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RIS
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Is India Digitally Prepared for International Trade?

Rashmi Banga*

Abstract: The paper assesses India's digital preparedness for international trade by comparing its digital infrastructure to other major developing countries' and identified developed countries' digital infrastructures. Further, the paper estimates value-added by digital services in exports of 43 countries using world input-output database (WIOD) and compares digital content in India's total exports and sectoral exports for the years 2007 and 2014. The results show that India lags many developing as well as developed countries in terms of its digital preparedness for international trade, including in its traditional export sectors. Despite ranking high in terms of its global exports of digital services, the value-added by digital services in India's exports of sectors other than ICT and telecommunications is found to be lower than many countries, indicating lopsided digitalization of India's exports. Given the many initiatives undertaken by the Government on digitally transforming India under its Digital India program, there is a need to leverage these initiatives to boost India's trade competitiveness. In this regard, the paper suggests designing Digitally-Informed Foreign Trade Policy with the objective of improving India's digital infrastructure for trade, enhancing digital content of its exports; building digital skills in tradeable sectors; promoting use of digital technologies in manufacturing exports; and using big data analytics to inform foreign trade policy on ways of improving trade competitiveness. The need to preserve policy space in the on-going trade and investment agreements is emphasized especially with respect to cross-border data flows.

Key words: Digitalization, Digital India, Digital Infrastructure in India, Foreign Trade Policy of India.

1. Introduction

With the onset of the fourth digital industrial revolution, also called Industry 4.0, India like many other developing countries is facing new opportunities and challenges in international trade. The rising digitalization can greatly impact on trade competitiveness of the countries, benefitting the countries which are able to increase the digital

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content of their production and exports while adversely impacting the countries which are unable to catch-up in the digital race. To digitally prepare itself India has initiated some concrete programs like '*Digital India'* which aims at transforming India into a digitally empowered society and knowledge economy. It aims at providing citizens with *Digital Infrastructure as a Utility; Governance and Services on Demand; and Digital Empowerment*[1]. Many sub-programs have been initiated by the Government under *Digital India*, for example, Aadhaar identity platform, agrimarket app; e-panchayat, MyGov, etc. The Government has also initiated a working group to design the *National E-Commerce Policy.* In this context, the main objective of this paper is to examine the digital preparedness of India for international trade by comparing India's digital infrastructure to other developing and developed countries along with various indicators of digital development and to estimate the extent of digital content in India's exports as compared to other countries in different sectors, including its traditional export sectors. A way forward is suggested in building India's trade competitiveness in the digital era.

Digitization can impact global trade competitiveness of countries since it impacts all stages of the value-chains, i.e., pre-production, production and post production stages, and therefore can lead to a massive reorganization of the existing global value chains (GVCs) and emergence of new GVCs. Firms are using big data analytics to analyze consumer preferences, forecast demand and customize products, while super platforms like GAFAA (Google, Amazon, Facebook, Apple and Alibaba) are providing two-sided and in some cases many-sided markets to producers and consumers to interact[2], which enables these platforms to collect more data and strengthen their capacity to reorganize international markets. The "network effect" increases the gains of these platforms, further enhancing their global competitiveness and allowing them to lock-in their attractiveness, destroy competition and emerge as powerful monopolies (See Belleflamme and Peitz, 2016).

Even though reining in the fast-growing super platforms and big tech firms is posing a challenge for the developing countries, these platforms are also opening access to new markets through e-commerce as well as exposing domestic consumers to new products/producers. Further, digital technologies like robotics and 3D printing are increasingly being used in the production stage. This creates new opportunities for the developing countries to upgrade in GVCs, as higher digital content can add value to the exports of the developing countries. But, it also heightens their risks. If countries are unable to digitize their manufacturing, there is a danger of losing their global trade competitiveness, even in their traditional export sectors and even within their domestic markets.

While there exists a vast literature on various factors affecting trade, digitalization is a relatively new factor and very few studies have empirically estimated the impact of digitalization on trade, especially for India. The debate on possible impacts of digitalization on international trade triggered in 1998, when countries decided in the WTO to apply a moratorium on custom duties on electronic transmissions. The growing digitalization of some of the exportable products like softwares, music, eBooks, video games etc., which were earlier exported as products but are increasingly being electronically delivered, prompted research on possible implications of moratorium on custom duties on ET. Makoni et al (2013) using surveys estimated a significant tariff revenue loss for Zimbabwe by not imposing custom duties on digital products. Banga (2017) estimated the impact of a permanent zero custom duty on identified 38 products, which are being increasingly digitalized and exported electronically, and found that a permanent moratorium would lead to a further rise in imports of digital products by the developing countries along with growing tariff revenue loss for many countries. India was found to be a net importer of these identified digitalized products in 2015.

It must be noted that digitalization has proceeded very rapidly over the past few years and its impact on international trade goes much beyond custom duties on ET. In this scenario, like many other developing

countries, India is also grappling to digitalize as fast as possible to retain its trade competitiveness. To assess whether India will be able to retain its competitiveness in the digital world, the paper compares the existing digital infrastructure & digital capacities; and use of digital technologies in India with other developing and developed countries. Further, the paper estimates the value-added by digital services (DS) to total exports and exports of different sectors for 43 countries[3]. The Digital services include computer programming, consultancy & related activities and information service activities; and telecommunications. The analysis is based on national input-output tables (derived from World Input-Output Tables) and World Input-Output database (WIOD) and is undertaken at an aggregate as well as sectoral level using Leontief decomposition (in the R package).

The paper further provides a way forward for India for building its trade competitiveness in the digital era by designing a ***Digitally-Informed Foreign Trade Policy***, which can help in increasing the digital content in sectoral exports of India and improve its global competitiveness. The key components of such a policy are discussed along with the importance of maintaining the existing policy space in the trade and investment agreements.

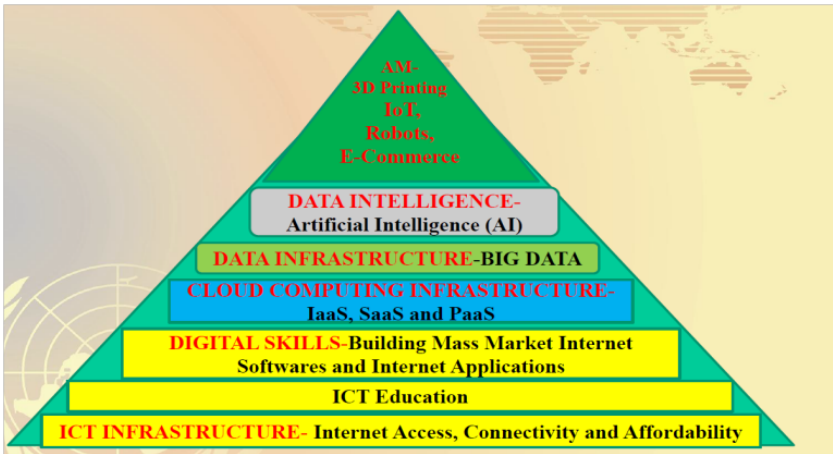
The paper is organized as follows: section 2 discusses the interrelated components of digital infrastructure and compares the existing digital infrastructure in India with other developing and developed countries' using various indicators; section 3 outlines the methodology and presents the results of empirical estimates of value-added by digital services to total exports of India and compares it with other countries. The comparison is made over time for total exports as well as for exports at the sectoral level; section 4 discusses the need for a digitally-informed foreign trade policy in India and highlights the importance of preserving policy space in trade and investment agreements, especially in the WTO; section 5 summarizes and concludes.

