931	8%	60887	38%	177594	42%
Electronics-telecommunication	459361	12%	606963	23%	793332	27%

Pharmacy	51582	4%	69254	0%	104344	1%
Scientific Instruments	496499	5%	429263	3%	593968	18%
Electrical Machinery	42338	3%	121796	19%	105293	30%
Chemicals	1465746	0%	351751	0%	432949	8%
Non-electrical Machinery	529371	0%	807890	0%	1389235	9%
Armaments	475462	15%	30213	5%	40459	0%

Source: Author's estimate from www.wits.worldbank.org

To explore the reason behind low level of economic engagement between the two, we analyse HT products at 4/5 digit level of disaggregation that these two countries export to the rest of the world (ROW). The relevant statistics are collated in Table 5. As this table shows, out of the HT items under aerospace product category that India export to ROW, only 43% of the same India is able to export to Russia in 2009. Except pharmacy category, we find that India is able to export only 50% or less of products to Russia that she exports to ROW! Even in pharmacy in which it is widely recognised that India has comparative advantage, not all products that India export to ROW are being exported to Russia. The picture is better on the other side (Russia to India). Under three categories, the value of the percentage is more than 80%. In one category (computer office machines), Russia is able to export to India all the products that she exports to ROW.

Table 5 Percentage of Exportable products in total that are bilaterally traded in 2009

Product Type	Percentage of number of Exportable Products at SITC 4/5 digit level in total that are exported from	
	India to Russia	Russia to India
Aerospace	43%	36%
Computers office machines	44%	100%
Electronics-telecommunication	40%	89%
Pharmacy	75%	14%
Scientific Instruments	51%	71%
Electrical Machinery	30%	80%
Chemicals	54%	38%
Non-electrical Machinery	16%	36%

Source: Author's estimate from www.wits.worldbank.org

Since the major trading partners of exportable/importable HT products of India and Russia are mainly developed economies like USA, EU, Japan, and China, it seems that inferior variety of product

may not be the sole reason for low level of trade. Does low level of trade occur due to mismatch in demand and supply of products? In other words, it is quite possible that the major HT products that India export to ROW do not figure among the major items of Russia's import from ROW and vice-versa. In that case, low level of trade between the two is expected. Since top 3 items of HT exports (imports) in any category constitute more than 50% of India's HT exports (imports) under the same category, we have done an exercise of matching top 3 items of HT exports of either country with top 3 items of imports of partner countries (see Pohit, Sanjib, 2011). If there is perfect match (100%), then top 3 items of India's HT exports should be same as top 3 items of Russia's HT imports and vice-versa. The matching indicator (in percent) is shown in Table 6. As Table 6 indicates, the value of matching indicator is generally less than 50%. In the case of chemicals, there is zero matching among the top 3 items of exports (imports) of India and Russia. This probably suggests that the low level of engagement in bilateral trade in the category of HT, to some extent, occur due to low of level of complementarily in HT trade between these two countries.

Table 6 Matching of Top 3 products of Bilateral Trade

Product Type	Matching in Percent
Aerospace	17%
Computers office machines	33%
Electronics-telecommunication	33%
Pharmacy	17%
Scientific Instruments	50%
Electrical Machinery	33%
Chemicals	0
Non-electrical Machinery	33%

Source: Author's estimate from www.wits.worldbank.org

It is generally believed that about one-third of world trade originates due to the trade between multinational affiliates located in different countries during the process of production (WTO, 1996). Consequently, if FDI flows between India and Russia is small in the category of HT products, low level of trade under the same would result since this trade through FDI channel would be absent in this case. An analysis of sources of FDI inflows in India indicates that Russia does not figure as an important source of FDI inflows (see www.indiastat.com). The same is true if we analyse the principal sources of FDI inflows in Russia (see www.stats.oecd.org). The two-way investment between the two countries stood only at approximately USD 7.8 billion. By contrast, FDI by Indian firms was to the tune of

US$43.9 billion in financial year 2010-11 and Russia was the preferred choice of this flow.[1] This suggests that bilateral trade in HT products through FDI channel plays a minimal role in this case. The governments in both countries need to play proactive role to reverse this tide.

