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Telecommunications: the underlying transport means for services exports

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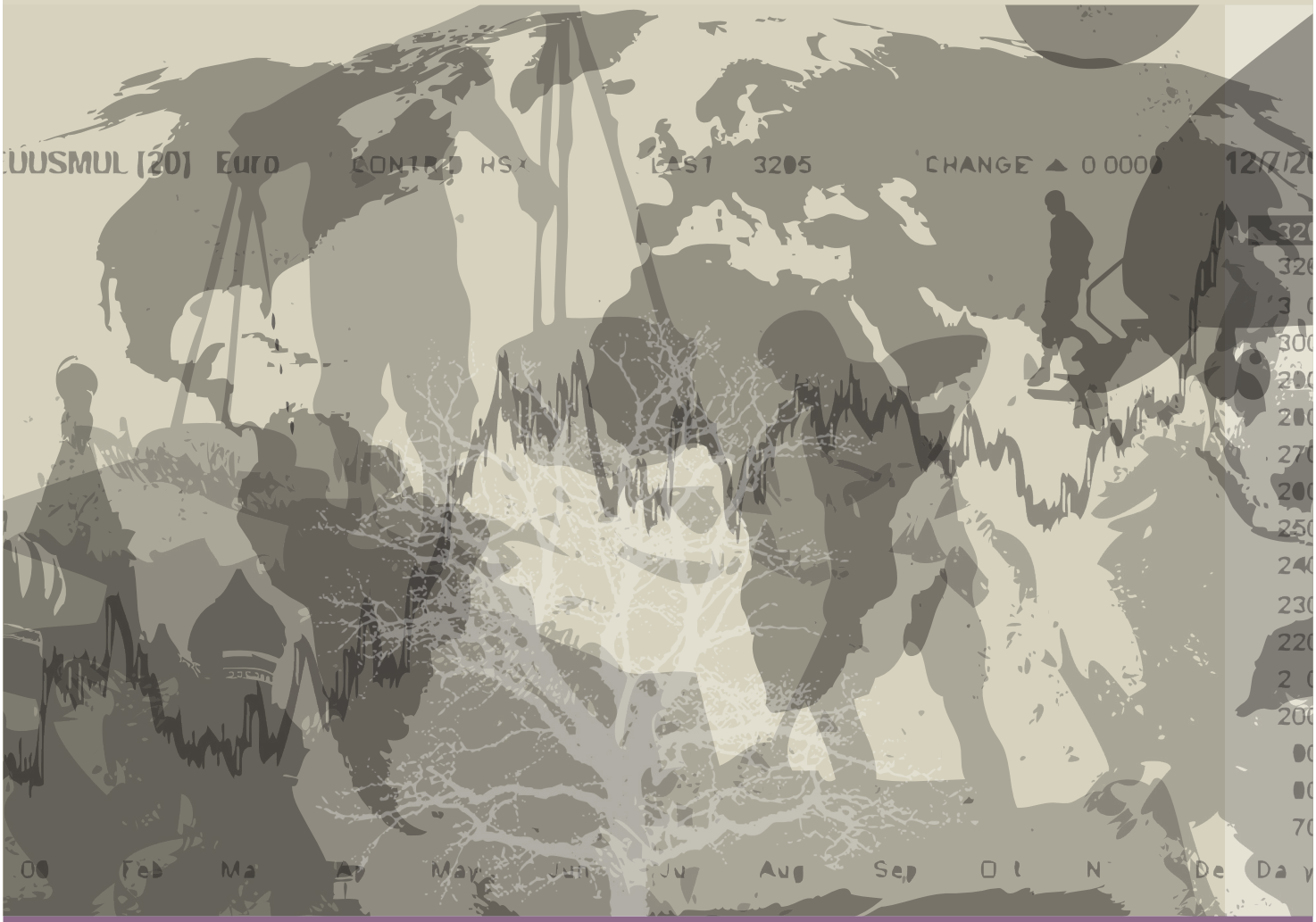

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Telecommunications: the underlying transport means for services exports

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Abstract

This paper analyses the role of telecommunications as the means of transport for services exports with a focus on computer and other business services from India. Telecommunications are typically dominated by major suppliers which need to be regulated and exposed to competition to fulfil their role. The 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 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, I find 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.

Keywords: Trade, regulation, business services, telecommunications, India

JEL classification: F13, F14

1 Introduction

Telecommunications are 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 Annex on telecommunications which establishes the principles of non-discriminatory access to and use of telecommunications networks and services. The provisions apply to all WTO members whether or not they have made commitments to liberalize telecommunications, and underscores the important role of telecommunications for services trade. Thus, even before the internet was commercialized 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 Annex, WTO members may also include telecommunications in their schedule of commitment, which amounts to a legal obligation to open the sector to foreign trade and investment. Finally, countries may take legal obligations to enforce pro-competitive domestic regulation that prohibits incumbent local operators from denying foreign suppliers access to their networks. Such obligations are enshrined in the GATS Reference Paper on competition safeguards, 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 percent of Indian computer and information services and are exported.[1] In recent years, other developing countries are catching up and India's world market share of computer services has declined from 16 to 12 percent between 2012 and 2018. At the same time Indian exporters have moved into more sophisticated business services,

[1] The share is calculated from the OECD TiVA database for 2015.

for which its world market share has increased from 4.3 to 5.1 percent.[2]

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 behind other middle income countries and the gap has been growing in recent years. 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. Kyvik Nordås (2020) shows a strong relationship 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.