2. Comparing Digital Infrastructure of India to other Countries

2.1 What is Digital Infrastructure?

Digital infrastructure (DI) goes much beyond ICT or e-commerce. It can be said to comprise three kinds of interrelated infrastructures, that are ***ICT infrastructure***; ***Cloud Computing infrastructure*** and ***Data Infrastructure*** accompanied with use of related ***digital skills*** and ***digital technologies***. Figure 1 presents the different layers of digital infrastructure.

Figure 1: Digital Infrastructure



Source: Author's representation

ICT infrastructure is the first step towards building DI. It constitutes universal internet access, connectivity and affordability. This is complemented by ICT education and skills. The second step towards building DI is to develop/use cloud-computing infrastructure. Cloud Computing infrastructure is a soft infrastructure, which can remotely provide computing services as a general utility to all internet users. These services can be further divided into three main categories, i.e., Infrastructure as a Service (IaaS), Software as a Service (SaaS) and

Platform as a Service (PaaS). IaaS are self-service models for managing remote datacenter infrastructures, e.g., networking services like firewalls or server spaces. SaaS eliminates the need to install applications on individual computers, for example emails or Google Apps, Facebook, Twitter, etc. while PaaS allows software developers' customization and reduces the amount of coding required. Users can create apps through software components that are made available by PaaS. Cloud computing infrastructure, by providing remote infrastructure, has the potential to greatly reduce the need for hard infrastructure like storage disks, etc. and drastically cut cost of computing and using softwares in a country.

The third step towards building DI is building ***data infrastructure***, which has now become the most important component of digital infrastructure, with the ability to give rise to global monopolies and change the relative positions of the countries in terms of their shares in global production, consumption, investments and international trade. Data infrastructure has two parts- 'data' and 'data intelligence' Many have termed 'data' as the 'new oil', which powers the digital economy the same way as oil powers the industrial economy.[4] Data is generated not just by the people who use internet, but by almost every person who uses smart technologies, like TVs, cars, phones, fridge, etc. as Internet of Things (IoT) has made it possible to connect devises through sensors and collect data. Non-personal data is also generated by purchasing goods, seeking admission in schools, admitting in hospitals, using roads, etc. Data intelligence combines layers of data to form 'Big Data' and transforms this big data into information by analyzing it. This information leads to knowledge that is converted into value. The value generated from big data is unique and forms the basis of 'Artificial Intelligence (AI)' producing unique products and services, which are more efficient and less costly to produce and consume.

Ownership of data and capability of intelligently transforming data into highly efficient products and services has led to growth of big tech firms also known as 'superstar firms' with monopolistic powers (Autor et al., 2017). Large economies of scale and large network effects make it

difficult for new firms to compete with these large monopolies. GAFAA (Google, Apple, Facebook, Amazon and Alibaba) along with AirBNB, UBER, etc. are some such monopolies created by the digital economy. Data intelligence manifests itself in designing digital technologies like AI, robots, 3-D printing, ecommerce etc.

Comparing the existing digital infrastructure in India with those of other developing and developed countries can provide an assessment of the relative position of India in the digital world.

2.2 Comparing India's ICT Infrastructure and Digital skills

India has progressed fast in terms of building its ICT infrastructure. The internet users increased from 1.4 mn in 1998 to 462 mn in 2016, which is an increase from 0.1% of population to 36.5% of population[5]. Despite this progress in number of internet users and other initiatives of the Indian Government, comparing India to other countries shows that India lags many developing countries not only in terms of its ICT development index ranking, which is based on internet access, connectivity and affordability, but also in terms of most of the ICT development indicators. In fact, India is found to lag even much smaller countries like Viet Nam, Cambodia, Bangladesh as well as Sri Lanka in many of the ICT development indicators.

Table 1 compares India to other countries in terms of some of the major ICT development indicators. India ranks 134 out of 176 countries in its ICT development index. Not only the developed countries, but most of the Asian developing countries like Thailand, Indonesia, Philippines, Malaysia, Singapore, Viet Nam, Cambodia as well as Sri Lanka rank higher than India. India ranks lower in terms of fixed broadband subscription per 100 inhabitants; active mobile broadband subscription per 100 inhabitants, 3G coverage; percentage of households with internet access; as well as in terms of international internet bandwidth per internet user from most of these countries. Compared to China, India ranks lower in almost all indicators of ICT development. In fact, India ranks lower than Asia Pacific average for most of the ICT development indicators.

Even within BRICS, India has the lowest ICT development index ranking and lags in other ICT development indicators. Compared to the world average, India lags in terms of all ICT development indicators considered.

In terms of digital skills, India appears to be in a much stronger position. In 2014, according to the International Data Corporation (IDC), there were 21.03 million software developers in the world at the outset of 2017, of which according to Evans Data Corporation 3.6 million developers are in the US, while Stack Overflow estimates 4.7 million in the Europe. However, according to Evans data projects, India has about 2.75 million software developers but by 2018, India will have 5.2 million developers, overtaking the US which is estimated to have around 4.5 million developers by the end of 2018[6]. Although, in terms of number of developers, India may have surpassed the US, but according to HackerRank, in terms of quality of developers, China ranks number one with best programmers, while India ranks 31st in a list of 50 countries. This is corroborated by the fact that the global software products market stood at $413 billion in 2017, growing at 10.4 per cent annually, but India's share was only 2 per cent[7].

Table 1: Key ICT Development Indicators (2016)

	ICT Development Index Ranking (1DI)-2017	Fixed Broadband Subscriptions per 100 inhabitants	Active Mobile-broadband subscription per 100 inhabitants	3G coverage (% of population)	Percentage of households with internet access	International internet bandwidth per internet user (kbits/s)
Korea (Rep.of)	2	41.1	111.5	99	99.2	54.3
United Kingdom	5	39.2	91.4	99.6	91.3	66.2
Japan	10	31.4	132.3	99.9	97.2	83

Table 1 continued...

...Table 1 continued

Germany	12	38.8	76.5	96.2	90.8	107.5
United States	16	32.4	124.9	99.9	84	126.5
Singapore	18	25.6	146	100	91.1	982.9
United Arab Emirates	40	13.3	156.7	100	94.3	133.7
Russian Federation	45	19.4	74.9	75	74.8	51.9
Malaysia	63	8.7	91.7	95	76.9	42.6
Brazil	66	13	89.5	96.9	52.4	66.2
Thailand	78	10.7	94.7	98	59.8	49.2
China	80	22.9	69.1	98	55.5	14.7
South Africa	92	2.1	58.6	98	53	263
Philippines	101	5.5	46.3	93	39.1	43.4
Viet Nam	108	9.6	46.6	77.3	23.5	91.3
Indonesia	111	2	34.2	74.9	47.2	24.9
Sri Lanka	117	4.1	18.3	85	21.1	22
Cambodia	128	0.6	50.2	80	26	23.6
India	**134**	**1.4**	**16.8**	**79.7**	**22.6**	**16**
Nepal	140	0.8	30.8	90	15	3.9
Bangladesh	147	4.1	27.2	91.4	14.5	9.2
Pakistan	148	0.9	20.1	67	22.1	16.6
World	176 countries	12.4	52.2	85	51.5	74.5
Asia and Pacific		11.3	47.4	87.6	45.5	48
Africa		0.4	22.9	59.3	16.3	51
Europe		30.2	80.1	98.5	82.5	178

Statista; Statista DMO@2 Statista 2018, ITU Estimates (2017) https://www.itu.int/en/ITUD/Statistics/Documents/publications/misr2017/MISR2017_Volume2.pdf

2.3. Comparing India's Cloud Infrastructure

India is proactively promoting cloud infrastructure in the country. *Digital India* includes initiatives like Digital Locker, which is a cloud-based storage system. Further, e- Governance which provides real time information; e-Banking which enables mobile banking services; etc. are all initiatives that involve huge data and therefore need cloud infrastructure. According to some estimates the public cloud market in India was worth US$ 1.9 billion in 2017 and is expected to grow to US$ 4.2 billion by 2020[8]. All global major cloud providers like Alibaba, Amazon, Google and Microsoft have opened data centers in the country.

