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Telecommunications: The Underlying Transport Means for Services Exports
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TELECOMMUNICATIONS: THE UNDERLYING TRANSPORT MEANS FOR SERVICES EXPORTS

HILDEGUNN KYVIK NORDÅS*

This paper analyses the role of telecommunications as a means of transport for services exports with a focus on computer and other business services in India. Telecommunications are typically dominated by major suppliers which need to be regulated and exposed to competition to fulfil their role. This paper notes that India took sweeping unilateral reforms in the telecommunications sector in the 1990s but has been reluctant to bind reforms in international trade agreements. It goes on to show that India is lagging as compared to other lower middle-income countries on international measures of connectivity, and that connectivity is strongly related to timely adjustment of policy to changing market conditions and technology. Second, using gravity estimates, it has been found that connectivity is an important driver for trade in computer and other business services. In particular, broadband connectivity significantly reduces the rate at which exports fall off with distance and extends the reach of exports to distant markets.

TABLE OF CONTENTS

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I. INTRODUCTION

Telecommunication is the underlying transport means for other economic activities. It is also subject to strong network effects, high natural barriers to entry, and a legacy of state monopoly. For these reasons, the General Agreement on Trade in Services (GATS) includes an Annexure on telecommunications,[1] which establishes the principles of non-discriminatory access to and use of telecommunication networks and services. The provisions apply to all World Trade Organization (WTO) Members regardless of whether or not they have made commitments to liberalise telecommunications and underscore its importance for trade in services. Thus, even before the internet was commercialised and widely used for business purposes, the WTO envisaged a crucial role for telecommunications for trade in any service.

Going beyond the minimum requirements stated in the Annexure, WTO Members may also include telecommunications in their schedules of commitments, which amount to a legal obligation to open the sector to foreign trade and investment. Finally, Members may take recourse to legal obligations to enforce pro-competitive domestic regulations that prohibit incumbent local operators from denying foreign suppliers access to their networks. Such obligations are enshrined in the GATS Reference Paper on competition safeguards,[2] which members may add under 'Additional Commitments' in their GATS schedules.

This paper explores the role of open and competitive markets in telecommunications for cross-border trade in business services with a focus on India. Digital transformation has made these services tradeable over electronic networks and Indian entrepreneurs were among the first to seize the opportunity to establish export-oriented computer and business services enterprises. Indeed, 66% of Indian computer and information services are exported as per the Organisation for Economic Co-operation and Development (OECD) Trade in Value Added (TiVA) dataset, 2015.[3] In recent years, other developing countries are

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[1] Annex on Telecommunications, General Agreement on Trade in Services, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1B, 1869 U.N.T.S. 183 [hereinafter GATS-Telecommunications].

[2] World Trade Org., Telecommunications Services: Reference Paper WTO TRADE TOPICS (Apr. 24, 1996), https://www.wto.org/english/tratop_e/serv_e/telecom_e/tel23_e.htm [hereinafter Reference Paper].

[3] Org. for Econ. Co-operation & Dev. [OECD], *Trade in Value Added*, OECD: STAT (2015), https://stats.oecd.org/Index.aspx?DataSetCode=TIVA2015_C1.

catching up and India's world market share of computer services has declined from 16% to 12% between 2012 and 2018.[4] At the same time, Indian exporters have moved into more sophisticated business services, for which its world market share has increased from 4.3% to 5.1%.[5]

The digital transformation of business services requires ever faster, more reliable, and cost-effective broadband. Hitherto, telecommunication connectivity has not been a constraint on Indian business services exports. Notably, exporters are concentrated in well-connected hubs such as Bangalore, Mumbai, and New Delhi. However, comparing national averages, India lags other middle-income countries and the gap has been growing in recent years (see Figures 2-4). Going forward, there is a danger that future competitiveness in export-oriented business services can be hampered by the widening connectivity gap.

Telecommunications performance depends critically on telecommunications-related policy. As a network industry where incumbents have significant market power, pro-competitive regulation may be needed to prevent major suppliers from abusing their market power. A strong relationship has been shown between trade and investment openness and best-practice regulation on the one hand, and performance in telecommunications as measured by broadband density on the other.[6]

This paper first discusses India's telecommunications policy reforms and commitments in the GATS as well as its recent trade agreement with Japan. Next, it relates telecommunications policy and performance indicators to trade in computer and other business services, using the gravity model. I find that trade in both computer and other business services are positively related to having committed telecommunications in the GATS. In the early days, mobile density was the most significant telecommunications indicator associated with trade in computer and other business services. In the years after 2012, broadband density has taken over as the most significant indicator.[7]

The rest of the paper is organised as follows: Part II presents the Indian trade and regulatory policy framework for telecommunications in a comparative perspective, while part III describes India's connectivity compared to other middle-income

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[4] Org. for Econ. Co-operation & Dev. [OECD], *Extended Balance of Payments Services Classification*, OECD: STAT (2010), https://stats.oecd.org/.
[5] *Id.*
[6] Hildegunn Kyvik Nordås, *The WTO Reference Paper Meets EU Common Regulatory Policy in CETA* (Norwegian Inst. Int'l Affairs, NUPI Working Paper No. 886, 2020) [hereinafter Working Paper 886].
[7] *Id.*

countries. It also shows how the price and density of broadband are related to telecommunications policy. Part IV provides an econometric analysis of the relationship between telecommunications performance and policy, and exports of computer and other business services. Finally, Part V concludes the paper.

II. THE POLICY FRAMEWORK FOR TELECOMMUNICATIONS

India has made modest commitments to liberalise its telecommunications sector both in the GATS and bilateral trade agreements. Nevertheless, in practice, mobile services are market-based and highly competitive, to the extent that recent years have seen cut-throat prices and falling revenue per user. A recent study from the Export-Import Bank of India (Exim Bank) points out that mobile operators are highly indebted due to high spectrum fees, rapid debt-financed roll-out of infrastructure, and high regulatory costs.[8] A heavy debt burden together with falling revenue per user has triggered the exit of several operators, and further consolidation is expected.[9]

In contrast, fixed-line subscriptions have declined over the past couple of decades and the market is more restricted with government enterprises featuring prominently.[10] India has established a semi-independent regulator, the Telecommunications Regulatory Authority of India (TRAI), which monitors the market, proposes and enforces regulation. Overall, India's applied policies are more liberal than its commitments in the GATS as well as Free Trade Agreements (FTAs).

A. Domestic reforms

India substantially liberalised its telecommunications market, starting in 1991. Until then, telecommunications were a public service offered by the Division of Telecommunications under the Ministry of Communications. The monopoly included not only network operations and services but also manufacturing of telecommunication equipment.[11] Liberalisation started with the entry of private manufacturers of equipment in 1991 and continued with the National

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[8] DR. H.A.C. PRASAD & EXIM BANK, INDIA'S SERVICES TRADE LIBERALISATION AND EXPORT PROMOTION: MAIN REPORT (2019), https://www.eximbankindia.in/Assets/Dynamic/PDF/Publication-Resources/SpecialPublications/STRI%20Study_Main%20Report.pdf [hereinafter Prasad & EXIM].

[9] *Id.*

[10] TELECOM REGULATORY AUTH. INDIA, YEARLY PERFORMANCE INDICATORS (3d ed. 2018).

[11] Rafiq Dossani, *Telecommunications Reform in India*, 1(2) INDIAN REV. 61 (2002).

Telecommunications Policy (NTP) in 1994, the New Telecommunications Policy in 1997 and finally the National Digital Communications Policy (NDCP) in 2018. The 1994 policy framework allowed private investment in telecommunications services and the Telecommunications Regulatory Authority Act of 1997 introduced a semi-independent regulator.[12]

The 2018 policy framework takes a holistic approach to the digital communication sector. Its stated priority is universal access to broadband to help unleash India's growth potential, not least in the digital economy.[13] The framework recognises the need to use all suitable networks, including broadcasting, satellite, electricity, rail infrastructure, fibre optic cables, and spectrum efficiently to reach the ambitious policy objectives. One of the milestones and strategic objective in the NDCP is to reach the top fifty in the International Telecommunications Union's (ITU) Information and Communication Technology (ICT) Development Index, up from 134 in 2017.[14]

Digital sovereignty, as well as protecting local industry, is part and parcel of the reform process envisaged in the NDCP. For example, it introduces local preferences in public procurement, promotes local manufacturing of satellite communication infrastructure, and the use of indigenous communication products and services.[15] Dr. H.A.C. Prasad, in a recent study commissioned by the EXIM Bank, notes that elevated tariffs on telecommunications equipment as well as high taxes and charges have hurt the sector in the past.[16] Nevertheless, the study advocates higher tariffs on optical fibre, for which India has considerable manufacturing capacity. It is, however, unclear if such tariffs would protect local manufacturing since Korea and Japan are major suppliers and India has FTAs with both of them. Furthermore, if higher tariffs are needed for Indian telecommunications operators to source fibre locally, there is a danger that higher tariffs will hurt them in the same manner as previous tariffs.

