International Journal of Arts & Education Research

IMPACT OF BROADBAND PENETRATION ON RURAL ECONOMIC GROWTH

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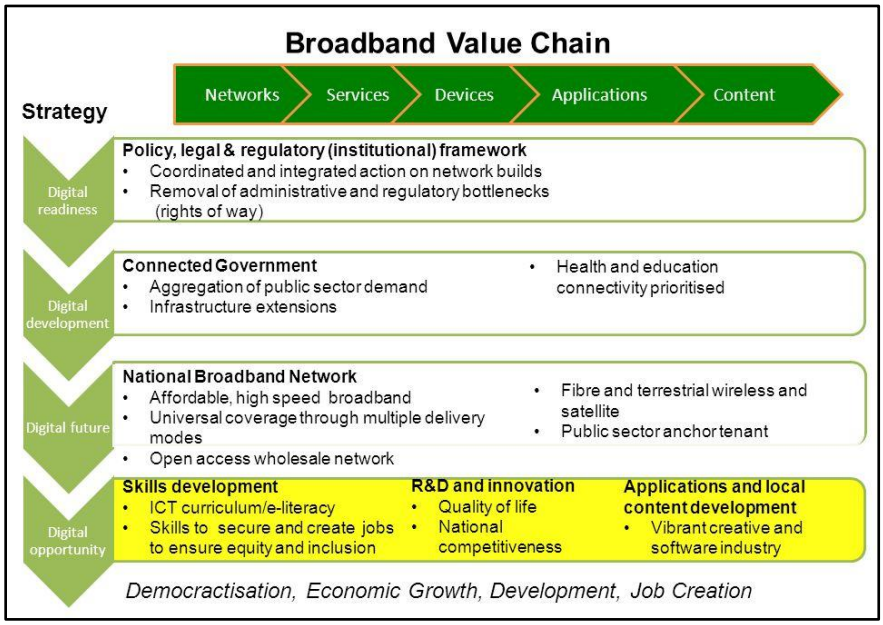
ABSTRACT:
Broadband can be characterized as high-speed, always-on Internet Connectivity. It began to appear in some high-income countries in the late 1990s, using the Copper wire in ordinary telephone connections (i.e., digital subscriber line (DSL)) or the coaxial cable in cable television networks (i.e., cable modem). In 2001, the first high-speed mobile networks were launched. Today commercialized fixed broadband networks reach download speeds of 1,000 Mb/s over fiber optic1and mobile broadband 300 Mb/s over fourth generation (4G) Long Term Evolution (LTE)networks.2 By the end of 2012, there were some 748 million fixed broadband subscriptions and2.7 billion mobile broadband subscriptions around the world.3This relatively recent emergence of broadband has already stimulated much discussion of it being a powerful general-purpose technology.4 Broadband has driven widespread changes in the Information Technology (IT) sector enabling services such as cloud computing and mobile apps. Equally, it is influencing innovation across many other sectors including agriculture health, transport and government. The impact of broadband Internet on the economy is therefore a subject of growing interest. Economists have often modeled economic growth where output is a function of capital, labor and technology (Barro and Sali-i-Martin 2004).

INTRODUCTION:

Econometric models use proxies to represent these variables such as investment for capital and employment for labor. In order to gauge the impact of broadband, it is used as the technology variable. The econometric models can be divided into three categories: cross sectional, panel and time series. The cross sectional studies are typically used to gauge the impact across a group of countries. Panel studies are used in observing the changes happening over time across a group of countries. Time series models have typically been used to investigate the impact in a single country.