However, in spite of this fast growth in cloud computing, India's performance compares unfavorably with its global competitors. Comparing internet bandwidth per internet user, which is one of the prime infrastructure needed to develop competitive cloud computing services, of India with other developing and developed countries, it is found that India ranks very low, i.e., 116 out of 143 countries (Table 2). This indicator refers to total used capacity of international internet bandwidth in megabits per second divided by total number of internet users. Many south Asian countries like Bangladesh, Pakistan and Sri Lanka have higher ranks than India while Southeast Asian countries like Malaysia, Indonesia, Philippines, Thailand and Cambodia also rank higher than India. Within BRICS countries India is second lowest in ranking, i.e., after Brazil, Russia and South Africa. There is no comparison of India with the developed countries like USA, UK and Germany in this regard as they all rank in top 50 countries.

Comparing the affordability to internet users, i.e., fixed broadband internet tariffs (or monthly subscription charge for fixed (wired) broadband Internet service in US PPP $), it is found that India compared to other developing countries ranks quite high (i.e., 36 out of 140) because of its well-regulated prices, although the difference in prices is not very huge. Other South Asian countries like Bangladesh, Sri Lanka, Nepal and Pakistan all rank higher than India with lower prices. However. many southeast Asian countries have higher prices than India.

The speed of internet is important along with the price of internet. In terms of average connection speed, India ranks 89 out of 149 countries according to Akamai, with average speed of 6.5 megabytes per second (Mbps), ending up second last in the ranking of the selected countries in the Table 2. India is also behind 100 countries in terms of secure internet services per million people. with most of the Southeast Asian countries ahead of India in their ranking.

Although India ranks low in the above indicators with respect to Cloud infrastructure, India has been projected as the one of the top global destinations and according to the National Association of Software and Services Companies (NASSCOM), Indian SaaS market which was worth US $ 407 million dollars in 2016 is expected to grow three times by 2020. India's tech-start-up ecosystem has been hailed as rising and shining and competing with China for the third position, after US and the UK (NASSCOM 2017). These trends are encouraging for India. However, other countries are developing their tech start-up ecosystems much faster and according to 2017 Global Startup Ecosystem Report, which use 55 startup ecosystems across 28 countries and rank the top 20, Bengaluru (India) ranked 20th in top 20 cities in the world, with its ranking dropping from 15th to 20th in a year.

Table 2: Key Indicators of Digital Infrastructure

	Internet bandwidth kb/s/ user	Rank-Internet bandwidth kb/s/ user	Fixed broadband Internet tariffs, PPP $/ month	Rank-Fixed broadband Internet tariffs, PPP $/ month	Secure Internet servers/ million pop	Rank-Secure Internet servers/ million pop	Average Connection Speed Matrix -Mbps (IPv4)	Rank-Average Connection Speed Matrix
Singapore	. 616.5	4	46.31	99	822.3	22	20.3	7
United Kingdom	429.8	7	. 14.12	6	1291.2	15	16.9	15

Table 2 continued...

...Table 2 continued

South Africa	149.5	18	30.6	61	115.6	50	6.7	82
Germany	146	19	44.4	97	1420	13	15.3	25
United Arab Emirates	79.6	35	83.4	120	294.4	35	8.6	65
United States	71	42	16.32	11	1548.2	12	18.7	10
Thailand	54.8	48	42.47	89	. 23.3	81	16	21
Japan	48.6	54	20.72	21	911.7	20	20.2	8
Korea (Rep. of)	45.2	57	35	73	.2178.3	5	28.6	1
Brazil	43	60	17.52	14	68.6	58	6.8	79
Russian Federation	29.9	75	15.73	10	84.4	55		
Philippines	27.7	79	54.59	104	10.9	96	5.5	100
Malaysia	27.2	81	60.97	110	88.5	54	8.9	62
Viet Nam	20.7	89	2.59	1	11.9	91	9.5	58
Cambodia	16.3	92	29.81	56	3	113		
Sri Lanka	12.7	96	12.56	3	11.4	92	8.5	68
Bangladesh	6.6	110	12.77	4	0.9	134		
Indonesia	6.2	112	27.92	46	6.2	103	7.2	77
Pakistan	5.7	115	18.04	15	. 1.8	123		
India	**5.7**	**116**	**24.89**	**36**	**5.5**	**105**	6.5	89
China	5	119	33.99	68	7	102	7.6	74
Nepal	. 3.1	128	22.8	29	3	114		

Source: The Global Information Technology Report 2016, Innovating in the Digital Economy, WEF; Q1 2017 State of the Internet - Connectivity Report | Akamai (https://www.akamai.com/us/en/multimedia/documents/state-of-the-internet/q1-2017-state-of-the-internet-connectivity-report.pdf)

2.4 Comparing India's Data Infrastructure and Digital Technologies

2.4.1 Big Data and Artificial Intelligence

Some of the important components of data infrastructure include Big Data analytics; AI; Robots 3D printing; and e commerce. Comparing the progress made by India with other countries in these areas is difficult due to scant statistics. However, the available statistics do show that even in this area India needs to catch up with other developing and developed countries.

In terms of Big Data analytics and AI, China has made rapid progress and is now catching-up with the US. The global Big Data market grew from $7.6 billion in 2011 to $22.5 billion in 2015. In 2017, it grew to $ 35 billion and is expected to reach $ 56 billion in 2020[9]. Big Data market in China grew by 45% in 2016 from 2015 to reach $ 2.5 billion. While according National Association of Software and Services, India also has a growing Big Data analytics sector which values around $2 billion. According to prediction of NASSCOM, India's Big Data market will grow by CAGR 26% and will amount to 32% of global market in 2022. However, some estimates suggest that the Big Data market in Asia Pacific will reach US$ 14.7 billion in 2018, of which, China will have the biggest market with a spending of US$ 5.5 billion. This will be followed by Australia, Indonesia, Philippines and Thailand[10].

While AI is still in its nascent stages in India, China has made AI its national priority and is rapidly developing its AI industry. India's budget allocation for Digital India program stands at $ 477 million, while China is developing a technology park in Beijing worth $ 2.1 billion[11], which is greater than AI spending of the USA on AI programs in 2016 of about $ 1.2 billion. China has announced plans to develop its AI industry which will generate $ 60 billion annual output by 2025 and will become $150 billion industry by 2030.

