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Factors Responsible For The Growth Of Indian Telcom Sector[1]

Dr. Anil, PhD (Economics), Jawaharlal Nehru University
Former Assistant Professor, SRCC, Delhi University
Deputy Director (Economics), Competition Commission of India

Abstract
The Indian telecom industry has experienced phenomenal growth over the past few decades, transforming from a luxury to a necessity in our daily lives. The world's total number of wireless subscribers was 846 Crores (World Bank Database) in 2021. China holds the first position with 173 crores wireless subscribers followed by India with 115 crores wireless subscribers. But what has driven this growth? What factors have contributed to the industry's success?This growth has been driven by various factors, including technological advancements, globalization, and economies of scale. The rise of mobile telephony and the internet has been a significant driver of the telecom industry's growth. The evolution from 1G to 5G technology has enabled faster and more efficient communication, making it possible for people to stay connected and access information from anywhere in the world. International trade and commerce have driven demand for telecom services, enabling people to communicate and do business across borders. Changing consumer behavior has also been a driving force behind the telecom industry's growth. In this article, we will explore the key factors responsible for the growth of the telecommunication industry. By examining these factors, we can gain a deeper understanding of the complex landscape of the telecommunications industry.

Keywords: *Telecom, Growth,Spectrum and Telecom Tariff*

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I. Introduction

Telecommunication not only accelerates economic growth but also helps in achieving other social goals. It does so through a speedy transfer of information at the lowest possible cost and optimal utilization of resources. Roller and Waverman (1996) believed that there exists a mutual relationship between telecommunication infrastructure and economic growth. Furthermore, Banumathy and Kalaivani (2006) focused on studying the attitude of customers involved in communication services towards their cell phones. They opined that the relevance of communication is indispensable when it comes to promoting socio-economic, political as well as personal developments and increasing efficiency.Apart from directly contributing to the GDP, it boosts other sectors indirectly. The telecom industry has been considered as one of the important sectors for the development of a country by contributing towards growth, fast expansion and up-gradation of different sectors. In the past, it has been noticed that the Indian telecommunication sector has played a very vital role in the growth of the Indian economy. The rapid growth of telecommunication in the country has been creating opportunities for many stakeholders across various industries. The Indian telecommunication sector is one of the important and fastest-growing sectors of our country and has the lowest tariffs in the world.As per the report, titled "A Twenty-Year Odyssey 1997-2017" published by TRAI in the Year 2017, TRAI talked about the growth of the Indian telecom sector. Gopika (2014) highlighted the significance of telecom industry in a developing country, like India and itscontribution to the nation's GDP. The author talked about the evolution of the telecom sector in the Indian economy, sequentially proving how it went on to lead the bandwagon as the fastest growing sector with the most economical tariff.In recent years, the telecommunications industry has experienced explosive growth, transforming the way we communicate and connect with each other. From the early days of landline telephones to the widespread adoption of mobile devices and high-speed internet, the industry has undergone significant technological advancements and innovations. The healthy growth of the Indian telecommunication sector can be attributed to a mix of multiple factors such as the emergence of new growth opportunities, healthy investment, and development of advanced technology.It is generally argued that the growth of the Indian telecommunication has taken place because of the reduction in price which is an offshoot of the hyper-competition. However, it is pertinent to note that apart from the competition, there are

[1]The views in the article are personal and do not reflect the views of the Competition Commission of India.

various factors such as technological advancement, efficient utilization of spectrum, economies of scale, spectrum allocation method, pricing of spectrum, etc. which resulted in reduction in tariff of telecom service and turned into robust growth of the Indian Telecommunication Sector.

Alternatively, few people tried to give credit to the 'first come first serve' (FCFS, 2007) spectrum allocation method. As per their opinion, the growth of Indian telecommunication was the result of lower tariff rates because of cheaper spectrum allocation to service providers due to the FCFS method. But in reality, the decline in the average price of per minute outgoing started very early since 2000 and it reached to Rupees 1.15 in 2007 which is very less compared to an average tariff in 1999 (Rupees 16.93).