Of course, high technology trade flow, like any other commodity, is influenced by duties and non-tariff barriers (NTBs). If barriers are high, trade would be low. Both countries are governed by WTO rules and have accorded MFN status to each other. In the earlier study, Pohit (2011) has suggested tariff is not a barrier of India's HT exports, but NTBs are a factor for low level of export. However, absence of mutual recognition of standard and conformity assessment procedures is a barrier for export In the case of trade with Russia. This is particularly true in case of pharmacy exports (see Sen, 2011).

Another problem for low level of trade is inefficient logistics networks for trade between the two. In the past decades, trade between the two has been managed by government agencies. The aspect of efficient logistics network was not a factor governing trade, but strategic relationship between the two was the guiding motive behind trade. Of late, the size of government controlled trade has declined. By contrast, the private sectors are currently the major engine of growth/trade in either country. Profit is the principal motive of their trade. If logistics networks for trade are not efficient, private sector would avoid trading with each other. They would look for market elsewhere. This has been happening for trade in general and HT products in particular. Currently, developed economies, China etc, have emerged as major partner country of trade for both India and Russia.

3. Complementarities in Technology and Skills between India and Russia

Often frontier technology – comes bundled with FDI inflows. Such technology spillovers of foreign capital lead to gains in host countries. For generation as well as diffusion of technology, skilled manpower is essential. We have seen that FDI flow is minimal between India and Russia. It may be possible that low level FDI flow is due to the absence of technology generation between them or due to absence of complementarities in technology and skills.

The data is Table 7 indicates that government expenditure on R&D as percent of GNP was only 0.71% in India in 2004 and 1.13% in Russia in 2007, significantly lower than technology driven countries like USA, Japan or even lower than that of China.[2] Furthermore, we see technician in R&D per million people in India is significantly lower than in Russia, even though Russian's data is almost half that of technology rich country like Germany (Table 8).

Table 7 Government's Expenditure on R& D as % of GDP

Year	USA	Japan	OECD	EU27	China	India (1)	Russia (2)
1996	2.55	2.81	2.10	1.66	0.57	0.65	0.85

[1] http://inchincloser.com/2011/06/24/fdi-flows-into-china-out-of-india/
[2] The latest year for which data are available.

1997	2.58	2.87	2.12	1.66	0.64	0.70	
1998	2.62	3.00	2.15	1.67	0.65	0.72	
1999	2.66	3.02	2.19	1.72	0.76	0.74	
2000	2.74	3.04	2.23	1.74	0.90	0.78	
2001	2.76	3.12	2.27	1.76	0.95	0.76	
2002	2.66	3.17	2.24	1.77	1.07	0.75	
2003	2.66	3.20	2.24	1.76	1.13	0.74	1.28
2004	2.59	3.17	2.21	1.73	1.23	0.71	1.15
2005	2.62	3.32	2.25	1.74	1.33		1.07
2006	2.62	3.39	2.26	1.76	1.42		1.07
2007	2.68	3.44	2.29	1.77	1.49		1.13

Note: (1) In India, the small-scale industry sector is only partially covered. Data for 2004-05 were estimated by applying sector-wise growth rates for the period 1998-99 to 2002-03
(2) Corresponds to 2005
Source: www.stats.oecd.org

Table 8 Technician in R&D per million people

Country Name	1996	2005
India	112	94
Russian Federation	654	519
South Africa		109
Germany	1346	1148

Source: www.data.worldbank.org

We also find from patent generation data in Table 9 that technology generation capability of both India and Russia has increased between the years 2000 and 2009. As Table 9 indicates, technology generation by these two countries is significantly lower than that of China and of course technology rich countries like USA/Japan. We can also see that collaborating partners of inventions are not each other but countries like Japan, USA, and EU. It seems that there are little exchange of skilsl with regard to technology generation between India and Russia. Furthermore emigration data of (skilled) labour of India and Russia indicates that neither India nor Russia is their favourite chosen country for emigration.[3] Thus, it seems that both the governments need to take pro-active action to develop complementarities in technology and skills to further bilateral trade between themselves.

[3] See www.worldbank.org/prospects/migrationandremittances.

