DIGITISATION

Cost-benefit analysis of digitisation interventions in Andhra Pradesh

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ANDHRA PRADESH PRIORITIES
AN INDIA CONSENSUS PRIORITIZATION PROJECT

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Part 1

Benefits of Installing Optic Fibre Network on the GDP of Andhra Pradesh

Andhra Pradesh Priorities
An India Consensus Prioritization Project

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Academic Abstract[1]

National Optical Fibre Network (NOFN), an ambitious initiative to trigger broadband revolution in rural India, is creating a robust middle network infrastructure layer to connect gram panchayats of the country through broadband connectivity. This program has been under the scanner due to delay in timeline and the quality of its services. Various telecom analyst and social scientists have criticized the program and suggested their recommendations to improve the program. This paper calculates the major cost and benefits of connecting rural households to NOFN. We find that though there is a considerable cost of connecting the remaining gram panchayats and households, the benefits are significantly higher. We find a positive benefit cost ratio of 7 at 5 percent discount rate for this intervention.

[1] The author would like to thank Brad Wong and Amit Sharma for their comments, valuable inputs and constant support which helped in completing the paper to a great extent.

Policy Abstract

Overview

High-speed broadband is transforming the lives of millions. Developed and developing countries have recognized the potential of broadband and investing in building broadband infrastructure as part of their national agenda. 'Access to broadband' has become critical, making the development of its infrastructure a priority for the Government and the industry. In September 2010, the broadband penetration in the country was 0.8% against a teledensity of 60.99. The target set for the year 2010 was 20 million, however, the number of broadband connections was only 10.3 million. India is one of the largest telecommunications market in the world with over 1 billion subscribers and 80% mobile penetration as on March 2016. However, only 1.4% Indians had a fixed broadband connection[2]. Therefore, the study recommends establishment of a National Broadband Network connecting all habitations with population of 500 and above in Andhra Pradesh. To achieve this, the Indian Government took a commendable step in 2011 by commissioning the National Fibre Optic Network (NOFN) with an investment of INR 21,000 crore to connect 2,50,000 gram panchayats with a speed of 100 Mbps.

In 2015, NOFN was restructured as a BharatNet under flagship program, 'Digital India' aiming to connect all gram panchayats and villages and the existing institutions (like government offices, public health centres, schools, banks, etc) through broadband. Implemented in two phases, the point of presence (PoP) with optical connectivity will be established at all gram panchayats by 2019. Further, it is expected that individual housholds will be connected by giving licence to private enterprises to connect the last mile and on-sell bandwith. NOFN was established to enable key services like e-governance, education, health, banking and agriculture in rural regions of the country. With the central government being directly engaged in the implementation of the program, the states had minimal role in executing the project. The Union Cabinet has approved the project at a total estimated cost of Rs. 42068

[2] https://telecom.economictimes.indiatimes.com/news/india-had-16-8-mobile-broadband-penetration-broadband-commission/60516269; accessed on 25th May 2018

crore which includes 11,148 crore for Phase I and 30,920 crore for Phase II[3]. The expenditure for NOFN for the duration 2014 to January 2017 is Rs. 8384 crore. [4]

The Universal Service Obligation Fund (USOF), under the Ministry of Communications, is providing the funding for the implementation of the project[5]. As per Telecom Regulatory Authority of India (TRAI), in June 2017, the number of broadband connections in India has risen to a whopping 300 million, a 200 percent increase in a short span of five years, albeit from a small base.

Broadband holds the potential to have a significant impact on economic and social progress and to transform the economy. There are several studies that demonstrate a robust connection between GDP growth and broadband with effects ranging from 0.9 to 1.4 pp for a 10% increase in penetration (Czernich et al. 2011, Koutroumpis 2018, OECD 2012, KPMG & CII, 2013). The use of broadband at household level is likely to have economic impacts, either by allowing workers to work from home or establishing the home-based firms. Other potential indirect benefits include the provision of using broadband connectivity by other sectors such as online education, tele-health services and opening new emerging markets that ride on broadband connectivity.

Kelly (2012) argues that the impact of broadband on the national economy is only possible when the supply of broadband infrastructure is available and functioning adequately. However, the demand of broadband is an important factor to make substantial network investments worthwhile. This multiplier effect of broadband can boost GDP, productivity and employment growth, provided there is absorptive capacity, to learn and incorporate broadband capabilities into other sectors to realize such benefits.

[3] BBNL Annual Report 2016-2017; http://www.bbnl.nic.in//admnis/admin/showimg.aspx?ID=1025; accessed on 14.5.2018

[4] PIB Press Release http://pib.nic.in/PressReleaseIframePage.aspx?PRID=1506002; accessed on 14.5.2018

[5] Agreement For Support from USO Fund For Creation, Operation and Maintenance of the National Optical Fibre Network (NOFN) for Provision of Broadband Connectivity to the Panchayats to be executed by Bharat Broadband Network Limited (BBNL) Under Universal Services Obligation Fund, The Indian Telegraph (Amendment) Rules, 2012' http://www.usof.gov.in/usof-cms/GagendaPdf/NOFN_Agreement.pdf accessed on 14.5.2018

Intervention: Connecting the last section of the unconnected households through NOFN

Currently, 601 GPs in Andhra Pradesh are connected to NOFN via 1544 kms of optic fibre. 12317 GPs remain to be connected.