In terms of research output, in 2017 Association for the Advancement of Artificial Intelligence (AAAI) indicated a 13% growth

in China in the period 2012-2017, as compared to 6% decline in the US. Although comparative figures are not available for India, but a study[12] shows that whole of India produces less machine learning papers than a single university in China. According to the Global AI Talent Report of 2018, India (with 386) is at the 10th place in terms of countries with the most number of AI researchers, trailing the US (9,010), UK (1,861), Canada (1,154), France (797), Australia (657), Germany (626), Spain (606), Switzerland (441), and China (413) but has the lowest number of PhD-level AI researchers among major economies.

Countries are rapidly increasing their investments in AI and India is also gearing up with the nationwide AI program and focused funding for R&D of AI. Under the nationwide AI program it is expected that new schemes and incentives will be given to the start-ups and venture funds and industrial policy but these will take time to fructify. With the growing investments in AI, there is also a growing demand for people with digital skills. While there is a large pool of IT workers in India according to NASSCOM almost 50% of the IT workforce will need to learn new technologies.

2.4.2 Digital Technologies- Robots; 3D Printing; and E-Commerce

Robotics

One of the fastest growing digital technology is the robotics. Since 2010, the demand for industrial robots has accelerated due to the rise in automation and AI. According to International Federation of Robotics (IFR) the average robot sales grew by 12% p.a. (CAGR) between 2010 to 2016. India has also experienced a rise in its use of robots (Table 3). The market sale or delivered industrial robots increased by more than 200% in 2016 (2,627) as compared to 2010 (776). However, compared to developed countries and China, India seems to lag far behind. In 2016, five countries accounted for 74% of total sales of robots, which are China, the Republic of Korea, Japan, the United States, and Germany. With 87,000 industrial robots in 2016, China surpassed US and Germany.

India's comparative performance vis-a-vis other developing countries and BRICS countries has been favorable as India's operational stock in 2016 surpassed most developing countries' operational stock.

An important indicator of trade competitiveness of manufactured products in future will be the use of robots in manufacturing sector. Table 3 reports the use of robots in manufacturing in 2010 and 2016 for selected developed and developing countries. India's manufacturing sector had an operational stock of 11,237 in 2016, while countries like China, Germany and US had more than 100,000. Other developing countries lagged India in their operational stock of robots used in manufacturing sector, except for Thailand.

While this indicator appears to provide an important competitive edge to Indian manufacturing, it is important to take into consideration the relative size of the manufacturing sector and compare the robot density (which is number of multipurpose industrial robots per 10,000 persons employed in manufacturing industry) across countries. In terms of robot density, India falls several peg and is found to have one of the lowest robot density in the group of the selected countries. The global average robot density is 74 robots per 10,000 employees in manufacturing sector. While China is close to the global average and has recorded the fastest growth in its robot density (increasing from 25 in 2013 to 68 in 2016), India's robot density remains lower than Malaysia, Thailand, Indonesia, South Africa and Brazil.

3-D Printing

Along with automation and robotics, additive manufacturing or 3D printing is fast progressing in the digitalized world. Although 3D printing was invented in 1980s, it became widespread only after some key patents expired in 2009 and 2014. In the period 2014 to 2017, the total number of desktop 3D printers sold nearly tripled, with a growth rate of 42% CAGR according to an industry report[13]. India has also made progress

in 3D printing although its 3D printing market is still at its initial stages of development. The International Data Corporation (IDC) estimates the global spending on 3D printing to be around $12 billion in 2018.

According to A.T. Kearney's 2017 3D Printing Index, (which is based on 38 quantitative metrics in six dimensions using indicators such as country's current 3D printing footprints; share in global sales of 3D printers; 3D printing patent applications; etc.) the leaders in this field with the index score between 4.1 to 7.5 are countries like US, Germany, Rep. of Korea, Japan. UK, Singapore, Canada, Sweden and France; the challengers with index score between 2.7 and 4.0 are Australia, Australia, China, Italy, Malaysia, Taiwan, Spain, Russian Federation, Czech Republic and Turkey; while the followers are countries with index score between 0.9 to 2.6 include India with a score of 2.5. In terms of 3D printing, India ranks 25th in the list of 28 countries, after countries like Indonesia, Malaysia, Vietnam, Brazil and South Africa.

E-Commerce

E-commerce is fast catching up as a popular mode of buying and selling goods and services on the internet. However, there is a need to distinguish between domestic e-commerce and cross-border e-commerce. According to UNCTAD (2017), using various country reports of ACATURE (2015), the market size in e-products and ET products is estimated to be approximately $22.5 trillion. Of this, around $21 trillion is estimated to be domestic e-commerce, i.e., buying and selling of e-products within the boundaries of the countries; $1.6 trillion is estimated as cross-border e-commerce, i.e., international trade in e-products where the products cross the national boundaries. According to NASSCOM Indian e-commerce market was $14 billion in 2015, up from US$ 10.5 billion in 2014 and with 30% CAGR since 2010. Despite this growth, India has a minuscule share in the global cross border e-commerce market, which is around 1% (UNCTAD 2017) with three countries namely China (40%); USA (20%); and UK (9%) capturing 69%. This is followed by Japan

Table 3 : Delivered and Operational Stock of Robots used in Manufacturing and All Industries: 2010-2016

		Manufacturing		All Industries		Robot Density in 2016
		2010	**2016**	**2010**	**2016**	
United States	Delivered Robots	12'746	29'400	16'356	31'404	189
	Operational Stock	96'826	223'105	173'174	250'479	
Germany	Delivered Robots	12'165	16'870	14'061	20'039	309
	Operational Stock	136'939	161'265	148'256	189'270	
United Kingdom	Delivered Robots	845	1'455	878	1'787	71
	Operational Stock	12'335	16'845	13'519	18'471	
China	Delivered Robots	13'008	76'636	14'978	87'000	68
	Operational Stock	26'578	282'807	52'290	339'970	
Thailand	Delivered Robots	966	2'049	2'450	2'646	45
	Operational Stock	2'660	16'951	9'635	28'182	
Malaysia	Delivered Robots	483	1'786	677	1'881	34
	Operational Stock	1'181	5'717	3'677	8'168	
South Africa	Delivered Robots	72	780	213	805	28
	Operational Stock	767	2'895	2'074	4'322	
Brazil	Delivered Robots	595	937	640	1'207	10
	Operational Stock	3'283	10'121	5'721	11'732	
Indonesia	Delivered Robots	191	954	357	964	5
	Operational Stock	387	4'162	1'285	7'155	
India	Delivered Robots	**215**	**2'284**	**776**	**2'627**	**3**
	Operational Stock	1'517	11'237	4'855	16'026	
Russian Federation	Delivered Robots	170	144	232	358	3
	Operational Stock	731	2'607	1'058	3'366	

Source: IFR, 2018.

(5%); Germany (4%) and France (4%). Thus, six countries capture more than 85% of the CBEC market.

The rise in cross border consumer spending in India needs to be an issue of concern rather than celebration. According to PayPal and Ipsos MORI, Indian shoppers spent more than US$ 8.7 billion on cross border ecommerce in 2016, an increase of 7% since 2015[14]. The report further predicts that the Indian shoppers are likely to spend 85% more on global online marketplaces next year[15]. Compared to the small share of India in cross-border ecommerce, the rising share of imports via e-commerce into India through the digital platforms needs urgent attention.