II. Factors Responsible for the growth of Indian Telecom Sector

Competition

In various research work and reports of the government of India, it has been argued that competition plays a very vital role in the growth of the telecommunication sector. Many authors have discussed the concept of competition with regard to telecom sector. They did not only explain the role of competition, but also discussed various methods to measure the degree of competition in telecommunication sector. Banumathy and Kalaivani (2006) stated that entry of private players has resulted in cut-throat competition amongst telecom service providers. The increasing competition forced innovation into the market, which motivated the mobile service providers to maintain the quality of their services at par with the increasing customers' demand, so that they could be able to adjust more users in their system. With the increase in private players entering the telecom market, the level of competition has increased fourfold.About the state of competition in the mobile cellular services market in India, Gupta (2012) analyzed the level of competition in the telecommunication sector in India. To measure the competition in the telecommunication industry, he used some standard measures of competition such as Herfindahl-Hirschman Index (HHI), concentration ratios along with market shares, revenues, and profit. He also looked at the degree of rivalry through changes in the market shares. He further discussed the effect of policymaking on competition and market development in India. Based on his analysis, he was of the view that there were many service providers in the telecommunication sector at that time. In some circles numbers of operators were up to twelve. Based on HHIs and four-firm concentration ratio, he argued there was good competition in all the circles at that time. About entry barriers, he also observed sufficient entry in the telecom industry.

Low Tariff Rates

According to TRAI (Telecom Sector in India: A Decadal Profile, 2012), the average mobile tariff on cellular prepaid in the world was $10.1 per month whereas the average mobile tariff in India was only $1.6 per month which was second-lowest after Bangladesh. Tariffs for telecommunication services were lowest in countries like Bangladesh, India, Switzerland, Pakistan, Sri Lanka, Nepal and Bhutan etc. Mobile tariffs were highest in Austria, Japan, Venezuela, Greece, Spain, Portugal, Australia, and France etc. The reasons for the lowest tariff in south Asia are intense competition, low purchasing power and strict regulatory environment. Hence, it is generally argued that the growth of the Indian telecommunication has taken place because of the reduction in price which is an offshoot of the hyper-competition. According to consultation paper No. 01/2012 of Telecom Regulatory Authority of India (TRAI), the average tariff per outgoing minute has been steadily falling. In 1999, the average tariff was Rupees 16.93 which reduced to only Rupees 0.51 in 2011. During 2007-2012, rates of telecommunication services have been continuously decliningbecause of healthy competition. ARPU of CDMA declined by 61.5 percent whereas ARPU of GSM declined by 68.1 percent. Some explained this decline because of tariff wars amongst service providers. An ITU report from 2013 found that telecom tariffs in India are of the lowest in the world, with subscribers paying less than users in the US, Australia, Pakistan and China. Rao (2007)[2] also noted that NTP 1999 provided a strategy to promote telecommunication services at an affordable rate and to encourage private players to invest. Highlighting the Economic Survey 2019-2020, an article dated 31st January 2020 published in the Economic Times[3] stated that the Indian telecommunication sector has been experiencing an intense competition which has led to rock bottom prices in the world and financial stress to the telecom service providers. In 2016, the price of per GB data price was Rs.200/- which has significantly reduced to Rs.7.7 per GP in 2019.

[2]Rao, C. S. (2007, Jan 20-26). Bridging the Telecom Divide. *Economic and Political Weekly*, 42(3), 209-211.

[3]Parbat, K. (2020, January 31). Economic Survey 2019-20: Intense competition led to stress in telecom industry. *The Economic Times*. https://economictimes.indiatimes.com/industry/telecom/telecom-news/economic-survey-2019-20-intense-competition-led-to-stress-in-telecom-industry/articleshow/73804693.cms?from=mdr

Efficient Spectrum Utilization Technology

As per the report[4] dated June 2015 on "GSMA - Mobile Spectrum: Data demand explained" by GSMA[5](Global System for Mobile Communications Association), the capacity of the existing network can be enhanced by installing more base stations and enhancing spectrum efficiency. The frequency spectrum is a non-exhaustible natural resource, but its quantity is limited. The population density of a well-developed area is very high which results in high demand for radiofrequency for communication. This problem was solved by the frequency reuse method. It splits the entire area into small cells. This helps to increase the capacity of the existing communication network. Splitting a cell is another commonly used method to increase the capacity of the telecommunication network. A cell is further divided into a few small cells by replacing a high and powerful antenna with few small height antennas.The said report also states that more mobile customer can also be served by offloading the mobile traffic on other networks such as Wi-Fi and fixed network. The technique of installing more base stations is used to improve the efficiency of the existing spectrum and to serve more customers. This technique is also known as network densification.