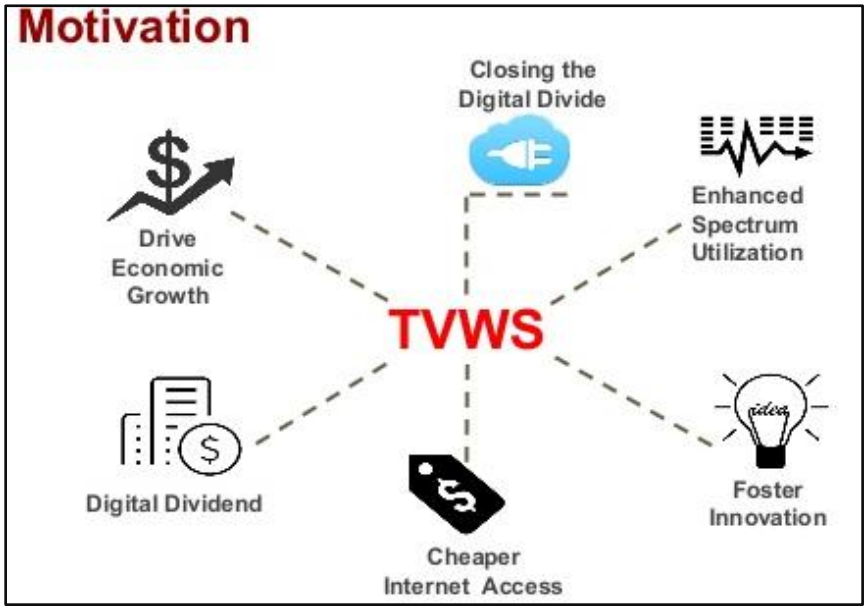
It should be noted that the economic impact of different Information and Communication Technologies (ICTs) have been studied for some time and these models have shaped the emerging framework for analyzing the effect of broadband (Roller and Waverman 2001).

This paper first looks at different studies on the economic impact of broadband illustrating the range of models and data that have been used. It then examines some of the issues that complicate the task of gauging how broadband impacts the economy. The paper concludes with a summary of the key results and suggestions for moving forward.



Among the technological advances of the last 50 years, the expansion and technological improvements of telecommunications infrastructure have been some of the most crucial. While the deployment of wire-line telecommunications networks allowed large parts of the world's population, especially in developed countries, to communicate via fixed-line telephony, the introduction of first and second-generation wireless telecommunications networks since the 1980's set another landmark for personal communications. However, the progress in information and communications technologies (ICT) was not limited to voice telephony only. Broadband internet technologies such as Digital Subscriber Line (DSL) or Cable Internet have created unprecedented opportunities for worldwide data transmission. In the last years, the deployment of so-called next-generation broadband networks has facilitated much faster up-and download speeds as fiber-based wire-line broadband access technologies like FTTH (Fiber-to-the-Home), Fiber-to-the-Building (FTTB) or hybrid Fiber-to-the-Cabinet (FTTC) and Fiber-to-the-Node (FTTN) technologies have started to replace the slower entirely copper- or coax-based first-generation wire line technologies. The introduction of the fourth generation (4G) mobile broadband technology Long Term Evolution (LTE) in 2010brought substantial speed improvement for the wireless telecommunications networks. Besides the benefits that these technologies have on the social lives of their consumers, their possible economic benefits have been increasingly emphasized by economic research. In particular, early estimations by Crandall and Jackson (2001) suggest that broadband technologies can create substantial amounts of consumer surplus. Furthermore, broadband internet is expected to generate new employment an opportunity particularly in remote areas enables a large amount of workers to work from home (so-called telecommuting) and thus reduces the importance of distances. Due to these advantages, broadband technologies have also gained the attention of policymakers in recent times. In 2010, the Federal Communications Commission (FCC) released the National Broadband Plan whose aims include that 'every American should have affordable access to robust broadband service' and 'at least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second' until 2020 (FCC 2010a, pp. 9-10).Similarly, the European Commission launched the Digital Agenda for Europe (DAE) that 'seeks to ensure that, by 2020, (i) all Europeans will have access to much higher internetspeeds of above 30 Mbit/s and (ii) 50% or more of European households will subscribe to internet connections above 100 Mbit/s' (European Commission 2010, pp. 19). While achieving these goals promise considerable economic returns,