This paper first discusses India's telecommunications policy reforms and commitments in the GATS as well as its recent trade agreement with Japan. It next 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.

The rest of the paper is organized as follows. Section 2 presents the Indian trade and regulatory policy framework for telecommunications in a comparative perspective, while section 3 describes India's connectivity compared to other mid-

[2]Other business services are a broad category that includes R&D; professional and management consulting services; technical, trade-related and other business services; and waste treatment, de-pollution, agricultural and mining services. Source: OECD EBOPS

dle income countries. It also shows how the price and density of broadband are related to telecommunications policy. Section 4 provide an econometric analysis of the relationship between telecommunications performance and policy and exports of computer and other business services while section 5 concludes.

2 The policy framework for telecommunications

India has made modest commitments to liberalize its telecommunications sector both in the GATS and in its 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 The Export-Import bank of India points out that mobile operators are highly indebted due to high spectrum fees, rapid debt-financed roll-out of infrastructure, and high regulatory costs. A heavy debt burden together with falling revenue per user have triggered the exit of several operators and further consolidation is expected (H.A.C Prasad 2019).

Fixed line subscriptions in contrast, have declined over the past couple of dcades and the market is more restricted with government enterprises featuring prominently.[3] 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 much more liberal than its commitments in the GATS as well as FTAs.

2.1 Domestic reforms

India substantially liberalized 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 manufacture of telecom-

[3]BSNL and MTNL together account for more than 60 percent of fixed line subscribers. Source: TRAI

munication equipment (Dossani 2002). Liberalization started with the entry of private manufacturers of equipment in 1991 and continued with the National Telecommunications Policy (NPT) in 1994, the New Telecommunications Policy in 1997 and finally the National Digital Communications Policy - 2018 (NDCP). The 1994 policy framework allowed private investment in telecommunications services, and introduced a semi-independent regulator.[4]

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. The framework recognizes the need to use all suitable networks, including broadcasting, satellite, electricity and rail infrastructure, fiber optic cables and spectrum efficiently to reach the ambitious policy objectives. A milestone and strategic objective in the NDCP is to reach the top 50 in the ITU's ICT development index, up from 134 in 2017.[5]

Digital sovereignty as well as protecting local industry are 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. H.A.C Prasad (2019) in a recent study commissioned by the Export-Import bank of India notes that elevated tariffs on telecommunications equipment as well as high taxes and charges have hurt the sector in the past. Nevertheless, the study advocates higher tariffs on optical fiber, for which India has considerable manufacturing capacity. It is, however, unclear if such tariffs would protect local manufacturing since Korea and Japan are the major suppliers and India has FTAs with both of them.[6] Furthermore, if higher tariffs are needed for Indian

[4]The regulator is independent from telecommunications operators, but the Ministry of Communications, Department of Telecommunications has the authority to instruct TRAI and overrule its decisions in certain areas.

[5]The ITU has worked on revising the methodology and did not publish the index in 2018 while the index for 2019 is delayed. See https://www.itu.int/md/D18-BDT-CIR-0027

[6]I use the term FTA for any bilateral or regional trade agreement for simplicity. However, the agreements differ in scope and depth and the agreements with Japan and Korea are Comprehensive Economic Partnership Agreements rather than merely trade agreements.

telecommunications operators to source fiber locally, there is a danger that higher tariffs will hurt them in the same manner as previous tariffs.

The NDPC aims for establishing India as a global hub for cloud computing, content hosting and delivery, and for data communication systems and services. For this to be feasible, it is recognized that India needs a comprehensive data protection regime as well as cyber security. However, the policy framework includes a controversial point on lawful intercept and analysis system for implementation of law and order and national security. This point is included in the draft Personal Data Protection Bill, which at the time of writing is pending in the Parliament. It has raised concern, among others from the judiciary, on the grounds of excessive surveillance and freedom of speech, and could deter foreign companies and other data owners from using Indian cloud services and content hosting.