Table 9 Technology Generation Capability of Selected Countries

	Foreign Ownership of Domestic Inventions					% of Patents owned by Foreign Residents			
Country	Total Patents	Total co-operation with abroad	Japan	United States	European Union (27)	Total co-operation with abroad	Japan	United States	European Union (27)
	YEAR 2009								
India	1051	392		175	121	37.3		16.7	11.5
Russia	557	142	5	47	61	25.5	0.9	8.4	11.0
China	7572	1095	50	375	482	14.5	0.7	5.0	6.4
USA	30089	3471	310		1858	11.5	1.0		6.2
Japan	17567	549		240	209	3.1		1.4	1.2
EU-27	32123	4109	204	2156	3650	12.8	0.6	6.7	11.4
	YEAR 2000								
India	329	125	1	66	47	38.0	0.3	20.1	14.3
Russia	680	242	5	88	79	35.6	0.7	12.9	11.6
China	1673	251	14	147	57	15.0	0.8	8.8	3.4
USA	42863	4326	381		2623	10.1	0.9		6.1
Japan	11186	934		562	274	8.3		5.0	2.4
EU-27	38972	4892	165	3132	3727	12.6	0.4	8.0	9.6

Source: www.statistics.oecd.org

The comparative position of Russia and India can further be seen by examining the Balassa indexed of revealed comparative advantage (RCA) for selected HT products. While this measure has well-known limitations for cross-country comparisons, it can nevertheless provide an instructive snapshot of a country's relative standing at a particular point in time. A good has RCA if the index is greater than 1 and revealed comparative disadvantage if less than 1. Table 10 shows results for 2009. It can be seen that Russian performance is not impressive and compares poorly in comparison to other BRICS countries. Note that China among BRICS members is way ahead in respect of number of products having comparative advantage.

Table 10 Revealed comparative Advantage Index for BRICS, 2009

Indicator	Brazil	China	India	Russia	South Africa
No. of HT products in which the country trade	57	61	63	56	61
No. of HT Products in which country has comparative advantage	6	19	6	5	9

Average of RCA index of HT products	0.384	0.871	0.390	0.509	0.385

Source: Authors estimates using World bank's WITS database

4. Complementarities and Potentials in Merchandise Trade & Economic Benefits

In the earlier section, we have seen economic engagement in the realm of HT trade is low between India and Russia. To what extent, economic engagement exists in case of merchandise trade? Are there exist trade potential between the two? These are the issues that we plan to analyse in this section. The data for this analysis is based on Global Trade Analysis Project (GTAP) data base, version 7, which provides consistent comprehensive bilateral trade flows at broad sectoral level. The relevant statistics is shown in Table 11.[4] As this table shows, China has emerged as most important partner for both India and Russia. As share of total trade, exports to Russia from India and exports to India from Russia seem to be of negligible amount. Apart from China, OECD countries like EU-27, USA, and Japan are more important trade partner for India/Russia.[5]

Table 11 Major Export Partners of India and Russia, year 2006

Product Category	India's Exports (Share in %) to				Russia's Exports (Share in %) to			
	Russia	Brazil	China	South Africa	India	Brazil	China	South Africa
Grains and Crops	2%	0%	12%	2%	12%	0%	1%	0%
Forestry and Fishery	0%	0%	0%	1%	0%	0%	47%	0%
Mining	0%	0%	67%	0%	0%	0%	6%	0%
Livestock and Meat Products	0%	0%	0%	0%	1%	0%	6%	0%
Processed Food	2%	0%	5%	1%	0%	0%	19%	0%
Textiles and Wearing Apparels	1%	1%	1%	1%	1%	0%	1%	0%
Leather products	1%	0%	5%	2%	1%	0%	2%	0%
Light Manufactures	0%	0%	2%	0%	3%	0%	8%	0%
Petroleum and Coal products	0%	4%	0%	2%	0%	0%	4%	0%
Chemicals, Rubber & Plastic products	2%	2%	7%	2%	2%	3%	12%	0%
Heavy manufacture	1%	1%	6%	1%	2%	0%	2%	0%
Transport Equipments	1%	0%	0%	8%	6%	0%	1%	0%
Electronic Equipments	1%	1%	4%	0%	3%	0%	9%	0%

Source: Author's estimate from GTAP database

We have seen that present economic engagement is low between India and Russia. Naturally, question arises whether trade complementarities exists between the two which may lead to gains in economic welfare in both countries. To do ex-ante analysis, we have used the well-known GTAP (Global Trade Analysis Project) modeling framework which is in detail documented in Hertel (1997).

[4] We have aggregated the data obtained from GTAP using the aggregation concordance map given in Table 12.
[5] Author's estimate based on GTAP database.