they also go along with substantial costs, in particular for the construction of the necessary new communications infrastructure which is partly or entirely fiber-based. It is hence a necessity to carefully evaluate whether these returns will exceed the accompanying costs or whether the expansion of new (high-speed) broadband networks will go along with economic losses. The central purpose of this survey is to provide a structured overview of the relevant empirical literature focusing on the impacts of telecommunications and broadband infrastructure and services on important economic indicators thereby focusing on productivity, growth, employment and regional development. In order to obtain appropriate guidelines for future public policies, we will only review quantitative research that attempts to identify causal links between telecommunications/broadband infrastructure (availability or coverage on the supply-side) or services (usage or adoption/penetration on the demand-side)and key economic variables.



THE ECONOMIC IMPACTS OF TELECOMMUNICATIONS NETWORKS

In this section, we focus on the economic impacts of telecommunications networks. Section2.1 reviews studies focusing on the impact of telecommunications networks on economic growth and Section 2.2 reviews studies that examine the Economic impacts of telecommunications networks Subsequently, Section 2.3will feature interim conclusions.

ECONOMIC GROWTH

Cronin et al. (1991) test the causal direction of the relationship between telecommunications investment and economic growth by using data for the U.S. from 1958 to 1988. For this purpose, Granger causality, Sims and Modified Sims tests with second-order lag structure are performed on the first differences of the variables for telecommunications investment, gross national product (GNP) and total output. The authors find significant evidence for bidirectional causal relationships between telecommunications investment and GNP as well as total output. Madden and Savage (1998) analyzes the relationship between telecommunications investment and economic growth in Central and Eastern Europe using data for 27 countries from 1990 to1995. The authors estimate static cross-country growth equations at the aggregate and the sectoral level by ordinary least squares regressions (OLS). The results show that a higher share of telecommunications investment in GDP significantly increases real GDP growth percapita. For a subset of 8

countries, real telecommunications investment, as measured by the growth rate of mainlines per 100 in habitants is associated with a significant positive increase in GDP growth per capita in the industrial sector. Moreover, Granger-causality tests provide evidence of mutual precedence between real economic growth and telecommunications investment at the aggregate level. Madden and Savage (2000) investigates the effects of telecommunications investment on GDP growth using data for 43 countries from 1975 to 1990. Telecommunications investment is measured by the share of telecommunications investment in GDP and the number of mainlines per working age population. The authors employ ordinary least squares and instrumental variable regressions to estimate a dynamic augmented supply-side growth model based on Mankiw et al. (1992). The results show a significant positive impact of telecommunications investment on the growth of GDP per capita for both telecommunications measures. Dutta (2001) analyzes the causal links between telecommunications infrastructure and economic growth with data for 15 developing and 15 industrialized countries from 1960 to1993. For this purpose, Granger causality tests are applied in which telecommunications usage is quantified through the number of telephones (total and per 100 inhabitants).

Using both the original variables and their logarithmic transformations, the authors observe that telecommunications infrastructure Granger-causes economic growth in over half of the examined developing countries. Similar results are obtained for industrialized countries even-though Granger-causality is found in slightly less countries. In contrast, significantly fewer countries show signs of a causal impact of economic growth on telecommunications. Based on these findings, the authors conclude that a unidirectional causal effect of telecommunications on economic growth is more probable than a bidirectional relationship between the two variables.