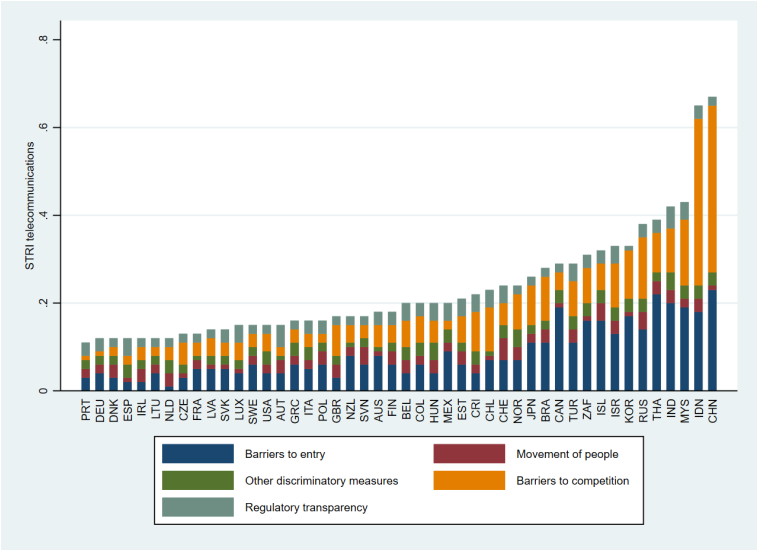
2.2 Trade related policy

This section first looks at applied policy and next commitments in the GATS and the Comprehensive Economic Partnership with Japan. Stating with applied policies currently in force, the OECD Services Trade Restrictiveness Indices (STRI) and database contain qualitative information on regulation, which is scored and weighted to create indices of services trade restrictiveness.[7] 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 organized 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 localization requirements. Restrictions on movement of people usually apply to business travel and temporary entry of e.g. 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

[7]The STRI and database contains annual information on telecommunications regulation for 46 countries from 2014 onward. It records applied policies from domestic laws and regulations currently in force, including relevant decisions by national regulators.

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 46 countries in 2019.[8]

Figure 1: STRI score on telecommunications, 2019



Source: OECD

India scores fourth to highest on the STRI for telecommunications in 2019. It is, however, worth noticing that the score is not very different from other developing countries included, and substantially below China and Indonesia. India currently has no foreign equity limitations in telecommunications, although foreign majority shares must be approved by 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 CEO or CFO in telecommunications companies. There is a requirement that data must be processed and stored locally, domestic mobile traffic must be hauled and routed within the bor-

[8]The country codes reported on the horizontal axis are the ISO3 codes.

ders of India, and a general restriction on access to land affects telecommunications which needs to use land for poles, ducts, and towers.

Restrictions under barriers to competition include state ownership in two major fixed line operators (BSNL and MTNL), and lack of regulatory independence. As noted in the recent study from the Export-Import bank of India, the regulator is independent from telecommunications operators, but it is not fully independent from the government in its day to day operations.[9] 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 percent. 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.

India has been cautious in including services in general and telecommunications in particular in its free trade agreements (FTA). Currently there are five FTAs in force that include services. These are the agreement with ASEAN, and the bilateral agreements with Japan, Malaysia, Singapore and Korea.[10] The ASEAN agreement opens for market access through commercial presence with an equity cap of

[9]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 SMPs, and cannot be instructed or overruled by the ministry in its day to day operations within its mandate (Intven and Tetrault 2000).

[10]the ASEAN agreement entered into force in 2015, and the bilateral agreements with Japan (2011), Malaysia (2011), Singapore (2005) and Korea (2010).

49 percent for basic telecommunications and 51 percent 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.[11]

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 percent. 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. 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. In particular unbundled interconnection with network components "shall" be offered accord-

[11] There are separate agreements with Indonesia and the Philippines, but it appears that there are no significant differences between theses and the other eight ASEAN members as far as telecommunications are concerned.

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

To summarize 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 index 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.

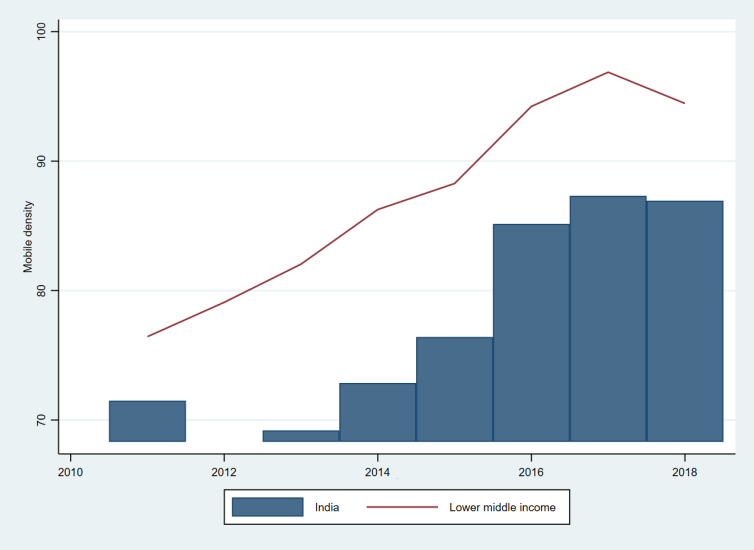
3 Connectivity

Figures 2-4 compare developments in telecommunications density in India to the lower middle income average over the past decade. The indicators are mobile and fixed broadband subscription rates per 100 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.