The GTAP model is a multi-region multi-sector static computable general equilibrium model (CGE) based on neoclassical macroeconomic theory[6]. Thus markets are perfectly competitive; profit maximizing producers use the technology that exhibits constant returns to scale. Like any other general equilibrium model GTAP provides detailed bilateral trade, transport and protection data with the vertical and horizontal linkages between all product markets both within the model's chosen countries and regions and also between the countries and regions via bilateral trade flows. For the present purpose, we have used a GTAP model consisting 9 regions and 16 sectors (see Table 12 for sectoral description). The aggregation of sectors and regions has been carried out keeping in view the important trading partners of India and Russia.

Table 12 Sectors & Regions of the CGE Model used for the present study

Regions		Sectors	
1	China	1	Grains and Crops (Rice, Wheat, Cereal Grains, Oilseeds, Vegetables, Fruits and nuts, Sugar cane, Sugar beet, Plant based fibres, Crops nec)
2	Japan	2	Livestock and Meat Products (Cattle, Sheep, Goat, Horses, Animal products nec, Wool, Silk-worm, cocoons, Meat & Meat products)
3	India	3	Forestry and Fishery
4	Russia	4	Mining (Coal, Oil, Gas, Minerals nec)
5	South Africa	5	Processed Food (Processed rice, Food products nec, Beverages &Tobacco products Vegetable oil and fats, Sugar, Dairy products)
6	NAFTA (USA, Canada, Mexico)	6	Textiles and Wearing Apparels
7	Brazil	7	Leather products
8	European Union (27 member countries)	8	Light Manufactures (Wood products, Paper products publishing, Metal products, Manufacture nec)
9	Rest of World	9	Petroleum and Coal products
		10	Chemicals, Rubber &Plastic products
		11	Heavy manufacture (Mineral products, Ferrous Metal, Metals nec, Machinery and Equipments nec)
		12	Transport Equipments (Motor Vehicles, Transport Equipments & parts)
		13	Electronic Equipments
		14	Utilities (Electricity, Water supply, Gas distribution, Construction)
		15	Transport and communication (Trade, Transport nec, Sea Transport, Air transport, Communication)
		16	Other Services
Note: nec - Not elsewhere classified			

The policy inputs to the model are various kinds of tariff and NTBs, subsidy parameter, Hicks-neutral productivity parameters, etc (see Hertel, 1997 for full list policy shocks parameters). When a policy shock is given to the model, resources are allocated along the line of comparative advantage, which results in change in welfare through channels like terms of trade effects, efficiency gains from trade, etc. It should be noted that the model simulates only static gains based on a single set of equilibrium conditions rather than relationships that vary over time. Moreover, the present version of the model used in the paper does not allow for very long-run adjustments that could occur through capital accumulation, population growth & technological change.

[6] A brief description of the model is given in Annex 1.

To find out the trade potential between India and Russia, we have undertaken two illustrative simulations as given below:

Simulation 1: India and Russia abolish completely bilateral tariffs and NTB on trade on commodities. In other words, India and Russia signs a free trade agreement on goods.

Simulation 2: Simulation 1 + 10% improvement in trade facilitation parameters. This simulation would capture the gains in trade if the trade logistics network, which is poorly developed in case of bilateral trade between India and Russia, is improved.

The results of the simulations are shown in Table 13-15. As Table 13 indicates, India income rises by US $ 1.6 billion or by 0.53% of GNP when India and Russia abolish completely bilateral barriers on trade in goods. Under this simulation, Russia's income rises by US $ 0.436 billion (0.59% of GNP). Note that the principal source of welfare gain in case of India is allocative efficiency effects while the same in case of Russia is gains from terms of trade effects. In simulation 2 which incorporates simulation 1 plus productivity improvement in trade facilitation measures, we find that there are further gains, albeit small, in both countries. What is evident that economic complementarities exist between India and Russia, only the government as well as private corporate sectors of either country need to be pro-active to exploit the benefits.