The NDCP aims to establish India as a global hub for cloud computing, content hosting and delivery, and for data communication systems and services. For this to be feasible, India needs to comply with data protection and security regimes in the source country, such as the General Data Protection Regulation (GDPR). However, the policy framework includes a controversial point on lawful intercept

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[12] *National Telecom Policy, 1994*, DEPT. OF TELECOMM., MINISTRY OF COMM., GOVT. OF INDIA, https://dot.gov.in/national-telecom-policy-1994.

[13] DEP'T OF TELECOMM., NATIONAL DIGITAL COMMUNICATIONS POLICY 2018 6 (2018).

[14] *ICT Development Index 2017*, Int'l Telecomm. Union (2017), https://www.itu.int/net4/ITU-D/idi/2017/index.html.

[15] Prasad & EXIM, *supra* note 8, at 16.

[16] *Id.*

and analysis system for implementation of law and order, and national security. This point is included in the Draft Personal Data Protection Bill, 2018, which at the time of writing is pending in the Parliament. It has raised concern, among others from the judiciary, on the grounds that it provides for excessive surveillance and curbs freedom of speech and could deter foreign companies and other data owners from using Indian cloud services and content hosting.

B. Trade related policy

This sub-part first discusses applied policy and next commitments in the GATS and the Comprehensive Economic Partnership with Japan. Starting with applied policies currently in force, the OECD Services Trade Restrictiveness Indices (STRI) and database contains qualitative information on regulation, which is scored and weighted to create indices of services trade restrictiveness.[17] The STRI indices take values between zero and one, where a higher score indicates more restrictions and one represents a completely closed sector. The measures are organised under five policy areas as indicated in Figure 1. Barriers to entry cover market access restrictions such as foreign equity caps, investment screening or data localisation requirements. Restrictions on movement of people usually apply to business travel and temporary entry of intra-corporate transferees irrespective of which sector the visitor calls on. Other discriminatory measures relate closely to national treatment — for instance, as far as regulated termination rates are concerned. The policy area entitled barriers to competition captures access and interconnection obligations in addition to measures on state ownership. Finally, regulatory transparency captures administrative procedures related to obtaining a license, permission, or visa where required, and public consultations during the legislation and regulatory process. Figure 1 reports the scores for the forty-six countries in 2019.[18]

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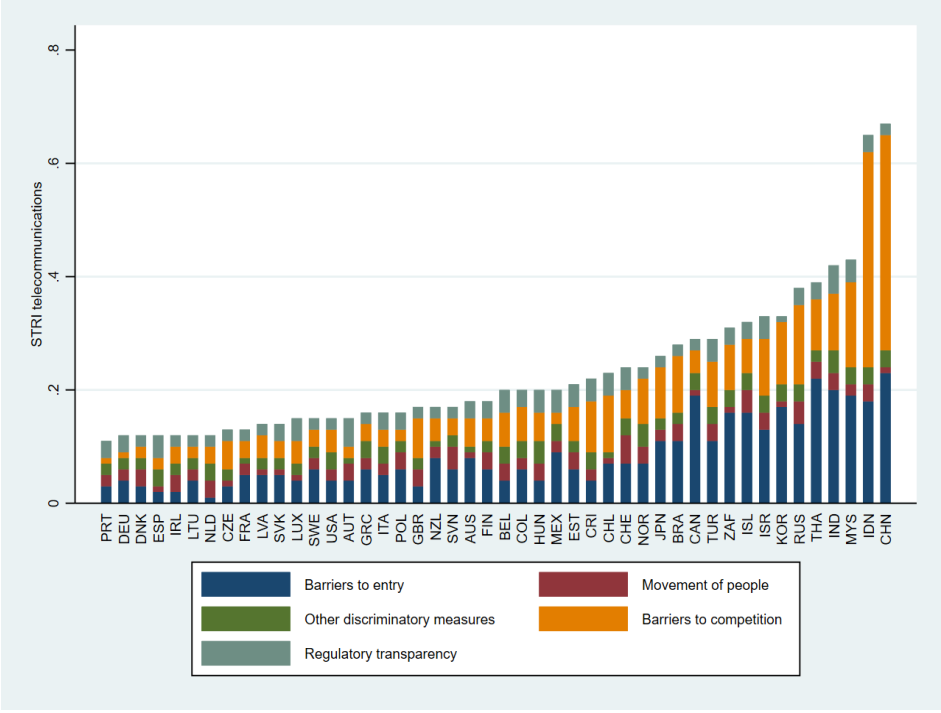
[17] Org. for Econ. Co-Operation & Dev. [OECD], *Services Trade Restrictiveness Index*, OECD: STAT, https://stats.oecd.org/Index.aspx?DataSetCode=STRI [hereinafter Services Trade Restrictiveness Index].

[18] *Country Code*, U.N. TRADE STAT. (2016), https://unstats.un.org/unsd/tradekb/knowledgebase/country-code.

Figure 1. STRI Telecommunications, 2019



Source: OECD.[19]

India scores fourth to highest on the STRI for telecommunications in 2019. It is, however, worth noting that the score is not different from other developing countries, and substantially below China and Indonesia. India currently has no foreign equity limitations in telecommunications, although foreign majority shares must be approved by the government. There is also a requirement that a majority of board of directors must be Indian resident citizens, and foreign nationals need security clearance to take up a position as Chief Executive Officer or Chief Financial Officer in telecommunications companies.[20] There is a requirement that data must be processed and stored locally, domestic mobile traffic must be hauled and routed within the borders of India, and a general restriction on access to land affects telecommunications which needs to use land for poles, ducts, and towers.[21]

[19] Services Trade Restrictiveness Index, *supra* note 17.
[20] *Id.*
[21] Working Paper 886, *supra* note 6.

Restrictions under barriers to competition include state ownership in two major fixed line operators Bharat Sanchar Nigam Limited (BSNL) and Mahanagar Telephone Nigam Limited (MTNL), and lack of regulatory independence. As noted in the recent study from the EXIM Bank, the regulator is independent from telecommunications operators, but it is not fully independent from the government in its day to day operations.[22] Other barriers to competition recorded in the database are minimum capital requirements, a rather detailed regulation on advertising, and lack of number portability obligations for fixed line operators.

Turning to commitments in trade agreements, India's GATS schedule offers market access only for voice telephone operators in fixed and mobile services through minority ownership in locally established operators. The committed equity limit is 25%. Nevertheless, such operators, conditioned on obtaining a license from the regulatory authority, are permitted to offer a range of services, including circuit-switched data services and leased lines. India reserves the right to prohibit resale of telecommunications services in its schedule. National treatment is unbound, which means that there are no obligations not to discriminate foreign operators. India has partly included the Reference Paper on pro-competitive regulation in its schedule, which implies that it must impose interconnection obligations at reasonable and transparent conditions on major suppliers.[23]

India has been cautious in including services in general and telecommunications, particularly, in its FTAs. Currently there are five FTAs in force that include services. These are the agreement with Association of Southeast Asian Nations (ASEAN), and the bilateral agreements with Japan, Malaysia, Singapore and Korea.[24] The ASEAN agreement opens for market access through commercial

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[22] JEREMY OLIVER ET AL., TELECOMMUNICATIONS REGULATION HANDBOOK (Hank Intven & McCarthy Tetrault eds., 2000); The STRI applies a similar definition of regulatory independence as the ITU. A country gets a clean score if the regulator is independent from any operator, has a mandate to enforce regulation on significant market powers, and cannot be instructed or overruled by the ministry in its day to day operations within its mandate.