Improvement in Technology

In terms of the use of spectrum, there are three types of technology; Frequency division multiple access (FDMA), Time-division multiple access (TDMA) and Code division multiple access (CDMA). TDMA is a kind of analog technology and also one of the earliest multiple-access techniques. It divides the entire frequency spectrum (assigned to a cell) into several frequency bands which are known as channels. A separate channel is given to each mobile phone for communication at a time. TDMA divides the entire frequency spectrum into time slots. Only one mobile phone can use a one-time slot of channels at a time i.e., a channel can be shared by various mobile phones. CDMA is the latest among the above technology. It does not divide the entire spectrum according to frequency or time slot but it allows all users to share the entire frequency spectrum. Each mobile phone is given a unique sequence code to avoid interference. Mobile signals use the entire allotted frequency spectrum while conversation and receiver use the same unique sequence code to recover the sender's signals.

Technological advancement has given a new dimension to mobile telephony. The capacity of CDMA is much more as compared to FDMA and TDMA, so it has been used in 3G technology. McKenzie and Small (1997) stated that TDMA divides a channel into three time-slot channels and offered a threefold increase in network capacity whereas CDMA offers 10 times increase in network capacity. Lee (1991) and Gilhousen et al (1991) also found that CDMA provides higher capacity than other digital technologies such as TDMA and analog technologies.

In the past, telecom operators have used many technologies. The broad classification of these technologies is 1G, 2G, 3G and 4G. Soon, the government is going to launch 5G. Here, G refers to Generation and each generation uses different network standards. Progression of generation allows high speed and more data-carrying capacity.1G was the first network standard used in commercial cellular services in the world. It was introduced in the late seventies and extensively used in the eighties. First Generation (1G) was analog technology. The maximum speed of 1G was 2.4 Kbps. It had also several limitations such as poor voice quality, dropped calls, high battery consumption of mobile phones, *etc.* Hence, the same was replaced by the Second Generation (2G). This was the major shift in telecommunication technology which replaced analog technology with digital technology. This also strengthens the security of the conversation channel and improved reliability. It was commercially launched in 1991 in Finland. Before shifting to 3G, 2.5G (GPRS) and 2.75G (EDGE) came into existence which bridged the gap between 2G and 3G[6]. The full form of 2.75G EDGE is Enhanced Data Rates for GSM Evolution. The maximum data speed of 2.75 was 500 kbps. The motive of the development of

[4]GSMA Report on "GSMA - Mobile Spectrum: Data demand explained" June 2015

[5]The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with almost 400 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organizations in adjacent industry sectors. (https://www.gsma.com/aboutus/)

[6]Comparison among 1G, 2G, 3G, 4G and 5G.
http://net-informations.com/q/diff/generations.html

2.75G-EDGE was to overcome the limitations of GPRS.[7] Thereafter, the much-awaited 3G was launched with a large range of services such as mobile television, high-speed internet, audio and video call, *etc*. In India, MTNL was the first service provider which launched 3G technology followed by BSNL. Similar to 2.5G and 2.75G, 3.5G - HSDPA (High-Speed Downlink Packet Access) and 3.75G – HSUPA (High-Speed Uplink Packet Access) were introduced before the launch of 4G technology and were intermediary technologies between 3G and 4G.[8] Majorly there are two type of 4G technology: Worldwide Interoperability for Microwave Access (WiMAX) and Long-Term Evolution (LTE). WiMAX is based on wireless digital communication system. 4G LTE uses GSM/EDGE and UMTS/HSPA network technology. In this series, 5G is a new upcoming technology that is going to be launched in future in India.

As per the news article[9] titled "Know the A-Z of LTE/4G technology" by Kailash Gupta in The Economics Times on 6th December 2016, the surfing speed of 2G is around 14.4 kbps to 474 kbps. However, the 3G is more powerful than 2G and its surfing speed is 2 Mbps to 14.4 Mbps. On the other hand, 4G network are also Known as LTE network and it stands for "Long Term Evolution". 4G has evolved over the period from 2G (GSM) → 2.5G (GPRS) →2.75G (EDGE) →3G (WCDMA) → 4G (LTE) and finally → 4G (LTE Advance). 4G uses Orthogonal Frequency Division Multiplexing Access (OFDMA) whereas 2G and 3G use TDMA. In 4G technology, the bandwidth is split into small carriers which carry the data over the air interface. Besides technology, the amount of data carried depends upon the size bandwidth. Higher the bandwidth, higher data is transferred.