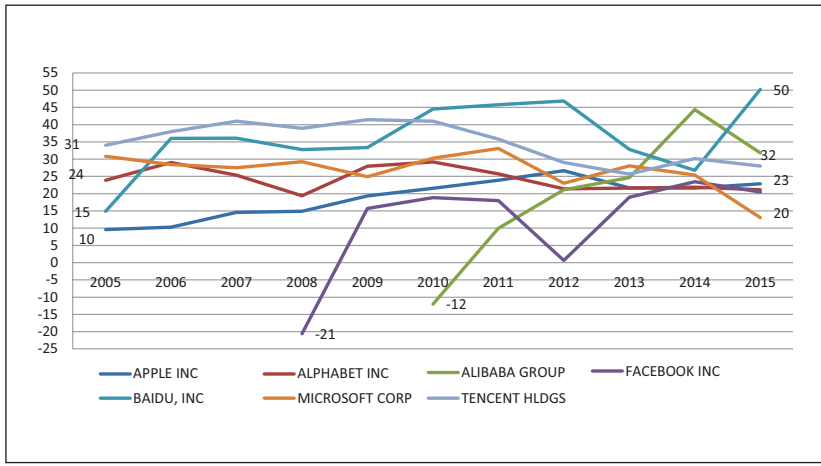
It is important to note that the rise of digital platforms like Amazon, Alibaba, etc make it extremely difficult for national e-commerce platforms to compete, especially given the anti-competitive practices of the digital platforms which include price wars. The recent buy-off of India's Flipkart by Walmart is an example of the growing anti-competitive practices of the global giants which follow predatory pricing and bear losses in identified countries to compete and wipe off competition in the national markets. Amazon's international losses on the back of its India business amounted to over $ 3 billion to fight off the domestic rival Flipkart[16], which then eventually sold off to Walmart.

Figure 2 depicts the rising global profit as a percentage of revenues of some of the platforms over time. This ratio is as high as 50% for firms like Baidu Inc, while average profits to revenues ratio for top 2000 Transnational Corporations for the period 2011-15 is 7%. This makes it possible for these digital platforms to compete with the national platforms in identified countries using predatory pricing.

Figure 2: Profits as a Percentage of Sales of Digital Platforms: 2005-2015

Source: Thomson Reuters

The profits of these international digital platforms are huge as



compared to India's e-commerce platforms, which are much smaller in size with most of them making negative profits or at best minuscule profits[17]. In 2015, profits of Amazon.com Inc were US$ 596 million while Alibaba Group Holding Ltd. recorded US$ 3.9 billion as profits.

To compare India's preparedness in E-Commerce with other countries, two indicators are used. According to UNCTAD's B2C[18] E-Commerce Index, which estimates a country's preparedness for E-Commerce and is based on the processes involved in an online shopping by consumers directly from the sellers, in 2016, India ranked 90th while in terms of World Economic Forum's Networked Readiness Index, it ranked 91st out of a list of 140 countries, with countries like China, Malaysia, Thailand, Sri Lanka, Viet Nam and Kenya ranking higher than India.

3. Value Added by Digital Services to Exports

To estimate the impact of digitalization on trade competitiveness, value-

added by digital services (Computer programming, consultancy & related activities and information service activities; and telecommunications) in total exports and sectoral exports is estimated for 43 countries, including India for the years 2007 and 2014. This indicates the changing trade competitiveness of countries which will crucially depend on the extent of the digital content added to their exports in the digital era.

3.1 Methodology

To estimate the extent of rise in the contribution of digital services to total exports and sectoral exports, national input-output tables (derived from World Input-Output Database) are used for 43 countries for the years 2007 and 2014. Further, using Leontief decomposition (in the R package), value added by digital services to total exports is estimated. Estimations are also carried out at a disaggregated sectoral level. The analyses are undertaken for all countries for which national input-output tables are available in WIOD database. These are 43 countries, most of which are developed countries but include the BRIC countries and Indonesia and Taiwan.

3.2. Value-Added by Digital Services to Total Exports: Results

Using the above methodology, Table 4 reports the estimated value-added by DS in total exports of some major economies in 2007 and 2014. Column (1) reports the results of value added by DS to total exports, while column (2) reports the value -added by DS to total exports, excluding exports of DS. Although, India appears to rank much lower than other countries in many of the indicators of digital preparedness, value added by DS to India's total exports compares favorably to many developing as well as developed countries.

In 2007, India ranked third in the world in terms of value added by DS in absolute terms, which amounted to US$ 35.5 billion as compared to US $ 38.6 billion in the USA. In 2014, there was a 46% rise in the value added by DS in total exports of India leading to a rise in its

value added by DS to total exports reaching US$ 51.8 billion, which maintained India's rank of third highest in the world. This may have lent a sense of confidence among the industry as well as the policymakers in terms of India's competitiveness in the digital world. However, a closer examination of the extent of value added by digital services to exports, excluding exports of DS themselves (i.e., exports of ICT and Telecommunications services), shows a very different picture. The value added by DS to total exports of India in 2014 excluding exports of DS, as reported in column (2), is only around US $ 5.9 billion as compared to US$ 34.2 billion in the USA and US$ 23.3 billion in China. This highlights the lopsided digitalization of India's exports which concentrates mainly on exports of digital services, which are Computer programming, consultancy & related activities; information service activities and telecommunications.

Table 5 reports the estimates of value added by DS to India's exports of different sectors in 2014. In terms of value added by DS, we find that US $ 51.8 billion of value added by digital services in 2014 concentrated in just a few sectors. Column 4 of Table 5 reports the shares of different sectors in VA by DS in India's Total Exports. The shares of Computer programming, consultancy &related activities; information service activities and Telecommunications were 84.5% and 4% respectively. These two sectors accounted for 88% of the total value added by DS to total exports of India. Only two sectors had a share equal to or greater than 1%, which are textiles and wearing apparels and leather products and chemicals and chemical products.

In textiles, wearing apparels and leather products, the value added by DS to its exports amounts to only 2.3%, while it is found to be highest in manufacture of computer, electronics and optical products (10.1%), followed by printing and air transport.

Table 4: Value Added by Digital Services to Total Exports: 2007-2017

	Value Added by Digital Services to Total Exports (US$ million) (1)				Value Added by Digital Services to Total Exports (excluding exports of DS) (US$ million) (2)		
	2007	2014	% Change		2007	2014	% Change
USA	38'603	58'509	52	USA	23'865	34'230	43
Germany	38'911	57'340	47	Germany	26'854	32'611	21
India	35'534	51'863	46	China	20'445	23'311	14
UK	30'755	38'111	24	UK	20'421	22'902	12
China	23'523	31'148	32	Japan	14'620	16'159	11
France	18'673	21'974	18	France	15'609	13'650	-13
Japan	15'988	17'553	10	Italy	12'934	10'754	-17
Italy	19'335	16'775	-13	Korea	5'298	6'283	19
Korea	6'028	7'915	31	India	2'829	5'948	110
Australia	3'587	5'730	60	Russia	4'390	5'113	16
Russia	5'366	5'704	6	Australia	2'824	4'346	54
Tawan	3'723	4'345	17	Tawan	3'325	3'472	4
Brazil	2'747	3'340	22	Brazil	2'513	2'912	16
Mexico	2'615	2'966	13	Mexico	2'484	2'906	17
Turkey	2'463	2'867	16	Turkey	2'283	2'758	21
Indonesia	1'822	2'804	54	Indonesia	1'442	2'011	39
ROW	76'236	111'273	46	ROW	45'283	50'324	11