ECONOMIC IMPACTS OF TELECOMMUNICATIONS NETWORKS

In contrast to wire line telecommunications, mobile telecommunications networks are found to significantly enhance economic growth in developed but even more so in less developed countries. Lee et al. (2012) further demonstrate that the impact of mobile telecommunications is stronger in developing countries with less developed wire line telecommunications infrastructure. Based on these findings, developing countries should put their focus on the further deployment of mobile telecommunications if they want to stimulate economic growth effectively. All of the studies focusing on both wire line and wireless telecommunications find at least partially significant positive impacts on productivity, firm performance or market performance. On the sectoral level, Cronin et al. (1993) and Greenstein and Spiller (1995) provide evidence that the benefits of wire line telecommunications are particularly concentrated in service sectors which generally require higher skilled workers. In contrast, studies by Jensen (2007) and Aker (2010) suggest that mobile telecommunications can help agricultural markets in developing countries to be more efficient and increase social welfare. In sum, the reviewed studies provide strong evidence that telecommunications networks (fixed-line and mobile) exert positive effects on economic growth as well as national and sectoral productivity (RQ 1). Regarding research question 2 (RQ 2), we find that mobile telecommunications networks have a stronger positive impact on developing countries while wire line telecommunications networks rather benefit developed countries. Furthermore, we observe no distinguished difference between the availability (infrastructure investment) and the adoption of both wire line and wireless telecommunications networks (RQ 3). Almost all microeconomic studies regarding the effects of wire line and wireless telecommunication networks on growth and productivity find positive effects in line with the macro-economic country-level studies (RQ 4).

RELEVANT TELECOMMUNICATIONS NETWORKS AND TECHNOLOGIES

With regard to the distinction between wire line and wireless networks, we follow the International Telecommunication Union (ITU) which defines fixed telephone lines as 'active line[s] connecting the subscriber's terminal equipment to the public switched telephone networks [PSTN] and which has a dedicated port in the telephone exchange equipment' (ITU2010, pp. 1) and accordingly includes 'analog fixed telephone lines, Integrated Services Digital Network (ISDN) channels, fixed wireless, public payphones and VoIP [Voice over Internet Protocol] subscriptions' (ITU 2010, pp. 1). Given that active lines had to be utilized within three months prior to the ITU data collection, studies that employ the number of mainlines will be defined as examining telecommunications adoption (actual usage) and not merely telecommunications availability (the existence of infrastructure).Mobile phone subscriptions refer to 'the subscriptions to a public mobile telephone service and provides access to Public Switched Telephone Network using cellular technology, including number of pre-paid Subscriber Identity Module (SIM) cards actively during the past three months. This includes both analogue and digital cellular systems (IMT-2000 Third Generation, 3G and 4G subscriptions), but excludes mobile broadband subscriptions via data cards or USB [Universal Serial Bus] modems' (ITU 2010, pp. 3).Our definition of fixed broadband will include both fixed wired technologies (such as cable modem, xDSL and FTTH/B/C/N technologies) as well as fixed wireless hybrid technologies such as Wi-Fi (WLAN). It should be noted at this point that most of the reviewed studies employ very broad definitions of fixed broadband with regard to broadband speed. While the lowest speed threshold in a study is set at 128 Kbit/s, a majority of the research that analyzes the effects of broadband availability in the US employs data from the FCC which, until 2010, defined broadband as an internet connection with either up- or downstream speeds of at least200 Kbit/s (see FCC 2010b). Similarly, most cross-country studies as well as several other publications make use of OECD (2012) and ITU (2010) standards which associate broadband with download speeds of at least 256 Kbit/s. Studies utilizing German data, on the other hand, apply slightly higher thresholds at 384 or 768 Kbit/s. Finally, mobile broadband will, in line with ITU (2010), be comprised of both satellite and terrestrial mobile wireless subscriptions that achieve download speeds of 256 Kbit/s or more. Accordingly, mobile broadband includes, in particular, Universal Mobile Telecommunications System (UMTS) 3G, 4G, Worldwide Interoperability for Microwave Access (WiMAX) and Long Term Evolution (LTE) technologies.

CONCLUSION:

Broadband is driving the development in Rural and have impact on the Economic Growth through innovations and e-agriculture, e-governance, e-health etc. In-fact broadband is supplementing the physical infrastructure in today's world in general and rural development in particular.

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