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.

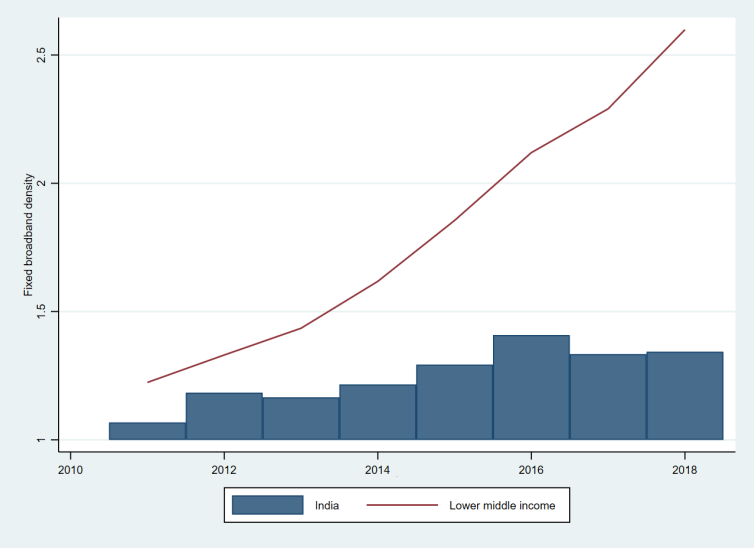
International comparison of prices is complicated because the market structure and subscription packages on offer differ both across countries and within

Figure 2: Mobile subscriptions per 100 inhabitants



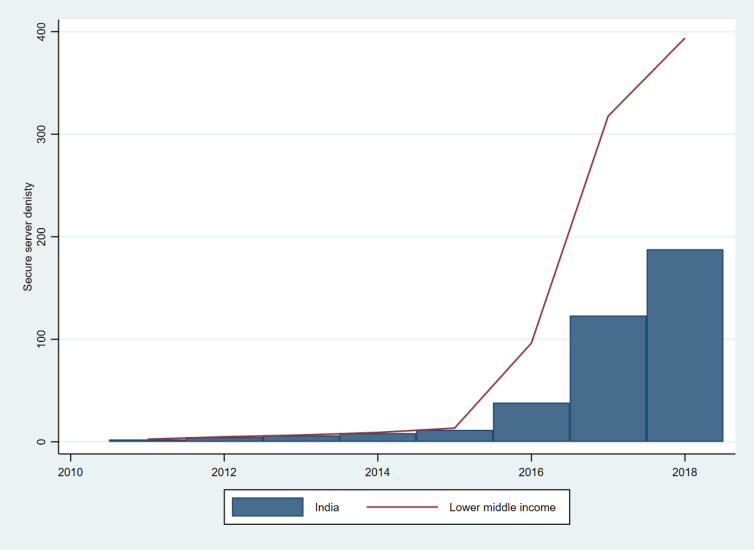
Source: WDI

Figure 3: Broadband subscriptions per 100 inhabitants



Source: WDI

Figure 4: Secure servers per mill inhabitants

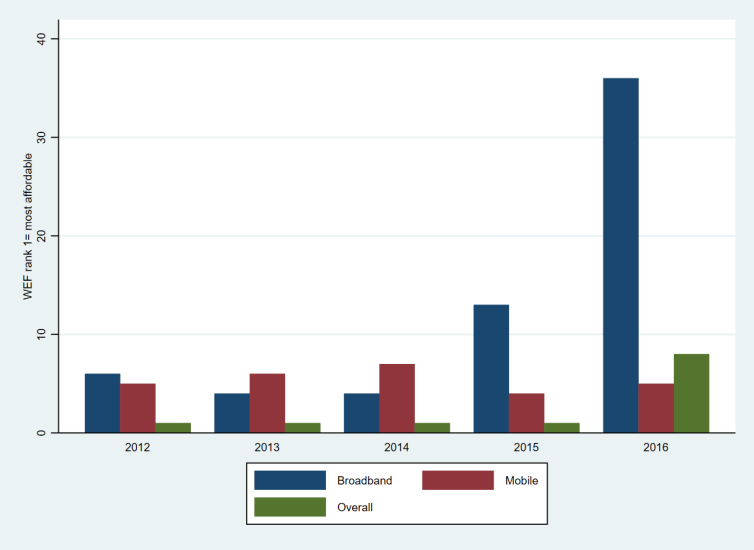


Source: WDI

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 36^{th} 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 the slippage in the ranking on affordability, suggesting a movement down the demand curve for broadband.

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 USD at nominal and purchasing parity prices. India ranks number 103 on the fixed broadband basket and is thus among the more expensive countries. The prices are not adjusted for speed and caps on use per month.