Spectral efficiency of technology refers to the capacity to carry data/information given fixed bandwidth and it measures the efficiency of technology. Higher the spectral efficiency, efficient is the technology. As per the Techplayon website[10], spectral efficiency refers to bits per second per hertz. A bit is a unit to measure the data information which is transferred using spectrum through a specific technology. To calculate spectral efficiency, net data/information (measured in bits per second) transferred through bandwidth per second is divided with bandwidth in hertz. Spectral efficiencies of the major technologies are listed in the Table below:

Table-6.2 Spectral efficiencies of the major technologies

Sr. No.	Network Technology	Spectral Efficiency (Bit/S/Hz)
1	**1G**	0.0015[11]
2	**2G-GSM**	0.16[12]
3	**2.5G- GPRS**	Could not find
4	**2.75G- EDGE**	0.33[13]
5	**3G-**	Could not find
6	**3.5G- HSDPA**	0.48[14]
7	**3.75- HSUPA**	0.8[15]
8	**4G- WiMAX**	2.41[16]
9	**4G- LTE**	16.32[17]

[7]Bhandari, N., Devra, S., & Singh, *K. (2017, Sep – Oct).* Evolution of Cellular Network: From 1G to 5G. *International Journal of Engineering and Techniques*, 3(5)

[8]Comparison among 1G, 2G, 3G, 4G and 5G.
http://net-informations.com/q/diff/generations.html

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https://telecom.economictimes.indiatimes.com/tele-talk/know-the-a-z-of-lte-4g technology/1974 accessed on 30.09.2020

[10]Techplayon (2018, July 18). *Spectral Efficiency: 5G-NR and 4G-LTE.*http://www.techplayon.com/spectral-efficiency-5g-nr-and-4g-lte/#:~:text=Spectral%20efficiency%20usually%20is%20expressed,usable%20payload%20and%20all%20overhead accessed on 12.09.2020

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[12] Report on "The Benefits of Technology Neutral Spectrum Licences" published by GSMA

[13]Furuskar, A., Naslund, J., & Olofsson, H. (1999, July). Edge—Enhanced data rates for GSM and TDMA/136 evolution. *Ericsson Review no. 1, IEEE Personal Communications*.

[14]Report for Ofcom (2011, January 27). *4G Capacity Gains Final Report – Appendices.*

[15]GSMA (2019, June). *The Benefits of Technology Neutral Spectrum Licences*

[16]Report for Ofcom (2011, January 27). *4G Capacity Gains Final Report – Appendices.*

10	**5G**	30[18]

Source: Table is prepared by the researcher using multiple sources

The above table shows the spectral efficiency of the major technology listed in the above table. However, the spectral efficiency of 2.5 GPRA and 3G could not be found. The spectral efficiency of 1G was 0.0015 bit/s/hz which is around 1/20000 of the spectral efficiency of 5G technology. Considering the limited availability of spectrum and exponential rise in demand for telecommunication services, improvement in technology was the demand of time and the same was achieved by the development of new technology in form of 1G, 2G, 3G, 4G and 5G. The transformation from 1G to 2G-GSM allowed the improvement in spectral efficiency more than 100 times. Similarly, 3G,3.5G and 3.75 further upgraded the efficiency of spectrum use and allowed to serve more and more telecom subscribers. 4G and 5G has completely changed the landscape of telecommunication service in terms of efficient use of spectrum. The capacity of carrying data of 5G technology is around 20000 times of 1G technology. In view of this discussion, it is observed that these technological advancements allowed the telecom service providers to use spectrum more efficiently which enable the service providers to meet the rising demand for telecom services. Without such technological advancement, it would not have possible to serve such robust growth of the telecom sector. Hence, Technology helped to expand the subscriber base in relation to mobile telephony and internet users.