[23] *Trade in Services - India - Schedule of Specific Commitments*, GATS/SC/42/Suppl. 3, WORLD TRADE ORG. (Apr. 11, 1997) https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-DP.aspx?language=E&CatalogueIdList=17946,29466,45355,37261,26014&CurrentCatalogueIdIndex=1&FullTextHash=&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True.

[24] Agreement on Trade in Services Under the Framework Agreement on Comprehensive Economic Cooperation, India-Ass'n of Southeast Asian Nations [ASEAN], Nov. 13, 2014, DEP'T OF COMMERCE, GOV'T OF INDIA, https://commerce.gov.in/writereaddata/UploadedFile/MOC_636040205325835433_ServicesAgreement.pdf; Comprehensive Economic Partnership Agreement, India-Japan, Feb. 16, 2011, DEP'T OF COMMERCE, GOV'T OF INDIA,

presence with an equity cap of 49% for basic telecommunications and 51% for value added services, subject to obtaining a license from the regulatory authority. Cross-border supply is unbound for basic telecommunications services while value added services may be provided across the border subject to commercial arrangements with licensed operators in India. Similar to the GATS commitments, national treatment is unbound for all modes of supply.

The most interesting bilateral agreements are the ones with Japan and Korea. Both have comprehensive and similar telecommunications chapters. Here, I focus on the most recent agreement, which is with Japan. The schedule of commitments distinguishes between voice services and data transmission services. Market access through commercial presence is conditioned on licensing and the foreign equity limit is 74%. There are no commitments on cross-border trade for voice services, but cross-border data transmission is allowed subject to commercial arrangements with a local operator. National treatment is granted for foreign operators established in India, although key personnel in voice services operators may be required to be Indian resident citizens. Parties may restrict resale of public telephone services.

The telecommunications chapter in the trade agreement builds on the GATS Annex and Reference Paper and expands on the coverage as well as the details. The FTA ensures that all services suppliers offering electronic content should be able to access and use public telecommunications transport networks to deliver their service to local customers. This obligation applies to cross-border as well as within the country access and use. The FTA with Japan goes beyond the GATS Reference Paper in including a 'best endeavour clause' for mobile number portability.[25] It also includes more details about the obligations of major suppliers to interconnect at non-discriminatory, cost-based conditions. It appears, however that parts of the provisions on treatment of major suppliers are GATS minus. Particularly, unbundled interconnection with network components 'shall' be

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https://commerce.gov.in/writereaddata/pdf_download/IJCEPA_Basic_Agreement.pdf; Comprehensive Economic Cooperation Agreement, India-Malay., Feb. 18, 2011, DEP'T OF COMMERCE, GOV'T OF INDIA, https://commerce.gov.in/writereaddata/trade/IMCECA/title.pdf; Comprehensive Economic Cooperation Agreement, India-Sing., Apr. 8, 2003, DEP'T OF COMMERCE, GOV'T OF INDIA, https://commerce.gov.in/PageContent.aspx?Id=41; Comprehensive Economic Partnership Agreement, India-S. Kor., Aug. 7, 2009, DEP'T OF COMMERCE, GOV'T OF INDIA, https://commerce.gov.in/writereaddata/trade/INDIA%20KOREA%20CEPA%202009.pdf.

[25] *Annex 5, Telecommunication Services*, MINISTRY FOREIGN AFF., GOV'T OF JAPAN, https://www.mofa.go.jp/region/asia-paci/india/epa201102/pdfs/ijcepa_x05_e.pdf.

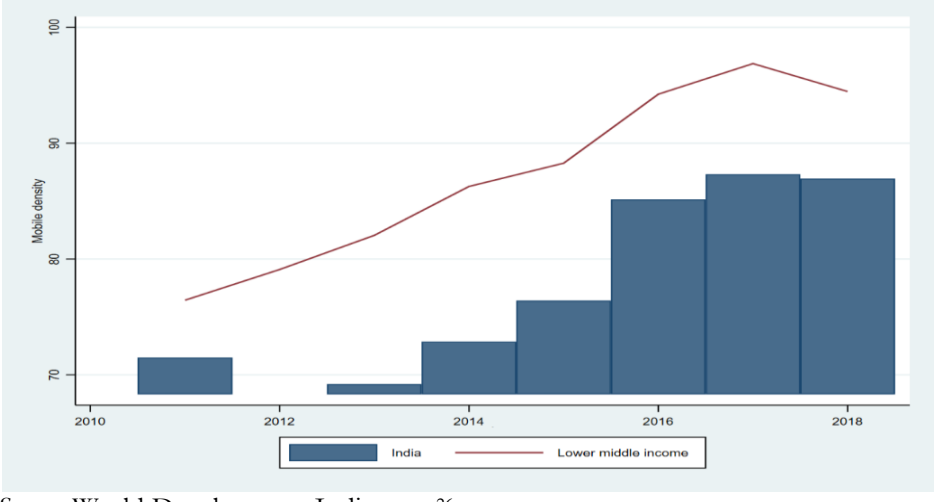
offered according to the GATS Reference Paper while the agreement with Japan includes a 'best endeavour clause' on unbundling.

To summarise the policy framework, the applied policy is relatively open and liberal as far as telecommunications services are concerned. The relatively high score on the STRI reflects the general regulatory environment facing foreign companies in India, including business services firms. The relatively liberal applied policy framework is, however, not committed in the GATS, or India's FTAs, although the difference between applied policy and commitments in the agreement with Japan is modest.

III. CONNECTIVITY

Figures 2-4 compare developments in telecommunications density in India for the lower middle-income average over the past decade. The indicators are mobile and fixed broadband subscription rates per hundred inhabitants, as well as secure servers per million inhabitants. Mobile subscription rates have grown very rapidly both in India and other lower middle-income countries. India's rate remains lower than average, but the difference narrowed sharply between 2016 and 2018. The graph also suggests that the mobile market is about to reach a level of saturation and that further development will be on the quality side with upgrades to 4G and in due course 5G subscriptions, as well as subscriptions with more data at higher speed.

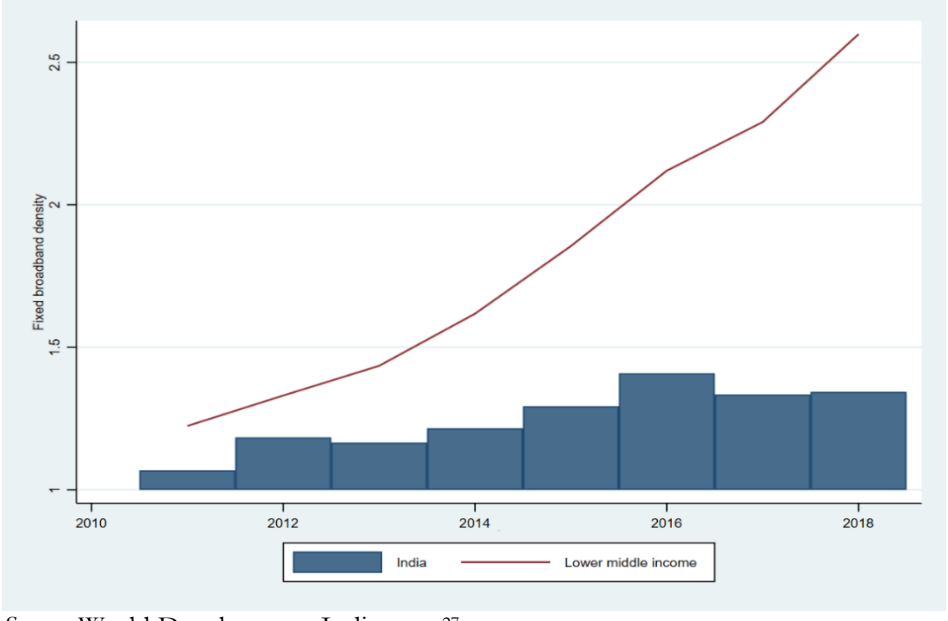
Figure 2. Mobile subscriptions per 100 inhabitants



Source: World Development Indicators.[26]

[26] *World Development Indicators*, WORLD BANK, http://datatopics.worldbank.org/world-development-