Figure 5: Telecommunications affordability ranking



Source: WEF

According to the ITU, the download speed is 2 Mbit per second and the cap per month is 1.5 gigabytes in India. For comparison, the average speed for all 177 countries included in the report is 17.8 Mbit per second, and the basket has no cap on use in 113 of the 177 countries. China ranks 72 on price relative to GNI per capita at a speed of 100 Mbit per second and unlimited use. The Philippines, which is emerging as a significant exporter of computer and business services, ranks 118 on price relative to GNI at a speed of 1 Mbits per second and unlimited use.

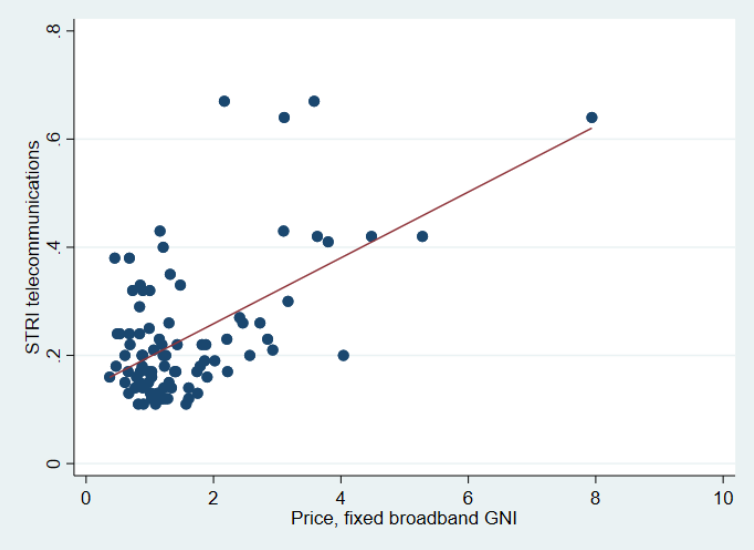
The Indian market for telecommunications is overwhelmingly wireless where private sector companies have a market share of almost 90 percent. The latest quarterly report from TRAI shows that at the end of December 2019 there were 1172.44 million telecommunications subscribers, of which 1151.44, or 98 percent were for wireless services. 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 21 million in Decem-

ber 2019. The last couple of years have also seen a levelling off also of wireless subscriptions.

The competition in the wireless market was fierce with 15 suppliers with a nationwide coverage in 2010. Cut-throat competition led to a low and declining monthly revenue per subscriber, falling from 131 rupee in 2010 to 71.3 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.

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 less broadband subscriptions per 100 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.

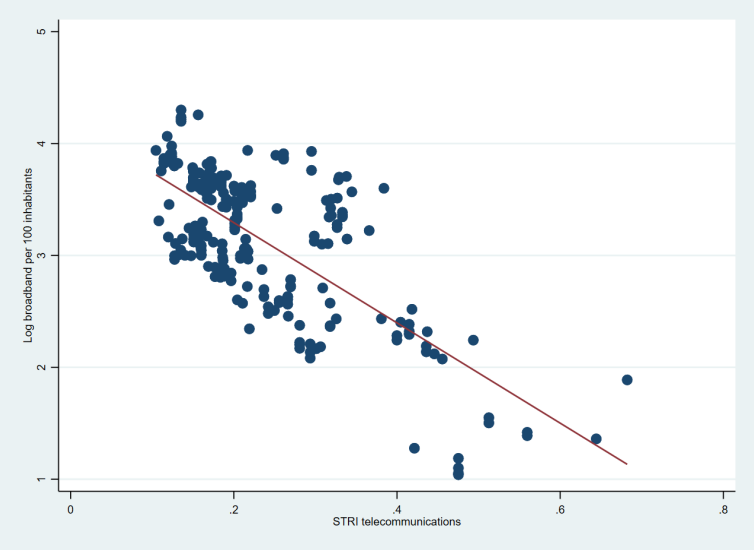
Figure 6: The STRI and the price of broadband relative to gross national income



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: OECD and ITU

Figure 7: The STRI and the density of broadband



The figure plots the GDP per capital adjusted broadband density against the STRI for telecommunications in 2014-2018.

Source: Author's estimate

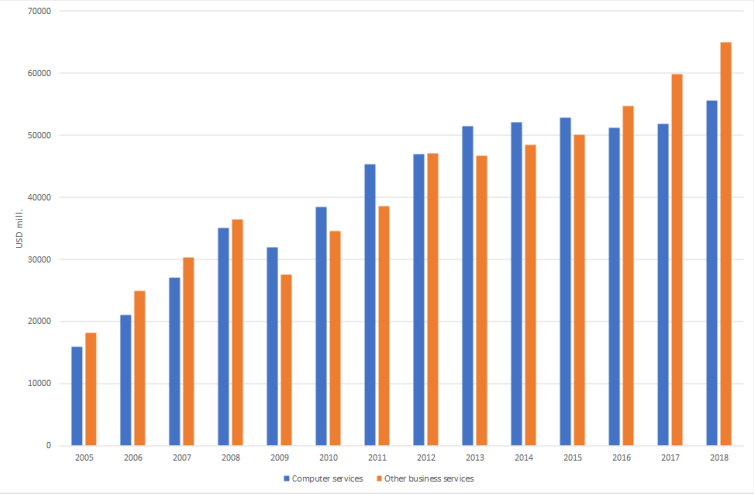
This section has demonstrated that although connectivity has improved substantially in India over the past decade, connectivity has improved even faster in other countries Indian services exporters compete with in third markets. The section also highlights that connectivity can be substantially improved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