Source: Author's estimates using Leontief Decomposition

Table 5: Value Added by DS in India's Sectoral Exports in 2014

India	India's Exports 2014 (US$ million) (1)	2014 VA by DS in Total Exports (US$ million) (2)	Share of VA by DS in Total Exports (3)	share of sectors in VA by DS in Total Exports (4)
Air transport	2'367	85	3.6	0.2
Architectural and engineering activities; technical testing and analysis	17'359	470	2.7	0.9
Computer programming, consultancy &related activities; information service activities	50'193	43'816	87.3	84.5
Construction	693	6	0.9	0.0
Crop and animal production, hunting and related service activities	12'338	26	0.2	0.1
Fishing and aquaculture	1'735	1	0.0	0.0
Forestry and logging	394	1	0.2	0.0
Insurance, reinsurance and pension funding, except compulsory social security	1'091	31	2.8	0.1
Land transport and transport via pipelines	7'585	116	1.5	0.2
Legal and accounting activities; activities of head offices; management consultancy activities	570	1	0.2	0.0
Manufacture of basic metals	21'299	226	1.1	0.4
Manufacture of basic pharmaceutical products and pharmaceutical preparations	1'665	29	1.8	0.1

Table 5 continued...

...Table 5 continued

Manufacture of chemicals and chemical products	26'318	503	1.9	1.0
Manufacture of coke and refined petroleum products	45'797	391	0.9	0.8
Manufacture of computer, electronic and optical products	3'350	339	10.1	0.7
Manufacture of electrical equipment	5'981	222	3.7	0.4
Manufacture of fabricated metal products, except machinery and equipment	8'077	265	3.3	0.5
Manufacture of food products, beverages and tobacco products	17'597	272	1.5	0.5
Manufacture of furniture; other manufacturing	16'192	428	2.6	0.8
Manufacture of machinery and equipment n.e.c.	9'331	314	3.4	0.6
Manufacture of motor vehicles, trailers and semi-trailers	15'587	357	2.3	0.7
Manufacture of other non-metallic mineral products	3'858	48	1.2	0.1
Manufacture of other transport equipment	13'283	469	3.5	0.9
Manufacture of paper and paper products	896	18	2.0	0.0
Manufacture of rubber and plastic products	6'416	111	1.7	0.2
Manufacture of textiles, wearing apparel and leather products	34'889	798	2.3	1.5

Table 5 continued...

...Table 5 continued

Manufacture of wood and of products of wood and cork,	1'703	16	0.9	0.0
Mining and quarrying	8'188	41	0.5	0.1
Other service activities	9'840	118	1.2	0.2
Printing and reproduction of recorded media	325	12	3.7	0.0
Retail trade, except of motor vehicles and motorcycles	9'881	66	0.7	0.1
Telecommunications	2'494	2'099	84.1	4.0
Warehousing and support activities for transportation	1'917	65	3.4	0.1
Water transport	3'418	59	1.7	0.1
Wholesale and retail trade and repair of motor vehicles and motorcycles	779	5	0.6	0.0
Wholesale trade, except of motor vehicles and motorcycles	6'051	40	0.7	0.1
	369'456	51'863	14%	100

Source: Author's estimates using Leontief Decomposition

While the above results show that India's digitalization has been concentrated in very few sectors, it is interesting to note that in other countries like China and the USA, digitalization is experienced across many sectors.

Table 6 reports the estimated sectoral shares in value added by DS to total exports in India, China and the USA. The results show that while in India this is highly concentrated in the exports of DS, in China and the USA, DS are contributing value added to exports of many sectors. In China, share of computer programing and related services

and telecommunications is around 25% while in the USA it is 42% as compared to India's 88%. 18 sectors out of 34 sectors account for more than 1% share in China as compared to 3 sectors in India and 16 sectors in the USA. In China, sectors with shares more than 3% of value added by DS include manufacture of computer, electronic and optical products; manufacture of electrical equipment; manufacture of machinery and equipment; and manufacture of textiles, wearing apparels and leather products; wholesale trade; and water transport. This indicates that in terms of adding digital content to its exports, India lags far behind China and the USA with a much more concentrated digitalization of its exports. Except for the digital services exports, India lags China and the USA in almost all sectors in terms of digital content in exports.

Table 6: Sectoral Shares in Value Added by DS in Total Exports in India, China and USA in 2014

Sectors	Share of Sectors in VA by DS in Exports in **India** (%)	Share of Sectors in VA by DS in Exports in **China** (%)	Share of Sectors in VA by DS in Exports in **USA** (%)
Air transport	0.2	1.0	1.2
Architectural and engineering activities; technical testing	0.9	0.0	1.3
Computer programming, consultancy and related activities; information service activities	84.5	21.7	23.7
Construction	0.0	0.8	0.0
Crop and animal production, hunting and related service	0.1	0.1	0.8
Insurance, reinsurance and pension funding, except compulsory social security	0.1	0.7	0.5
Land transport and transport via pipelines	0.2	0.7	1.1

Table 6 continued...

...Table 6 continued

Legal and accounting activities; activities of head offices; management consultancy activities	0.0	2.1	2.0
Manufacture of basic metals	0.4	2.1	0.9
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.1	0.5	0.9
Manufacture of chemicals and chemical products	1.0	2.4	2.4
Manufacture of coke and refined petroleum products	0.8	0.6	2.8
Manufacture of computer, electronic and optical products	0.7	24.5	2.1
Manufacture of electrical equipment	0.4	6.7	0.7
Manufacture of fabricated metal products	0.5	2.5	1.5
Manufacture of food products, beverages and tobacco	0.5	0.8	1.8
Manufacture of furniture; other manufacturing	0.8	1.8	1.2
Manufacture of machinery and equipment n.e.c.	0.6	5.9	3.7
Manufacture of motor vehicles, trailers and semi-trailers	0.7	1.5	3.1
Manufacture of other non-metallic mineral products	0.1	1.2	0.3
Manufacture of other transport equipment	0.9	1.4	4.8
Manufacture of paper and paper products	0.0	0.3	0.8
Manufacture of rubber and plastic products	0.2	1.5	0.8
Manufacture of textiles, wearing apparel and leather products	1.5	6.1	0.5
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.0	0.4	0.2

Table 6 continued...

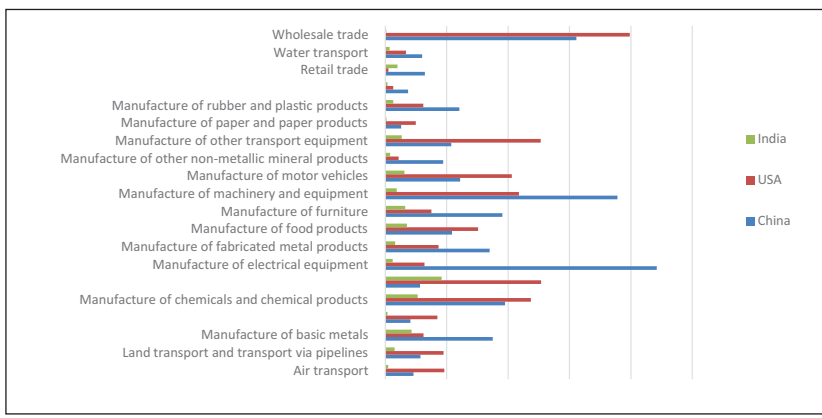
...Table 6 continued

Mining and quarrying	0.1	0.3	0.9
Other service activities	0.2	0.3	0.1
Printing and reproduction of recorded media	0.0	0.1	0.2
Retail trade, except of motor vehicles and motorcycles	0.1	0.8	0.1
Telecommunications	4.0	3.5	17.8
Warehousing and support activities for transportation	0.1	0.1	0.3
Water transport	0.1	2.9	0.6
Wholesale trade, except of motor vehicles and motorcycles	0.1	3.7	5.8
Others	0.0	0.9	15.3
	100	100	100

Source: Author's estimates using Leontief Decomposition

Further, in absolute terms, India is found to have very low digital content in its sectoral exports as compared to China and the USA. Figure 2 compares value added by DS in exports of selected sectors in China, India and the USA. The only sector where the value added in India is higher than that of China is in exports of coke and petroleum products.