Table 13 Welfare effects of Economic Integration between India and Russia

Country	Simulation 1			Simulation 2		
	Equivalent Variation	Allocative Efficiency Effects	Terms of Trade Effects	Equivalent Variation	Allocative Efficiency Effects	Terms of Trade Effects
	US $ Mill.	US $ Mill.	US $ Mill.	US $ Mill.	US $ Mill.	US $ Mill.
India	1570.8 (0.53%)	912.0	123.1	1604.1 (0.54%)	920.1	127.4
Russia	435.9 (0.59%)	-1050.5	1361.4	444.0 (0.60%)	-1063.1	1378.7

Note: Author's estimate.
The figure in parenthesis indicates percent of GNP.
Simulation 1: Complete Removal of tariffs on good between India and Russia
Simulation 2: Simulation 1 + 20% improvement in trade facilitation parameters

The data in Table 14 indicates that real return to all factors in both countries registers positive gains under these two policy shocks. Thus, this is a win-win situation in both counties.

Table 14 Effects of Real Returns of Factors (Percent Change)

Factors	India		Russia	
	Simulation 1	Simulation 2	Simulation 1	Simulation 2
Unskilled Labour	0.45	0.45	1.03	1.03
Skilled Labour	0.37	0.36	0.68	0.68
Capital	0.34	0.34	0.29	0.29

Note: Author's estimate.

Table 15 indicates the sectors which gain in exports under simulation 1. It must be noted that the percentage change are of large magnitude in several sectors due to low level of trade in base year. As this table shows, exports from either country to the partners increases significantly for mining and manufacturing sector. High technology products are embedded in several sectors of this model economy, particularly non-food manufacturing sectors. Growth in exports in these sectors implies existence of significant trade potentiality including that in high technology products. What is probably needed is the environment, improved trade logistics networks and corporate to corporate networks.

Table 15 Exports (Percentage Change) -- Simulation 1

Goods Sector Only	India to Russia	Russia to India
Grains and Crops	-0.76	-2.3
Livestock and Meat Products	-1.89	-3.2
Forestry and Fishery	0.13	-1.28
Mining	1210.29	1203.17
Processed Food	427.01	428.78
Textiles and Wearing Apparels	732.26	745.47
Leather products	804.45	804.26
Light Manufactures	695.33	668.85
Petroleum and Coal products	422.21	415.8
Chemicals, Rubber & Plastic products	652.94	652.89
Heavy manufacture	775.9	749
Transport Equipments	629.19	615.72
Electronic Equipments	884.05	873.94

Note: Author's estimate. Since result of simulation 2 is similar, we have not produced the same here

5. Concluding Remarks

In this paper the complementarities between India and Russia in merchandise trade in general and high technology trade in particular has been mapped out along with measuring the potentials of bilateral transfers of investments, technology and skills. The analysis showed that bilateral trade flow is minimal, even though there exists trade complementarities between the two countries. We find that significant potentials exist for growth in bilateral trade whether in the realms of HT trade or in general merchandise trade if bilateral barriers in trade are abolished. Moreover, closer economic co-operation is beneficial to both countries since both of them registers gain in economic welfare with none of the factors suffering loss in returns.

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Annex 1. GTAP Model

In the GTAP model the firm's production structure is characterized by Constant Elasticity of Substitution functional forms to combine intermediate inputs and primary factors of production such as land, natural resources, skilled and unskilled labour and capital. Intermediate inputs are composites of foreign and domestically produced components. In our model run, we have considered only three factors of production namely, unskilled labour, skilled labour and capital. International trade is characterized by Armington specification (Armington 1969) such that foreign components of intermediate goods are differentiated by region of origin. Thus firms can decide the sources of their imports and based on the composite import price they decide on the optimal mix of the domestic and imported inputs. On factor market, full employment is assumed with labor and capital being mobile within the countries but immobile internationally. On the demand side of the GTAP model, each region is comprised of a representative household who disposes of the entire regional income according to a Cobb-Douglas utility function specified over three forms of final demand such as private household expenditure, government expenditure and savings. Now, private household expenditure is defined over a Constant Difference of Elasticity (CDE) demand system that permits different price and income responsiveness across countries (MacDougall 2003).

Moreover, there is an explicit treatment for international trade and transport margins and a global banking sector intermediates between global savings and consumption. The model determines trade balance in each region endogenously and hence foreign capital inflow may supplement regional domestic savings.

The closure of the model is of general neo-classical general equilibrium type with saving investment equality and clearance of the factor markets. It ensures endogenous wages and full employment of all the resources. Each of the economic relationships described in the model are based on literature reviews and econometric estimates.