4 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 R&D. These services are information intensive and are increasingly digitized, opening new opportunities for cross-border trade. While traditional back-office business process services and call centers require good telephone connectivity, digitized professional services often require fast, reliable and

cost-effective broadband. This section explores the relationship between access to such telecommunications services and exports of computer and other business services.

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



Source: WTO

Figure 8 shows that India's exports of computer and other business services tripled in current 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.

4.1 Empirical strategy

This section 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. I

therefore analyse the data from 1995 to 2012 and from 2010 to 2018 separately.[12] Broadband was in its infancy in the 1990s and the World Development Indicators (WDI) report data on broadband density only from 1998. I therefore use mobile telephones per 100 inhabitants as the telecommunications indicator in the first period, while broadband is used in the second period.[13]

As indicated in the previous sections, 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 provider to enter export markets. As indicated in a number of studies, e.g. (Bhattacharya, Patnaik, and Shah 2012) 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 but a few. 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 (Head and Mayer 2014). The structural gravity equation system is given by three equations in three unknowns:

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

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

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

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

$$P_j^{1-\sigma} = \sum_i \left(\frac{t_{ij}}{\Pi_i} \right)^{1-\sigma} \frac{Y_i}{Y} \tag{3}$$

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, (X_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. 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:[14]

$$X_{ij,t} = exp[A_t + \alpha_1 lnY_{i,t} + \alpha_2 lnE_{j,t} + \alpha_3 lnt_{ij,t} + \alpha_4 (l-\sigma) lnP_{j,t} + \alpha_5 (l-\sigma) ln\Pi_{j,t} + \varepsilon_{ij,t}] \tag{4}$$

The parameter of interest in this study is α_3. The trade costs captured by 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 geographic, 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.

[14] 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.

4.2 Data

Data on bilateral trade in other business services and computer services are from the OECD and 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 (Fortanier et al. 2017). This may bias the regression results.

For the period 2010 onward, international organizations report trade data using EBOPS 2010. From this period data is available at more detailed sector breakdown. Unfortunately, the details come at the expense of coverage. The WTO services trade statistics has a slightly better coverage, so we used WTO statistics from 2010. India is not recorded as a reporter in either database, but appears as a partner to 28 reporters in computer services and 36 reporters for other business services.

Information on geographic, cultural and institutional distance as well as FTAs is taken from CEPII's gravity database. I added the FTAs that have entered into force after 2015 using the WTO RTA database. Information on mobile and broadband density is from the WDI. Information on GATS commitments are from Roy (2019).[15] I follow Hoekman (1995) in creating indices from the GATS commitments by country, sub-sector and mode of supply. 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.

[15]The author is grateful to Martin Roy from the WTO Secretariat for sharing the underlying data on commitments in the GATS telecommunications sector by sub-sector, mode and country.

Table 1: Summary statistics

Variables	Obs.	Mean	Std. dev.	Min	Max
1995-2012					
Imports business services (USD mill)	399654	24.79	248.61	0	17421
Imports computer services (USD mill)	399654	3.39	54.91	0	10656
GATS telecom commitment	2788	0.85	0.25	0	1
2010-2018					
Imports business services (USD mill)	11178	323	1336	0	35959
Exports business services (USD mill)	11615	276	1049	0	18320
Imports computer services (USD mill)	8881	48	243	0	7167
Exports computer services (USD mill)	8843	76	323	0	7550
STRI telecommunications	276	0.23	0.12	0.11	0.68
STRI computer services	276	0.23	0.07	0.12	0.45
STRI professional services	276	0.31	0.13	0.13	0.68
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

4.3 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 100 inhabitants therefore represent telecommunications performance in the first

period, while broadband subscription rates are used for the second period.[16] The regression results are reported in Table 2 for computer services and Table 3 for other business services.

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 taken into account.[17] 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 suggest that country pairs with a common legal origin trade about 35 percent more computer services all else equal.

Perhaps surprisingly, sharing a language does not have a significant impact on trade in computer services, while it is associated with 20 percent 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 suggest that country pairs that are part of the same FTA trade about 65percent more computer services and 43 percent more other business services with each other than countries that are not part of the same trade agreement. We finally note that EU membership is not associated with more trade in these two services categories than other FTAs.[18]

[16]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 percent level. Mobile density should therefore be a good indicator of the overall performance of telecommunications during the first period.