Figure 2: Value Added by Digital Services in Sectoral Exports of China, India and the USA: 2014



Source: Author's estimates using Leontief Decomposition

The above results highlight the low level of India's digital preparedness for international trade, particularly as compared to some of the developing as well as developed countries, which are its key competitors in international trade.

4. Need for a *Digitally-Informed Foreign Trade Policy*

Comparing India's progress in digital infrastructure, digital skills and use of digital technologies, India is found to lag many developing as well as developed countries. In terms of value-added by digital services to its total exports, India is found to rank third in the world, however, if exports of digital services are removed from total exports, India ranks much lower as compared to other developed countries as well as China. This indicates the lop-sided digitalization of India's exports, which concentrates mainly in exports of digital services, i.e., computer programing &related services and telecommunications. To remain competitive in global trade, India needs to boost digital content in its exports as well as develop its digital infrastructure and skills and increase the use of digital technologies in its exportable sectors.

While many initiatives within the *Digital India* program are being designed to accelerate India's digital transformation and the Government is also in the process of preparing its National E-Commerce policy, there is an urgent need for a much more holistic approach towards digitalization to improve digital content in India's exports. E-commerce development may help link exporters to digital platforms and give them access to global markets but if their exportable products have lower digital content, they will not be able to successfully compete in the global markets in the digital era. Further, e-commerce platforms also provide access to India's domestic markets to international sellers with more competitive products and higher embedded digital content. This may lead to erosion of domestic market shares of Indian producers. There is therefore an urgent need to develop a ***Digitally-Informed Foreign Trade Policy (DIFTP)*** for India with an objective to increase the digital content of India's exports

and enhance use of digital services, skills and digital technologies in the trade sector, especially in the traditional export sectors.

The key components of a DIFTP include building digital infrastructure for trade, i.e., enhancing digital connectivity of traders; promoting digital skills in export sectors; developing data infrastructure for trade; fostering digital start-ups especially in the tradable sectors; encouraging use of digital technologies and digital services in traditional export sectors; and promoting national digital platforms.

Government of India has already initiated *IndiaStack* which is a unique digital infrastructure which allows governments, businesses, startups and developers to utilize presence-less, paperless, and cashless service delivery. In 2009, Unique Identification Authority of India (UIDAI) was set up to empower the citizens of India with a unique identity or Aadhaar and a digital platform to authenticate anytime anywhere. This was followed by launch of Aadhaar payments bridge and Aadhaar enabled payment system which used the unique identity to electronically channelize the government benefits and subsidies. In 2012, e-know your customer (eKYC) was launched which allows the businesses to perform customer verification digitally using biometric or mobile OTP. This was followed by launching of eSign by Controller of Certifying Authority in 2015 which allowed the Aadhaar holder to digitally sign a document accompanied by a national platform called DigiLocker a (national Digital Locker System) which allowed issuance and verification of documents and certificates in a digital way, eliminating the use of physical documents. In 2016, the National Payments Corporation of India launched Unified Payments Interface to revolutionize digital payments in India.

While several initiatives have been launched by the Government of India to digitalize the economy, India's foreign trade policy needs to keep pace with these initiatives to incorporate them to boost digitalization of the international trade sector. These schemes if used effectively for

informing the Foreign Trade Policy can greatly improve India's trade competitiveness. For example, there is a need to redesign and digitalize India's subsidies to its farmers which are challengeable in the WTO. These schemes can effectively use the Aadhaar payments bridge as well as eKYC and eSign to protect farmers' agricultural revenues and design alternative agricultural subsidy systems like US's agricultural subsidies i.e., via direct payments. This would not only boost agricultural production but also its exports as farmers become more tuned to digital payments as well as trading in the digital world.

The traditional export sectors of India also need to be injected with digital initiatives under DIFTP. First and foremost, there is a need to protect the national digital platforms. Digital platforms are the backbone of global digital trade and are fast emerging as global monopolies with increasing rents. The global digital platforms have the power to reorganize sectors and global trade. GAFAA- Google, Apple, Facebook, Amazon and Alibaba along with others like UBER and AirBNB are rising global platforms which are wiping away competition due their network effects and the associated power of data analytics.

India's DIFTP needs to initiate 'national infant platform protection' schemes. These platforms can be used to incentivize domestic producers to export as well as provide access to new markets to the existing exporters. National E-Commerce Policy needs to be designed around this objective. Public private partnerships could be encouraged to form national e-commerce platforms to boost exports as well as use the data analytics of the engaged customers to forecast future demand and changing tastes and preferences. Linking domestic producers to the national e-commerce platforms can be a part of the national trade promotion schemes. Chinese e-commerce platform policies can provide rich learnings for India. For example, a Chinese e-commerce platform called Kikuu, operates in six African countries, only selling Chinese goods.

Building digital infrastructure for trade is the key to building trade competitiveness in the digital era. While a lot of emphasis has been laid on building ICT infrastructure, there is need to shift focus on building data infrastructure. Many developing countries have started developing their National Data Policies, for example Rwanda has initiated its national data revolution policy. Data needs to be stratified into different categories and classifications to identify data that can be made available publicly for big data analytics; data which needs to be analyzed by the Government before being shared with key stakeholders; and data that cannot be shared with the foreign firms. Further, developing digital skills like skills for designing using computer-aided designs (CAD); skills for building softwares; etc. must be prioritized, especially in the traditional export sectors like textiles, clothing and leather products. Many countries have initiated digital education in schools and Universities are now offering courses on building digital skills. Special courses need to be initiated for training workforce in the trade sectors in terms of using digital technologies and digital services.

One of the important components of the DIFTP needs to be the use of Big Data Analytics to inform trade policy and promote trade. While personal data is protected under the right to privacy in India, non-personal real time data needs to be analyzed by the national governments for trade trends, existing opportunities and upcoming challenges for designing trade policies and for trade promotion. Trade policy in many countries has started being informed by the big data analytics. For example, companies such as Panjiva in the US employs machine learning based intelligent feature extraction to aggregate and derive custom transaction information through analytics to support decision makers on trade policy and provide them with actionable trade information like how developing countries are shifting their product mix in response to new competitors (World Bank 2017). Such information used by a country can provide a competitive edge to the country's trade policy. Schemes also need to be developed to provide Big Data analytics support to the SME sector of the country to guide their future production and export destinations, especially if the

traditional trade sectors have to remain globally competitive. Lack of such a support can endanger losing out on international market shares in the traditional export sectors.