Economies of Scale

Economies of scale refer to a reduction in long-run average cost as output increases. The main source of the economics of scale is the expansion of product mix and cost complementarities output. Economies of scale in the expansion of product mix is only possible if we have excess capacities. Firms can reduce per-unit fixed cost by utilizing excess capacity. The same is confirmed by the theory of the firm, Clark (1923) and Hicks (1935). Bailey and Friedaender (1982) stated if a firm's intangible and skill are transferable among different output then it helps to achieve economies of scale (known as cost complementarities output). Expansion of the product mix concept can be linked to the present telecommunication sector. Earlier telecommunication service providers were only offering voice services but now they are offering multiple services such as voice, short message service (SMS), media, finance, game, education and healthcare etc. services (through the internet). Therefore, the expansion of the product mix helps to achieve economies of scale. Kwon (2012) stated that the real fixed cost of the telecommunication sector had been stable in Korea whereas data usage (internet) services have gone up rapidly in the past. He gave two reasons for that one is the existence of underutilized capacity and equipment and second is fall in prices of telecommunication equipment. Nam et al (2009) found in their study that economies of scale exist only for big firms. Two big service providers in Korean cellular industries enjoy economies of scale whereas small firms do not. They reached at this conclusion by looking at a long-run average cost which was downward sloping.

It has been observed that in the Indian telecommunication sector also, the initial fixed cost or sunk cost is very high whereas the marginal cost of providing services to the additional customers is either very low or negligible. In such a situation, as the size of firms increase and efficiency increases. With the rise in output, the average cost falls because of low or negligible marginal cost and distribution of fixed cost over large subscribers. Advancement of technology has played a big role to attain economies of scale where a service provider is able to achieve low average cost. In this regard, it pertinent to note that the availability of the spectrum is limited and it was impossible to cater to a dense area without technological advancement and the invention of new technology. In such a scenario, all the service provider would try to expand their customer base to reduce their average cost which may help them to increase their profit. Considering that the spectrum is a limited resource that has limited capacity, these service providers would not be able to add more customers unless there is continuous up-gradation of the capacity of the spectrum *i.e.,* enhancement of spectral efficiency. As discussed above, efficient spectrum utilization techniques and technological advancement enabled the service provider to add more customer by enhancing spectral efficiency and reduce their average cost. Without such technological advancement, it would have not been possible for the telecom service providers to achieve economies of scale and lower average cost which in turn resulted in the low tariff.

[17]Tayade, P. P., &Rohokale, V. M. (2015, January 8-10). Enhancement of spectral efficiency, coverage and channel capacity for wireless communication towards 5G. *2015 International Conference on Pervasive Computing (ICPC), Institute of Electrical and Electronics Engineers.*

[18]CTIA: 5G Will Provide Big Spectral Efficiency Gains. https://www.telecompetitor.com/ctia-5g-will-provide-big-spectral-efficiency-gains/#:~:text=5G%20networks%20will%20provide%20major,%2DAdvanced%20technology%2C%20CTIA%20said accessed on 15.11.2020

Healthy Foreign Direct Investment (FDI)

National Telecom Policy 1994 helped in attracting foreign direct investment (FDI) and private domestic players. In 2005, FDI limit was increased from 49 percent to 74 percent to attract more investments for the telecommunication sector. Recently, the cap on FDI has been removed which was earlier 74 per cent. Now, it is 100 per cent. This has resulted in a significant FDI inflow into the telecommunication industries in the last quarter of the financial year 2019-20 and the total FDI inflow was US$ 37.11 billion. Singh and Sahu (2008) highlighted the role of FDI in the growth and development of telecom sector. The outcome of their analysis showed that more the availability of the infrastructure is, more will be the likelihood of the adoption and use of ICT. The availability of infrastructure predicts the likelihood of the adoption of ICT and the extent of the use of ICT, thereby playing an important role in bridging the digital divide and growth of telecom sector.

III. Conclusion

The telecom sector in India has experienced tremendous growth over the past few decades, driven by a range of factors that have transformed the industry. The widespread adoption of mobile phones, the growth of the internet, and the increasing demand for data services have all contributed to the expansion of the industry. Additionally, regulatory support, investments in infrastructure, and innovation in applications and services have enabled the industry to flourish. The growth of the telecom sector in India has had a profound impact on the country, transforming the way people communicate, access information, and conduct business. The sector has enabled greater connectivity, improved access to information and services, and has contributed to the country's economic growth and development.Looking ahead, the telecom sector in India is poised for further growth, with the development of innovative technologies, such as 5G, and the increasing demand for data services, creating new opportunities for the industry. Regulatory support and investments in infrastructure will continue to play a critical role in the growth of the industry, as will innovation in applications and services.Overall, the growth of the telecom sector in India has been a remarkable success story, driven by a range of factors that have transformed the industry and enabled it to become a key driver of economic growth and development. As the industry continues to evolve and expand, it will undoubtedly continue to play a critical role in shaping the future of the country.

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