[17]For trade in goods and transport services countries that share a common border typically trade as much as 60 percent more with each other all else equal (Head and Mayer 2014).

[18]EU's internal market for services include free movement of capital and labour and has com-

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

Variables	(1)	(2)	(3)
Ln distance	-0.560***	-0.568***	-0.576***
	(-9.69)	(-9.45)	(-9.45)
Contiguous	-0.034	-0.037	-0.041
	(-0.30)	(-0.32)	(-0.35)
Common language	0.043	0.034	0.030
	(0.42)	(0.32)	(0.28)
Common religion	0.479**	0.463*	0.460*
	(2.60)	(2.49)	(2.47)
Common legal origin	0.295***	0.304***	0.304***
	(4.45)	(4.48)	(4.48)
FTA	0.503***	0.476***	0.491***
	(5.18)	(4.87)	(5.08)
Both EU	0.149	0.165	0.109
	(1.20)	(1.29)	(0.78)
Exporter mobile		0.221***	0.209***
		(10.32)	(8.95)
Importer mobile		0.092***	0.072**
		(3.95)	(3.20)
Exporter GATS			0.578***
			(6.21)
Importer GATS			0.249***
			(3.31)
Pseudo R square	0.932	0.934	0.934
N	399654	392687	392687

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 percent level respectively. All variables except distance are indicator variables or indices and are not logged.

The variables of main interest for this study are telecommunications perfor-

mon regulations in many areas of relevance to computer and business services. EU does however fall short of automatic recognition of qualifications in professional services, which account for a large part of other business services (Nordås 2016).

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

Variables	(1)	(2)	(3)
Ln distance	-0.542***	-0.542***	-0.549***
	(-17.09)	(-16.10)	(-16.16)
Contiguous	0.098	0.100	0.098
	(1.35)	(1.37)	(1.35)
Common language	0.206***	0.206***	0.200**
	(3.57)	(3.32)	(3.22)
Common religion	0.513***	0.506***	0.504***
	(5.33)	(5.20)	(5.19)
Common legal origin	0.189***	0.189***	0.190***
	(4.02)	(3.77)	(3.80)
FTA	0.367***	0.361***	0.370***
	(5.71)	(5.74)	(5.95)
Both EU	-0.082	-0.095	-0.141
	(-1.19)	(-1.37)	(-1.93)
Exporter mobile		0.117***	0.095***
		(7.38)	(5.89)
Importer mobile		0.072***	0.062***
		(5.24)	(4.63)
Exporter GATS			0.325***
			(7.04)
Importer GATS			0.256***
			(5.77)
Pseudo R square	0.945	0.946	0.946
N	399654	392687	392687

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 percent level respectively. All variables except distance are indicator variables or indices and are not logged.

mance 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 percent increase in mobile density is associated with 2 percent more exports of computer services and

1 percent more exports of other business services all else equal. Importantly, having fully committed telecommunications in the GATS is associated with as much as 75 percent more exports of computer services and 35 percent 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 instill confidence in potential exporters ready to take the leap and make the considerable investment needed to enter foreign markets.

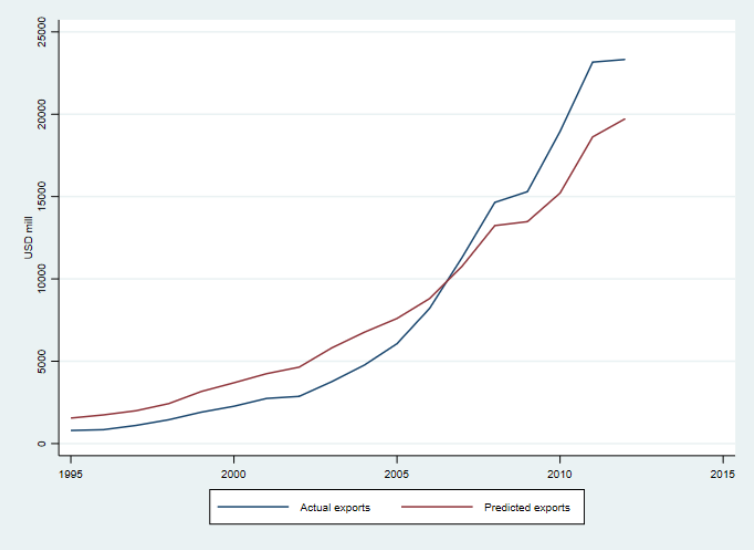
India has only partly committed telecommunications in its GATS schedule as noted in the previous section. The results suggest that if India implemented the necessary reforms to make a full commitment, its cross-border exports of computer services could have been about 40 percent higher and business services about 20 percent higher, all else equal. Nevertheless, India's unilateral reforms as discussed in Section 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.[19]

As discussed in Kyvik Nordås (2020), best practice regulation in telecommunications evolves rapidly with technology and market structure. 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 46 countries for the period 2014-2018.[20]

[19]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 summarizing bilateral trade by trading partner in the data used for the regressions.