Apart from providing digital infrastructure for trade and support for the use of big data analytics to inform trade policy and domestic producers, there is a need to maintain policy space for designing DIFTP in future trade and investment agreements, especially in the multilateral trade agreements at the WTO. It is essential that no agreement is signed which restricts the policy space for regulating cross-border data flows of the Indian Government. 'Data' being the core resource in a digital economy needs to be owned by the national governments and stored locally. Data provides competitive edge in international trade in the digital world. For example, data with respect to behavior of the consumers, especially in traditional export sectors like textiles, wearing apparels and leather products, provides a comparative advantage to the owner of the data as this data forms the basis for Big Data analytics and AI to forecast demand, customize production and determine international demand. Localization restrictions on data give governments authority to control and regulate their data. But if data is stored in a cloud by foreign firms outside the national boundary then governments cannot stop the use or abuse of data by foreign firms as it lies outside its jurisdiction. Further, there is a need to develop national digital skills and digital technologies for which technology transfers from foreign firms become imperative. Any agreements, especially at the multilateral level that restrict the ability of the governments to control or regulate data and develop national digital skills and technologies through promotion of technology transfer measures should not be signed.

Many proposals at the WTO on e-commerce can have far reaching implications for restricting policy space for designing national policies around data flows[19]. These proposals if accepted will not allow the governments to have the freedom to make rules around restricting cross-border free flow of data and localization of data, which are both

needed to enable the governments to 'own' and 'regulate' the data of their citizens. Further, governments will not be able to make policies to encourage technology transfers through source-code sharing. Foreign firms when exporting services to India using digital technologies need to be encouraged to share their source-code, a policy adopted by China which forced the tech firms to share their source-codes, set up research and development centers in China and build hardware and software back doors to enable Chinese official to monitor their data. Checking the growth of monopolistic powers and anti-competitive practices of international digital platforms also need to be addressed within the DIFTP as the boundaries between trade an investments blur, especially with the rise of digital platforms.

Given the rise in the use of 3D printing and its potential as a future mainstream manufacturing process, it is important to carefully examine the proposals regarding the custom duties on electronic transmissions in the WTO. The import of computer-aided designs used in 3D printing along with other digitalized products and potential electronic transmissions, if not monitored through custom duties, can change the trade patterns of the economy. Many countries like Indonesia are initiating custom duties on electronic transmissions like ebooks and softwares.[20] India also needs to consider taking control of imports of electronic transmissions through custom duties and oppose the permanent moratorium.

There is a need to revisit the traditional approach to foreign trade policy (FTP) by India and adapt it to the digital world with emphasis on regulating and using data and developing digital infrastructure to promote trade and inform trade policy to remain globally competitive. Sri Lanka has formed a Ministry of Digital Infrastructure to build its digital capacities. This can be an important way forward since such a Ministry can draw expertise from various Ministries like ICT, Trade, Technology and Industry.

5. Summary and Conclusions

In the context of the rising digitalization of the global economy and advent of Industry 4.0, the paper assesses India's digital preparedness for international trade and argues for a need to design India's Digitally-Informed Foreign Trade Policy with the objective of boosting India's trade competitiveness in the digital era. Comparing India's digital infrastructure and various indicators of ICT development, it is found that India lags developed countries as well as major developing countries. It ranks below most of the Asian developing countries like Thailand, Indonesia, Philippines, Malaysia, Singapore, Viet Nam, Cambodia as well as Sri Lanka in its ICT development index. While number of software developers in India may surpass that in US in 2018, India ranks 31st in a list of 50 countries in terms of quality of programmers. In terms of its cloud infrastructure, India is found to lag most of the developed and developing countries. India ranks 116 out of 143 countries when comparing internet bandwidth per internet user, which is one of the prime infrastructure needed to develop competitive cloud computing services. It also ranks low in terms of speed of the internet. Although in terms of affordability to internet users, India ranks high but all other south Asian countries including Bangladesh, Sri Lanka, Nepal and Pakistan have lower prices as compared to India. The digital tech-startup ecosystem in India has been ranked high globally, however other countries are outpacing India in this regard as well.

The paper argues that the use of digital technologies like Artificial Intelligence, robotics etc are still in their nascent stages in India, especially when compared to China. Stock of Robots in manufacturing is rising in India which can provide an important competitive edge to India's manufacturing exports, but robot density is much lower in India as compared to the world average as well as lower than its trade competitors like Malaysia, Thailand, Indonesia and South Africa. In terms of 3D printing index, India ranks 25th in the list of 28 countries.

The paper estimates the value-added by digital services to total exports for 43 countries for the years 2007 and 2014, using world input-output database and applying Leontief Decomposition. The results show that India although ranks much lower than other countries in many of the indicators of digital preparedness, value added by DS to India's total exports compares favorably to many countries. In 2014, India ranked third in the world in terms of value added by DS in absolute terms with a 46% rise compared to 2007. However, digitalization of India's exports is found to be extremely lopsided with almost 84% of total value added by DS being concentrated in exports of computer programming and related services and around 4% in telecommunications. Only 12% of VA by DS is spread across other sectors as compared to 74% in China and 58% in the US. In terms of value added by DS in sectoral exports, except for manufacture of coke and refined petroleum products, India is found lagging China and the US in all sectors, including its traditional export sectors.

The lagging digital preparedness of India may weigh heavily on its trade competitiveness in near future. The paper suggests designing a Digitally-Informed Foreign Trade Policy with an objective of increasing the digital content of India's exports and enhancing use of digital skills and digital technologies in the trade sector. Some of the components of such a policy are discussed in the paper. This includes focusing on improving India's digital infrastructure for trade, enhancing digital content in its exports; improving digital skills and technologies and using Big Data analytics for informing trade policy to improve trade competitiveness of India.

The paper argues that special emphasis needs to be laid on promoting and protecting national digital platforms and linking domestic producers to these platforms to enhance their competitiveness in international markets as well as in domestic market. Big data analytics needs to be used to inform the trade policy with respect to ways of promoting trade and improving competitiveness. The big data analytics can provide insights

into emerging opportunities and challenges in terms of trade shares and measures adopted by different countries. This can also be used to inform the trade policy on globally rising non-tariff measures and their implications for India's exports. It is also important to initiate custom duties on electronic transmissions, as done by some of the developing countries, to regain control over composition of imports in the digitalized global trade with rising share of digitalized products.

To be able to design such policies and strategies to boost India's digital capacities, there is a need to preserve policy space in the on-going multilateral trade negotiations at the WTO as well as in the future bilateral and regional trade and investment agreements. Control over cross-border data flows is necessary to maintain comparative advantage in the international trade in the digital era. Indian Government has initiated many programs for India's digital transformation under *Digital India*, it is now time for leveraging the gains from these programs to boost India's trade competitiveness through structured foreign trade policy which is digitally-informed.

Endnotes

1 http://digitalindia.gov.in/

2 See Gürkaynak et al (2017) and Rysman (2009)

3 Australia, Austria, Belgium, Brazil, Bulgaria Canada, China, Croatia, Cyprus, Czech Republic, Denmark , Estonia, Finland, France, Germany, Greece, Hungary, Indonesia, Ireland, Italy, Japan, Korea, Rep., Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan China, Turkey, United Kingdom, United States and ROW (rest of the World).

4 For more discussion on 'data is the new oil' see UNCTAD 2018.

5 Source: Internet and Mobile Association of India (IAMAI) and ITU

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