Figure 3. Fixed broadband subscriptions per 100 inhabitants

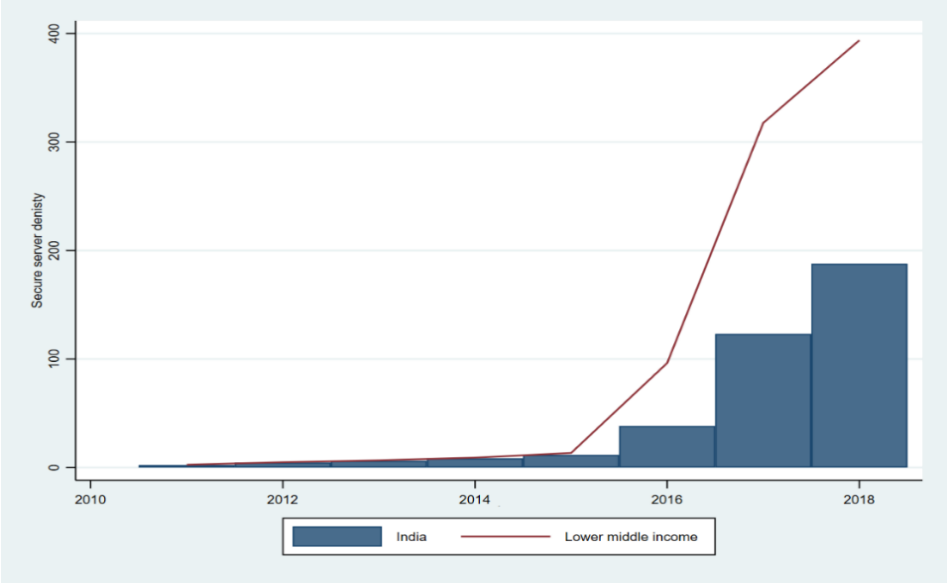


Source: World Development Indicators.[27]

indicators/#:~:text=World%20Development%20Indicators%20(WDI)%20is,country%20comparable%20data%20on%20development.&text=The%20World%20Development%20Indicators%20is,and%20the%20fight%20against%20poverty [hereinafter *Development Indicators*].

[27] *Id.*

Figure 4. Secure servers per million inhabitants



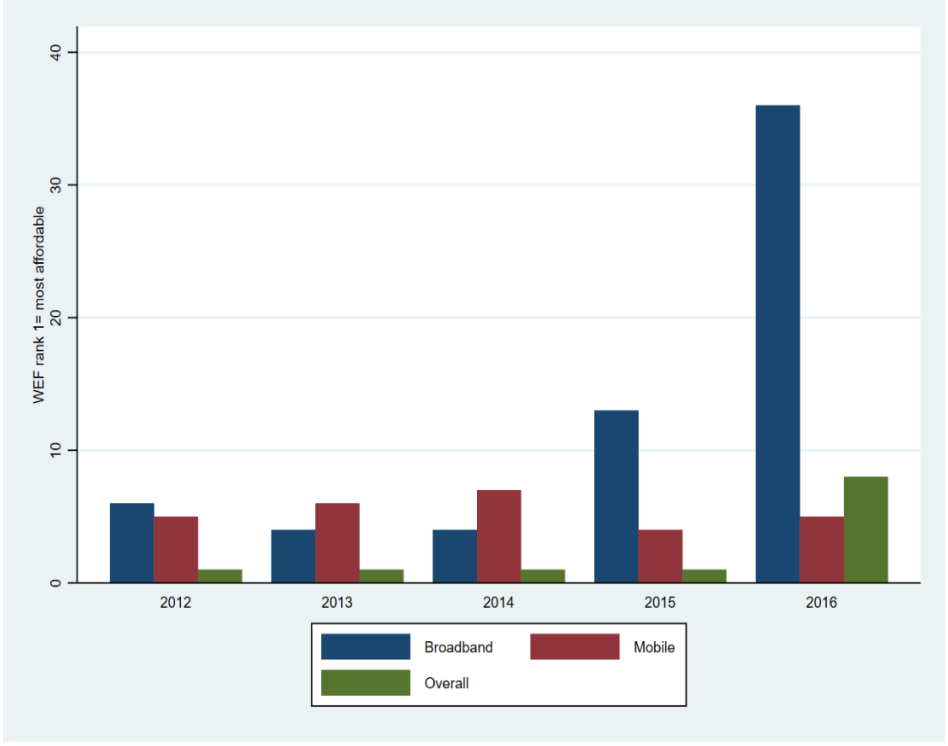
Source: World Development Indicators.[28]

India has seen a widening gap towards the lower middle-income average on fixed broadband subscription rates, with no progress over the past four years. In contrast, the average fixed broadband subscription rate has more than doubled over the same period in lower middle-income countries, albeit from a low base. A similar picture emerges for the density of secure servers. The density has risen sharply in India the past few years, but not as fast as the average for the lower middle-income group.

International comparison of prices is complicated because the market structure and subscription packages on offer differ both across countries and within countries over time. The World Economic Forum produces network readiness indices across countries, the latest was issued in 2016. It includes sub-indices for mobile and broadband as well as an overall index of affordability. India's ranking on this index (out of 151 countries) is depicted in Figure 5. It scored on top of the overall affordability index during the period 2012 to 2015 but slipped to the thirty-sixth place in 2016 due to a sharp increase in the ranking on broadband affordability. From Figure 3 above, we see that lower broadband subscription rates occurred shortly after the slippage in the ranking on affordability, suggesting a movement down the demand curve for broadband.

[28] *Id.*

Figure 5. Telecommunications affordability ranking



Source: World Economic Forum, World Competitiveness Index.[29]

The ITU publishes information on prices for mobile subscriptions, mobile and fixed broadband. The prices are calculated using a standard basket that may vary across countries. Prices are reported relative to gross national income (GNI) per capita as well as in US Dollars at nominal and purchasing parity prices. India ranks at number eighty-five on the fixed broadband basket and is thus among the more expensive countries.[30] The prices are not adjusted for speed and caps on use per

[29] *See Global Competitiveness Index*, WORLD ECON. F., https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1#:~:text=The%20Global%20Competitiveness%20Report%202016%2D2017%20assesses%20the%20competitiveness%20landscape,is%20threatening%20growth%20and%20prosperity.

[30] Martin Schaaper, *Measuring digital development: ICT Price Trends 2019*, INT'L TELECOMM. UNION 1, 62 (2020) https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf [hereinafter Schaaper].

month. According to the ITU, the download speed is eight megabytes per second and unlimited use. For comparison, the median speed for all 173 countries included in the report was 6.5 megabytes per second. China ranks fourth on price relative to GNI per capita at a speed of twenty megabits per second and unlimited use.[31] The Philippines, which is emerging as a significant exporter of computer and business services, ranks 102 on price relative to GNI at a speed of three megabits per second and unlimited use.[32]

The Indian market for telecommunications is overwhelmingly wireless where private sector companies have a market share of almost 90%. The latest quarterly report from TRAI shows that at the end of December, 2019 there were 1172.44 million telecommunications subscribers, of which 1151.44 million or 98% were for wireless services.[33] The wireless subscriber-base has almost doubled in a decade. Wire-line subscriptions, in contrast, have seen a steady decline over the past decade, from 36.96 million subscribers in 2010 to twenty-one million in December, 2019. The last couple of years have also seen a levelling off of wireless subscriptions.

The competition in the wireless market was fierce with fifteen suppliers with a nationwide coverage in 2010. Cut-throat competition led to low and declining monthly revenue per subscriber, falling from INR 105 in December, 2010 to INR 74.38 in September, 2019. However, with the consolidation of suppliers down to eight operators in 2019, the decline in monthly revenue per subscriber has bottomed out.[34]

Competition is important for the performance of telecommunications. Figures 6 and 7 show the correlation between openness and regulation as measured by the STRI, and prices and subscriber density for broadband, both adjusted for income per capita. Clearly, trade restrictions and regulatory burden are associated with fewer broadband subscriptions per hundred inhabitants at higher costs. As we shall see, this has detrimental effects on the role of telecommunications as the underlying transport means of computer and business services exports.