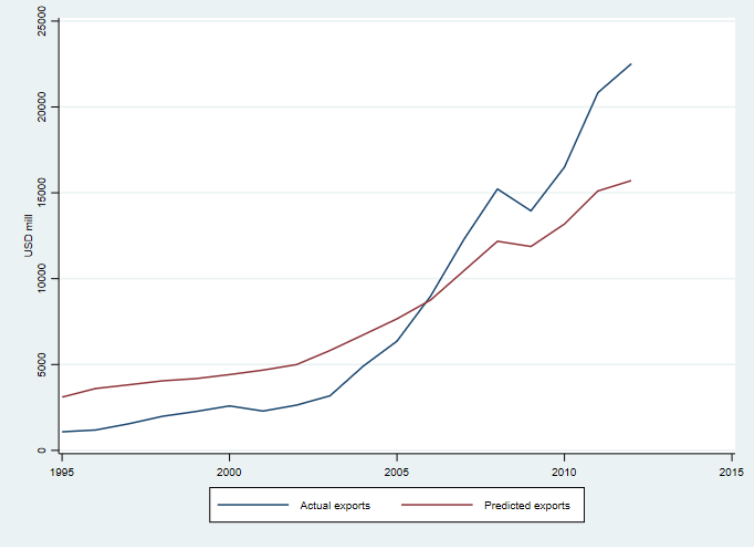
[20]One may ask why not using the GATS for this period as well. The reason is that all countries

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



Source: author's estimates

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



Source: author's estimates

that report bilateral trade in EBOPS 2010 have also scheduled telecommunications in the GATS, such there is no variation in this variable.

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 few observations, their effect on trade may be fully or partly captured by the country fixed effects. To deal with this problem, we interact the broadband and policy indices by with 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, as discussed in e.g. (Egger 2008), gravity theory suggest that the marginal effect of trade costs do vary with distance. Therefore, to exploit possible variation in the marginal effect of telecommunications depending on distance, I interact broadband with contiguity or distance.[21]

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 broadband connectivity reduces the importance of distance. For example, exports fall off with distance at a rate of about 15 percent for every 10 percent increase in distance when broadband density is zero, by 14 percent when broadband density is 1.4 (the latest number for India), by 9 percent when broadband density is 12

[21] 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.

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

Variables	(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)
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	0.358	0.404	0.452
	(1.30)	(1.49)	(1.60)
Exporter broadband		0.234***	0.456***
		(2.71)	(3.52)
Exporter STRI TC			-2.894*
			(-1.82)
Pseudo R square	0.889	0.890	0.892
N	9971	9971	5021

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 percent level respectively. Indicator variables (the STRI) are not logged. Broadband density is interacted with distance.

(the sample mean), and about 5 percent 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 loose 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 has a stand-alone impact on trade in computer ser-

vices. 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 business services, 2012-2018

Variables	(1)	(2)	(3)
Ln distance	-0.587***	-0.579***	-0.548***
	(-10.70)	(-10.53)	(-9.17)
Contiguous	0.111	1.966**	2.142**
	(1.17)	(2.09)	(2.15)
Common language	0.152	0.171	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	-0.153	-0.129	-0.001
	(-0.89)	(-0.75)	(-0.01)
Exporter broadband		-0.534**	-0.580**
		(-2.01)	(-2.09)
Exporter STRI TC			-1.704
			(-1.05)
Pseudo R square	0.920	0.921	0.925
N	11599	11599	5872

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 percent level respectively. Broadband density is interacted with distance. Columns (1) to (3) regressions are on exports, column (4) on imports.

Turning to other business services, reported in Table 5, the impact of the standard gravity variables are 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 differ strongly when moving from next door neighbors to more distant trading partners. Thus, when taking into account connectivity, trade with the countries with which the exporter shares a land border is very important, but becomes less so the better the broadband connection in the exporting country. In the hypothetical case that the exporter has no broadband, the predicted export value that goes to the immediate neighbors are about seven times (the exponential of 1.966) higher than to other countries, all else equal. To use the same examples as for computer services, when broadband density is 1.4 (as for India), a country would export about six times more to its neighbors, if broadband density is 13 (the sample mean), exports to neighbors would be 1.8 times larger, and if broadband density is 62 (the maximum value in the sample), the immediate neighbor would receive slightly less exports than otherwise, all else equal.

Business services are heterogeneous. Some, such as design and paralegal services, can be easily digitized 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 requires a substantial amount of business travel, which is expensive and time consuming and usually limited to neighboring 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 summarize the findings in this section, 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 digitization which allows them to be traded across borders over the internet. Broadband connectivity not only affect the total volume of services

trade, but also considerably extends the distance over which services travel.

5 Conclusions

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 very 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 NDPC 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 NDPC recognizes 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 NDPC 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.

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