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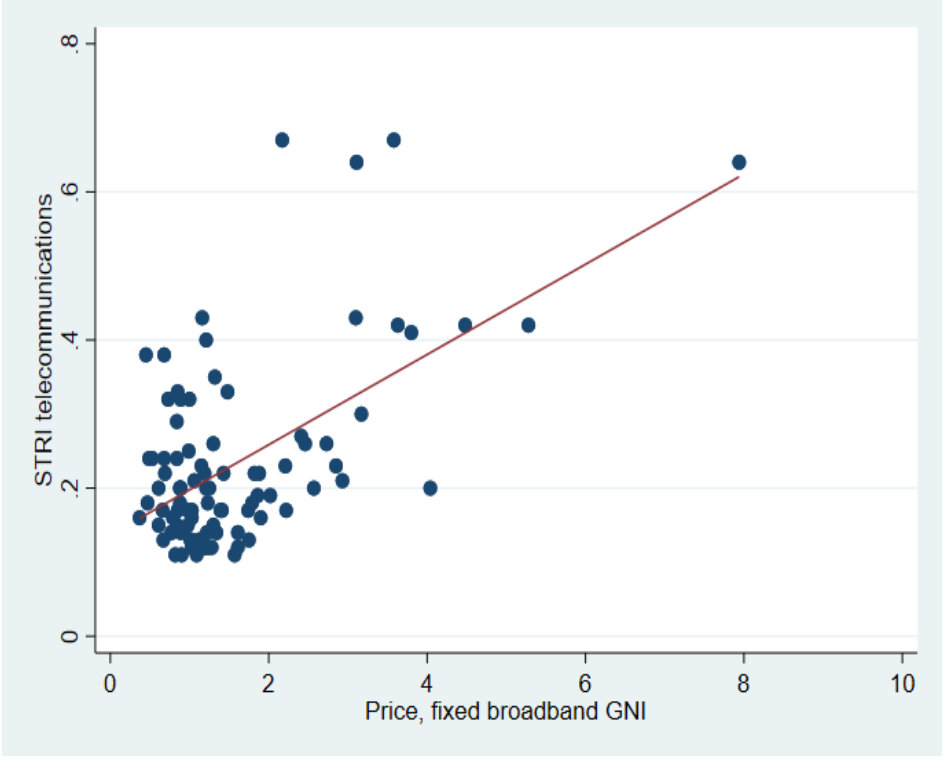
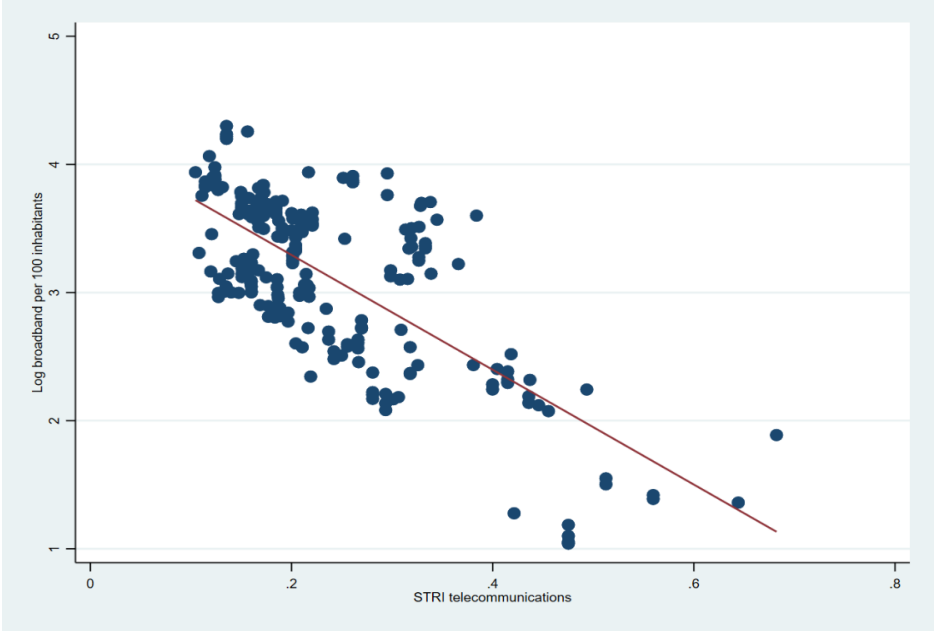
[31] *Id.* at 60.
[32] *Id.* at 63.
[33] Press Release, Telecomm. Reg. Auth. of India, Highlights of Telecom Subscription Data as on 31st December, 2019, No. 17/2020 (Feb. 25, 2020), https://trai.gov.in/sites/default/files/PR_No.17of2020.pdf.
[34] TELECOMM. REG. AUTH. OF INDIA, THE INDIAN TELECOM SERVICES PERFORMANCE INDICATORS (Oct.-Dec., 2010).

Figure 6. The STRI and the price of broadband relative to gross national income



Note: The figure plots the price of standard broadband subscription fees as a share of gross national income against the STRI for telecommunications in 2014-2018.
Source: Author's estimation

Figure 7. The STRI and broadband density



Note: The figure plots the GDP per capital adjusted broadband density against the STRI for telecommunications in 2014-2018.
Source: Author's estimation

This part has demonstrated that although connectivity has improved substantially in India over the past decade, connectivity has improved even faster in other countries Indian services exporters compete with in third markets. The part also highlights that connectivity can be substantially improved through openness and best practice regulation.

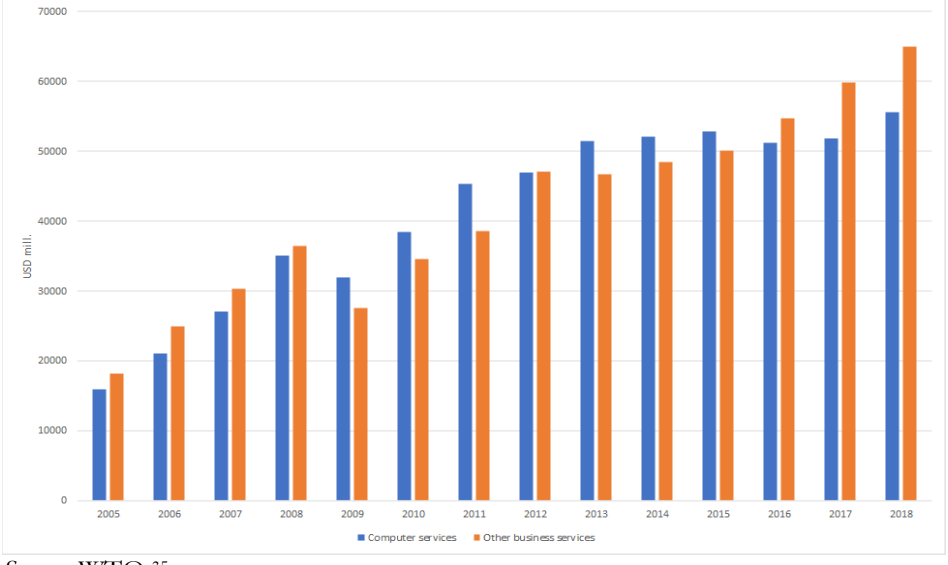
IV. CROSS-BORDER TRADE IN BUSINESS SERVICES

Business services are a large and diverse category including professional services such as engineering, architecture, accounting, and legal services as well as advertising and research and development (R&D). These services are information intensive and are increasingly digitised, opening new opportunities for cross-border trade. While traditional back-office business process services and call centres require good telephone connectivity, digitised professional services often require fast, reliable, and cost-effective broadband. This part explores the relationship

between access to such telecommunications services and exports of computer and other business services.

Figure 8 shows that India's exports of computer and other business services tripled in current US Dollar terms from 2005 to 2018. The first few years saw rapid growth, followed by a sharp decline during the financial crisis in 2008-2009. Both sectors recovered in 2010-2012, but exports of computer services have since stagnated, while exports of other business services continue to expand.

Figure 8. Exports of computer and other business services from India



Source: WTO.[35]

A. Empirical strategy

This sub-part investigates empirically the role of telecommunications in stimulating trade in computer and other business services since 1995. International services trade statistics are recorded according to the Extended Balance of Payment System (EBOPS). Early years used the 2002 classification, while more recent years use the 2010 EBOPS classifications. These are difficult to match since the changes to the classification particularly affected knowledge-intensive services. Therefore, I analyse the data from 1995 to 2012 and from 2010 to 2018 separately.[36] Broadband

[35] *Statistics on Trade in Commercial Services,* WORLD TRADE ORG., https://www.wto.org/english/res_e/statis_e/tradeserv_stat_e.htm.

[36] There is some overlap in the data for the two classification systems around 2010.

was in its infancy in the 1990s and the World Development Indicators (WDI) begun reporting data on broadband density only from 1998. I therefore use mobile telephones per hundred inhabitants as the telecommunications indicator in the first period, while broadband is used in the second period.[37]

As indicated in the previous parts, open and competitive markets in telecommunications are important for the performance of the sector. Policy may affect not only indicators for which comparable statistics are available across countries and over time, but also factors such as reliability, security, and speed of the services. Not least, making legally binding commitments to keep telecommunications open to trade and investment may encourage business services providers to enter export markets. As indicated in several studies, services exports involve considerable entry costs in foreign markets, including complying with regulation in the export market, entering contracts with foreign clients, and translation to the local language to mention a few.[38] I therefore explore a possible impact of committing telecommunications in the GATS as well as openness and best practice regulation as captured by the STRI in the analysis. For this, I use the gravity model, which is the workhorse tool for analysing the relationship between trade costs and trade flows.[39] The structural gravity equation system is given by three equations in three unknowns:

$$X_{ij,} = \frac{Y_i E_j}{Y}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \quad \ldots\ldots (1)$$

$$\Pi_i^{1-\sigma} = \sum_j \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \frac{E_j}{Y} \quad \ldots\ldots (2)$$

$$\mathrm{P}_j^{1-\sigma} = \sum_i \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} \frac{Y_i}{Y} \quad \ldots\ldots (3)$$

The first equation expresses a product *X* shipped from origin *i* to destination *j* as a function of the total shipments from *i*,(Y_i), total expenditure in destination *j* (E_j) and bilateral trade costs between origin and destination relative to price indices that reflect the average trade resistance facing all exporters and importers respectively.

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[37] During the second period, most countries had obtained a mature mobile market which no longer constitutes a competitive advantage for services exports.

[38] Rudrani Bhattacharya et al., *Export Versus FDI in Services*, 35(1) WORLD ECON. 61 (2012).

[39] Keith Head & Thierry Mayer, *Gravity Equations: Workhorse, Toolkit, and Cookbook*, *in* 4 HANDBOOK OF INTERNATIONAL ECONOMICS 131-195 (Gita Gopinath et al. ed., 2014) [hereinafter Head & Mayer].

The price indices are defined in equations (2) and (3) and represent the expenditure-weighted and shipment-weighted, respectively, average of bilateral trade costs. Intuitively, the equation system captures the fact that bilateral trade depends not only on the characteristics of the two trading partners, but also third countries with which they trade, or could have traded. We derive the regression equation from equation (1) as follows:[40]

$$X_{ij,t} = exp\left[A_t + \alpha_1 lnY_{i,t} + \alpha_2 lnE_{j,t} + \alpha_3 lnt_{ij,t} + \alpha_4(1-\sigma)lnP_{j,t} + \alpha_5(1-\sigma)ln\Pi_{i,t} + \varepsilon_{ij,t}\right]$$

The parameter of interest in this study is α_3. The trade costs captured t_{ij} consist of costs related to bilateral geographical, institutional, and cultural distance as well as policy induced trade costs such as trade restrictions and regulation. The geographical, institutional, and cultural distances are routinely captured by geographic distance between countries *i* and *j*, and dummies for common language, common land border, common religion, and common legal origin to mention the most important. We notice that the price indices do not vary over trading partners. They are also difficult to measure. Therefore, it is common practice to use country fixed effects to capture them in the regressions.

B. Data

Data on bilateral trade in other business services and computer services are from the OECD and the WTO. The database covering the period 1995 to 2012 applies the EBOPS 2002 classification. It reports bilateral trade between most country pairs in the world at a one-digit level. It should, however, be noted that to obtain such a good coverage, some trade flows are created by filling gaps using various statistical techniques including predictions from the gravity model.[41] This may bias the regression results.

For the period 2010 onwards, international organisations report trade data using EBOPS 2010. From this period, data is available at a more detailed sector break-down. Unfortunately, the details come at the expense of coverage. The WTO services trade statistics have slightly better coverage, so we used WTO statistics from 2010. India is not recorded as a reporter in either database but appears as a

[40] The gravity regression is specified this way, first taking logs of both sides and then anti-log to allow the inclusion of zero trade flows in the regression using Poisson Pseudo Maximum Likelihood estimator.

[41] Fabienne Fortanier et al., OECD-WTO Balanced Trade in Services Database, WORLD TRADE ORG. & ORG. ECON. CO-OPERATION & DEV. (Nov. 2017), https://www.oecd.org/sdd/its/OECD-WTO-Balanced-Trade-in-Services-database-methodology.pdf.

partner to twenty-eight reporters in computer services and thirty-six reporters for other business services.

Information on geographical, cultural, and institutional distance as well as FTAs is taken from Centre d'Études Prospectives et d'Informations Internationales' (CEPII's) gravity database. I added the FTAs that have entered into force after 2015 using the WTO Regional Trade Agreements database. Information on mobile and broadband density is from the WDI. Information on GATS commitments are from the WTO working paper by Martin Roy.[42] I follow a World Bank Discussion Paper in creating indices from the GATS commitments by country, sub-sector and mode of supply.[43] A full commitment is scored unity, a commitment with reservations 0.5, and no commitments or 'unbound' is scored zero. A country's total score is the simple average of the sub-sector scores. Finally, information on applied regulation is from the OECD STRI database. Note that that STRI indices increase with the level of trade restrictiveness while the GATS scores increase with the level of commitments. We should therefore expect opposite signs on the coefficient of the GATS and the STRI in the regressions. Table 1 reports summary statistics.

Table 1. Summary statistics

	Obs.	Mean	Std. Dev.	Min	Max
1995-2012					
Exports, business services (US $ million)	399654	24.75	248.53	0	17421.21
Exports, computer services (US $ million)	399654	3.39	54.88	0	10656.1
GATS telecoms commitment	211878	0.85	0.25	0	1
2011-2018					
Exports, business services (US $ million)	11615	276	1049	0	18320
Exports, computer services (US $ million)	8843	76	323	0	7550
STRI telecoms	246	0.23	0.12	0.11	0.68

[42] Martin Roy, *Elevating Services: Services Trade Policy, WTO Commitments, and Their Role in Economic Development and Trade Integration* (WTO Econ. Res. & Stat. Div., Staff Working Paper ERSD-2019-01, 2010).

[43] Bernard Hoekman, *Assessing the General Agreement on Trade in Services* (World Bank Discussion Papers, No. 327, 1995).

Variables with no time variation					
Contiguous	22203	0.02	0.14	0	1
Common language	22203	0.13	0.34	0	1
Common religion	22203	0.16	0.24	0	0.99
Common legal origin	22203	0.31	0.46	0	1
Distance (Km)	22203	7460	4278	115	19781

C. Results

The analysis is divided into two periods and two data sets. The first uses trade data from the period 1995-2012 classified according to EBOPS 2002. During the early 2000s, the most important trade agreement affecting trade in services was the GATS. Therefore, I use the indicator for whether countries have, fully or partly, scheduled telecommunications in the GATS as the policy indicator for this period. Broadband was in its infancy in the 1990s while mobile subscriptions reached maturity in the late 2000s in many countries. Mobile subscriptions per hundred inhabitants therefore represent telecommunications performance in the first period, while broadband subscription rates are used for the second period.[44] The regression results are reported in Table 2 for computer services and Table 3 for other business services.

Table 2. Gravity regressions, exports of computer services 1995-2012

	(1)	(2)	(3)
Ln distance	-0.560***	-0.568***	-0.570***
	(-9.69)	(-9.45)	(-9.70)
Contiguous	-0.034	-0.037	-0.038
	(-0.30)	(-0.32)	(-0.34)
Common language	0.043	0.034	0.036
	(0.42)	(0.32)	(0.34)
Common religion	0.479**	0.463*	0.476*
	(2.60)	(2.49)	(2.57)

[44] The correlation rate between mobile and broadband density was 0.24 between 1995 and 2000, rising to 0.62 between 2000 and 2005 after which the correlation fell to 0.42 between 2015 and 2018. All correlation coefficients are significant at a 0.1% level. Mobile density should therefore be a good indicator of the overall performance of telecommunications during the first period.

Common legal origin	0.295***	0.304***	0.296***
	(4.45)	(4.48)	(4.45)
FTA	0.503***	0.476***	0.521***
	(5.18)	(4.87)	(5.44)
Both EU	0.149	0.165	0.076
	(1.20)	(1.29)	(0.55)
ln exporter mobile		0.222***	
		(10.34)	
Ln importer mobile		0.096***	
		(4.00)	
Exporter GATS telecom			0.698***
			(6.98)
Importer GATS telecom			0.353***
			(4.08)
Pseudo R	0.932	0.934	0.932
N	399654	392687	399654

Note: Poisson Pseudo-Maximum Likelihood (PPML) regressions with country and year fixed effects. Standard errors clustered on country pairs are reported in parentheses. ***, ** and * signify statistical significance at a 1%, 5% and 10% level, respectively. All variables except distance and mobile density are indicator variables or indices and are not logged.

Comparing the two sectors, some interesting patterns emerge. Trade in both sectors fall off with distance, but less than is commonly observed for goods where the coefficient on distance usually ranges between -0.7 and -1. It is also interesting to note that contiguity does not matter for either sector. Thus, there is no bias towards trading among country pairs that share a common border once distance is considered. Turning to cultural and institutional distances, the most important for computer services is common legal origin, while common language and common religion are much more important for other business services. A possible explanation for the elevated importance of common legal origin for computer services may be that such trade has traditionally involved outsourcing of business operations on a long-term contractual basis, which in turn may have involved the processing of sensitive data. The coefficient suggests that country pairs with a common legal origin trade about 35% more computer services, all else equal.

Surprisingly, sharing a language does not have a significant impact on trade in computer services, while it is associated with 20% more trade in other business

services. Being part of a common FTA is important for trade in both services, but more so for computer services. The coefficient suggests that country pairs that are part of the same FTA trade about 65% more computer services and 43% more other business services with each other than countries that are not part of the same trade agreement. We finally note that European Union (EU) membership is not associated with more trade in these two services categories than other FTAs.[45]

Table 3. Gravity regressions, exports of business services, 1995-2012

	(1)	(2)	(3)
Ln distance	-0.542***	-0.543***	-0.549***
	(-17.09)	(-16.11)	(-17.23)
Contiguous	0.098	0.1	0.096
	(1.35)	(1.37)	(1.34)
Common language	0.206***	0.206***	0.199***
	(3.57)	(3.32)	(3.45)
Common religion	0.513***	0.505***	0.510***
	(5.33)	(5.20)	(5.31)
Common legal origin	0.189***	0.189***	0.190***
	(4.02)	(3.77)	(4.05)
FTA	0.367***	0.360***	0.376***
	(5.71)	(5.74)	(5.94)
Both EU	-0.082	-0.095	-0.128
	(-1.19)	(-1.37)	(-1.80)
Ln exporter mobile		0.120***	
		(7.45)	
Ln importer mobile		0.080***	
		(5.40)	
Exporter telecoms GATS			0.336***
			(5.50)
Importer telecoms GATS			0.253***
			(5.02)
Pseudo R^2	0.945	0.946	0.946
N	399654	392687	399654

[45] Hildegunn Kyvik Nordås, *Does Mutual Recognition of Qualifications Stimulate Services Trade? The Case of the European Union*, 48(20) APPLIED ECON. 1852-65 (2016) [hereinafter Nordås-EU].

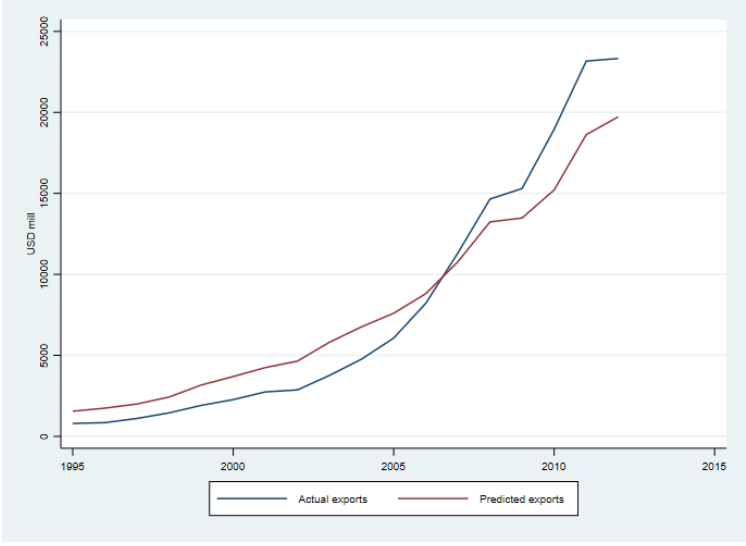
Note: PPML regressions with country and year fixed effects. Standard errors clustered on country pairs are reported in parentheses. ***, ** and * signify statistical significance at a 1%, 5% and 10% level, respectively. All variables except distance and mobile density are indicator variables or indices and are not logged.

The variables of main interest for this study are telecommunications performance and policy. Mobile subscription density is strongly associated with more exports of both computer and other business services, with a slightly higher impact of computer services. The coefficients suggest that a 10% increase in mobile density is associated with 2% more exports of computer services and 1% more exports of other business services all else equal. Importantly, having fully committed telecommunications in the GATS is associated with as much as 75% more exports of computer services and 35% more exports of business services. These are large numbers and should be interpreted with caution. It does not imply that a country will boost its exports of computer and business services merely by scheduling telecommunications in the GATS. Rather, it suggests that countries that were prepared to make a legally binding GATS commitment to keep telecommunications open and well-regulated in perpetuity are more likely to instil confidence in potential exporters ready to take the leap and make the considerable investment needed to enter foreign markets.

India has only partly committed telecommunications in its GATS schedule, as noted in the previous part. The results suggest that if India implemented the necessary reforms to make a full commitment, its cross-border exports of computer services could have been about 40% higher and business services about 20% higher, all else equal. Nevertheless, India's unilateral reforms as discussed in Part 2, probably helped a lot, even if not committed in a trade agreement. Thus, as indicated in Figure 9, India under-performed the model predictions in the 1990s and early 2000s, but then caught up and over-performed substantially after around 2005 both for computer services and business services.[46]

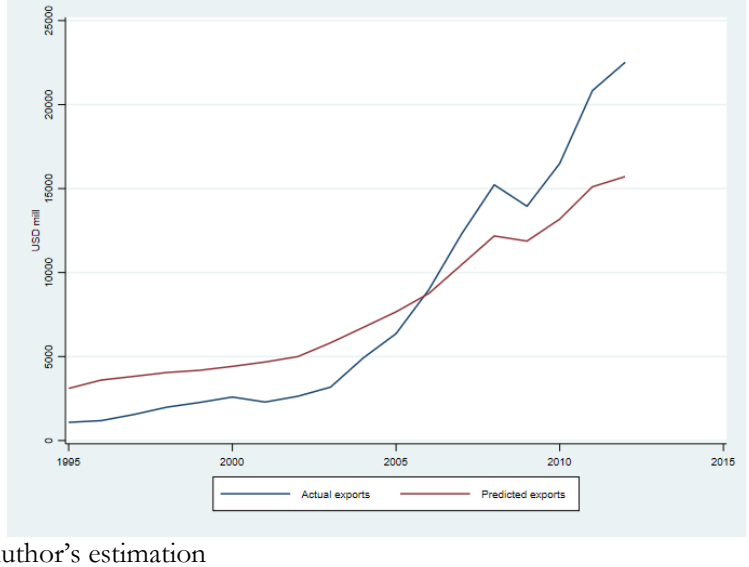
[46] The charts show the predicted trade values from the gravity regressions reported in Tables 2 and 3 versus the actual export figures which are derived by summarising bilateral trade by trading partner in the data used for the regressions.

Figure 9. Actual versus predicted exports of computer services, India



Source: Author's estimation

Figure 10. Actual versus predicted exports of other business services, India



Source: Author's estimation

As discussed, best practice regulation in telecommunications evolves rapidly with technology and market structure.[47] The GATS commitments included in the Reference Paper on telecommunications do not change over time, and may no longer reflect current practices, let alone best practices. The STRIs capture current telecommunications policy in force and is used as the policy measures in the regressions for the second period, using EBOPS 2010 data for the period 2011 to 2018. The policy information is, however, available only for forty-six countries for the period 2014-2018.[48]

Unfortunately, services trade statistics reported in EBOPS 2010 have much weaker coverage than the EBOPS 2002 data. Only a few countries offer comprehensive bilateral trade statistics for services and most cover only the most important trading partners. Therefore, it is more challenging to identify the impact of broadband density and telecommunications policy in this data set. These are exporter-specific variables and when we have relatively a few observations, their effect on trade may be fully or partly captured by the country fixed effects. To deal with this problem, we interact with the broadband and policy indices by distance or contiguity. There are reasons to believe that the marginal impact of broadband may vary with distance. Thus, while countries close to home can be served through business travel and representative offices, more distant markets probably depend more on cross-border trade over the internet. Furthermore, the gravity theory suggests that the marginal effect of trade costs do vary with distance.[49] Therefore, to exploit possible variation in the marginal effect of telecommunications depending on distance, I interact broadband with contiguity or distance.[50]

Table 4. Gravity regressions, trade in computer services 2012-2018

	(1)	(2)	(3)
Ln distance	-0.654***	-1.477***	-2.303***
	(-5.51)	(-4.73)	(-5.07)
Contiguous	-0.178	-0.187	-0.168
	(-1.13)	(-1.20)	(-1.10)
Common language	-0.001	0.024	-0.003
	(-0.01)	(0.15)	(-0.02)

[47] Nordås-EU, *supra* note 45.

[48] The reason for not using GATS for this period as well, is that all countries that report bilateral trade in EBOPS 2010 have also scheduled telecommunications in the GATS, such that there is no variation in this variable.

[49] Peter Egger, *On the Role of Distance for Bilateral Trade*, 31(5) WORLD ECON. 653-62 (2008).

[50] As a robustness check, I also used interaction terms for the first set of regressions on EBOPS 2002 data, but these were not statistically significant, and the overall fit of the regressions were better without the interaction terms.

Common religion	0.420**	0.413*	0.446**
	(2.01)	(1.96)	(2.08)
Common legal origin	0.407***	0.397***	0.402***
	(4.39)	(4.24)	(4.17)
FTA	0.170**	0.129*	0.115*
	(2.54)	(1.78)	(1.68)
Both EU	0.36	0.40	0.45
	(1.30)	(1.49)	(1.60)
ln exporter broadband		0.234***	0.456***
		(2.71)	(3.52)
Exporter STRI telecoms			-2.894*
			(-1.82)
Pseudo R^2	0.889	0.89	0.892
N	9971	9971	5021

Note: PPML regressions with country and year fixed effects. Standard errors clustered on country pairs are reported in parentheses. ***, ** and * signify statistical significance at a 1%, 5% and 10% level, respectively. Indicator variables are not logged. Broadband density is interacted with distance.

Table 4 depicts the results for computer services. Reassuringly, even if the sample is much smaller for this period, the standard gravity variables representing geographical, institutional, and cultural distance take similar values as in the first set of regressions. The variable of interest here is broadband density. From columns (2) and (3), we see that when interacting distance with broadband, the coefficient on distance increases substantially. The coefficient now reflects how much exports fall off with distance in the hypothetical case when the exporter has no broadband connectivity. The positive coefficient on broadband means that the broadband connectivity reduces the importance of distance. For example, exports fall off with distance at a rate of about 15% for every 10% increase in distance when broadband density is zero, by 14% when broadband density is 1.4 (the latest number for India), by 9% when broadband density is 12 (the sample mean), and about 5% when broadband density is 62, which is the maximum density observed.

We finally added the STRI indicator for open and well-regulated telecommunications to the regressions. We then lose about half of the observations. The results are thus not quite comparable to the two previous regressions run on the larger sample. The results clearly demonstrate that, in this sample, open and well-regulated telecommunications have a stand-alone impact on

trade in computer services. This probably stems from the impact of policy on reliability, speed and cost of broadband and other telecommunications services.

Table 5. Gravity regressions, trade in other business services, 2012-2018

	(1)	(2)	(3)
Ln distance	-0.587***	-0.579***	-0.548***
	(-10.70)	(-10.53)	(-9.17)
Contiguous	0.11	1.966**	2.142**
	(1.17)	(2.09)	(2.15)
Common language	0.15	0.17	0.285**
	(1.11)	(1.26)	(2.00)
Common religion	0.442**	0.467***	0.466***
	(2.55)	(2.66)	(2.66)
Common legal origin	0.329***	0.312***	0.302***
	(4.18)	(4.18)	(3.91)
FTA	0.241***	0.220***	0.156***
	(4.13)	(3.96)	(3.10)
Both EU	(0.15)	(0.13)	(0.00)
	(-0.89)	(-0.75)	(-0.01)
ln exporter broadband		-0.534**	-0.580**
		(-2.01)	(-2.09)
Exporter STRI telecoms			(1.70)
			(-1.05)
Pseudo R	0.92	0.921	0.925
N	11599	11599	5872

Note: PPML regressions with country and year fixed effects. Standard errors clustered on country pairs are reported in parentheses. ***, ** and * signify statistical significance at a 1%, 5% and 10% level, respectively. Broadband density is interacted with contiguous.

Turning to other business services, as reported in Table 5, the impact of the standard gravity variables is similar as for computer services. Interestingly, broadband has quite a different impact on the sensitivity of exports to distance compared to computer services. Interacting broadband with distance in this sector did not produce any significant results (not reported for space considerations). However, the impact of broadband differs strongly when moving from next door neighbours to more distant trading partners. This implies that countries with low

broadband penetration export business services mainly to neighbouring countries, while the better the connectivity the further afield they export. In the hypothetical case that the exporter has no broadband, the predicted export value that goes to the immediate neighbours is about seven times (the exponent of 1.966) higher than other countries, all else equal. To use the same examples for computer services, when broadband density is 1.4 (as for India), a country would export about six times more to its neighbours; if broadband density is 13 (the sample mean), exports to neighbours would be 1.8 times larger; and if broadband density is 62 (the maximum value in the sample), the immediate neighbour would receive slightly less exports than otherwise, all else equal.

Business services are heterogeneous. Some, such as design and paralegal services, can be easily digitised and traded over the internet. Others, such as management consulting, are mainly delivered through face-to-face interaction with clients. Nevertheless, professional services automation software has enabled cross-border exports also of a host of business consulting and technical business services given adequate access to reliable broadband. The results reported in Table 5 suggest that with good broadband access, cross border exports over the internet dominates trade in business services, while in the absence of adequate broadband, exports of business services require a substantial amount of business travel, which is expensive and time consuming, and usually limited to neighbouring countries. We finally notice that telecommunications policy does not have a statistically significant impact on trade in business services beyond its impact on broadband density.

To summarise the findings in this part, telecommunications connectivity, and the policy that support connectivity are important drivers of trade in computer and other business services. Such services are knowledge-intensive and susceptible to digitisation which allows them to be traded across borders over the internet. Broadband connectivity not only affects the total volume of services trade, but also considerably extends the distance over which services travel.

V. CONCLUSION

India was one of the first developing countries to benefit from digital trade in services and turned from under to over performing in export markets during the 2000s. So far, connectivity does not seem to hamper services exports. However, India is a large country with excellent connectivity in high-technology hubs, while rural and smaller cities are lagging way behind. If lagging areas are to become part of India's services export success story, connectivity needs to be extended to them as well. The NDCP envisages an ambitious objective of universal access to broadband, which it sees as essential for unleashing India's growth potential. This

paper shows that connectivity is indeed crucial for services exports – an important driver of India's growth since the early 2000s.

The NDCP recognises that India lags behind and needs to catch up. This study shows that growth in telecommunications density has grinded to a halt in recent years both for mobile and fixed broadband, and the gap towards other lower middle-income countries has widened. Bearing in mind that other developing countries, such as China and the Philippines, are gaining market share in India's traditional export markets, reforms are needed to stay competitive. Reliable, high quality connectivity is best obtained when telecommunications markets are well-regulated and open to trade and foreign investment. To achieve the NDCP objective of establishing a global hub for cloud computing and content hosting, data must be allowed to flow seamlessly across borders, protected by strong privacy and cyber security law enforcement. Privacy must be protected from unwanted commercial exploitation, as well as from government interception.