We analyse the cost and benefit of connecting the remaining GPs through NOFN and the households that take up connections thereafter. Estimates in this paper suggest broadband would reach 17% of rural households by 2035, and 33% by 2067. Benefits are measured through increased GSDP enabled by increasing broadband penetration.

Implementation Considerations

Over the years, many telecom analysts and social scientists have criticized NOFN as an initiative. Issues like extending the launch of NOFN project from 2012 to 2014; inability to lay the optic fibre within timeline by service providers, non-availability of G2C services and sustainable framework are some issues that have been continuously raised.

Costs and Benefits

Costs

There are four categories of cost associated with this intervention 1) cost of connecting the remaining GPs and ongoing maintenance; 2) cost to connect remaining households and ongoing maintenance; 3) upgrading the data centre cost to connect institutions (such as public health centre (PHC), schools, government agencies, etc) and 4) costs of accessing broadband services.

Data from published reports suggests that it costs Rs. 29 lakh to connect one GP to NOFN, while the cost of connecting one household is about Rs. 3,200. Maintenance costs for the network are Rs. 1.5 lakh per GP, and Rs. 163 per HH. Upgrading data centers requires a cost of Rs. 27 lakh per year, while costs of accessing broadband are Rs. 300 per HH. Total undiscounted costs until 2067 is Rs. 29,212 crores, presented below. The cost at a 5% discount rate is Rs. 10179 crores.

Costs of connecting NOFN to households until 2067 (figures in 2016, Rs. Crore)

Cost of connecting remaining GPs	3,586
Cost of connecting HHs	896
Operations cost for NOFN including data center upgrades	21,042
Operations cost for HH connections	1,298
Costs of accessing broadband	2,391
Total (undiscounted)	**29,212**

Benefits

Using the relationship from Koutroumpis (2018) we estimate the annual boosts to GSDP arising from the pathway of fixed broadband growth across the entire state attributable to the NOFN. After three years the boost to GSDP is small, measured at only 0.02%. By 2035 the boost is 0.1%, by 2050 the boost is 0.2%, and by 2067 it is 0.3%. Note that these GDP jumps *accumulate and compound*, such that small boosts to GDP have significant benefits over a 50-year period. The incremental boost to GSDP is Rs. 112 crore by 2020, Rs. 2708 crore by 2035 and Rs. 23,925 crore by 2067. In GDSP per capita terms, the corresponding values are Rs. 20, 453 and 4329. Total benefits until 2067 equal 69,707 crores at a 5% discount rate. The benefit-cost ratio (BCR) of the intervention is 7

Summary BCR Table

Intervention	Benefit (in Rs crore)	Cost (in Rs. crore)	BCR	Quality of evidence
Providing the NOFN connectivity from gram panchayat (GP) to household (HH) level using wired infrastructure	69,707	10,179	7	Medium

Source: Author's Calculation; all figures at 5% discount rate

1. Introduction

Internet continues to influence every aspect of life from education, health care to businesses. Economic activities, both at domestic and international level, are increasingly dependent on internet for their efficient and effective functioning. The rapid deployment of broadband infrastructure and internet around the world is not only giving opportunities to local businesses to go international but also creating new opportunities. It is also changing the nature of method to deliver content and service through conventional and non-conventional channels (Wolf, 2000). The roll out of high-speed broadband Internet services brings changes in the nature and shape of innovations in the digital domain (Rao, 2001). Due to its ability to connect global markets, the Internet is changing fundamental nature of global business by connecting people and local businesses overcoming geographical barriers (Sprano, 2000). Apart from its economic benefits, broadband infrastructure also enables citizens to participate in the governance system by improving access to information resulting in a more accountable, transparent and efficient public service delivery system.

The impact of broadband internet on the economy is substantial. Developed countries or high-income economies with an average of 10 broadband subscribers per 100 people would have enjoyed a 1.21 percentage point increase in per capita GDP growth. Similarly, developing countries have enjoyed 1.38 percentage point increase in their GDP for each 10 percent increase in broadband penetration (Qiang, 2009).

Amongst various broadband services, the Government of India initiated several initiates such as National Broadband Network, National Optical Fibre Network, National Knowledge Network, and Digital India to promote demand for broadband access and to provide last mile Internet services in rural areas of the country. Small enterprises and SMBs (small and medium businesses) have begun to realise the long-term benefits of mobility and digitization. An increase in 1 percentage point in broadband penetration growth results in 0.028 percentage points increase in the employment rate (International Telecommunication Union, 2012). In the last 10 years, telecommunications sector as percentage of India's GDP has steadily

increased from ~ 1.2 % in 2002 to ~ 6.9% in 2012-2013, which clearly indicates that telecom sector has significantly contributed in the Indian economy[6].

National Optical Fibre Network (NOFN), initiated by the Government of India is one of the largest schemes aiming to provide broadband connectivity in 250,000 *gram panchayats* (GPs) of the country[7]. Thoughmapproved in 2011, the project was actually rolled out in the latter half of 2014. The project is executed by Bharat Broadband Network Limited (BBNL) a telecom infrastructure provider set up by government of India. The progress in the scheme has not been slow in Andhra Pradesh connecting just 601 GPs out of 12918 GPs in the state[8].

This paper attempts to calculate the costs and benefits derived from; i. connecting the unconnected GPs through NOFN and ii. Conneting rural households to Broadband using the NOFN infrastructure. The present value of total cost of the intervention for 50 years is estimated at Rs. 10179 crores at 5% discount rate.

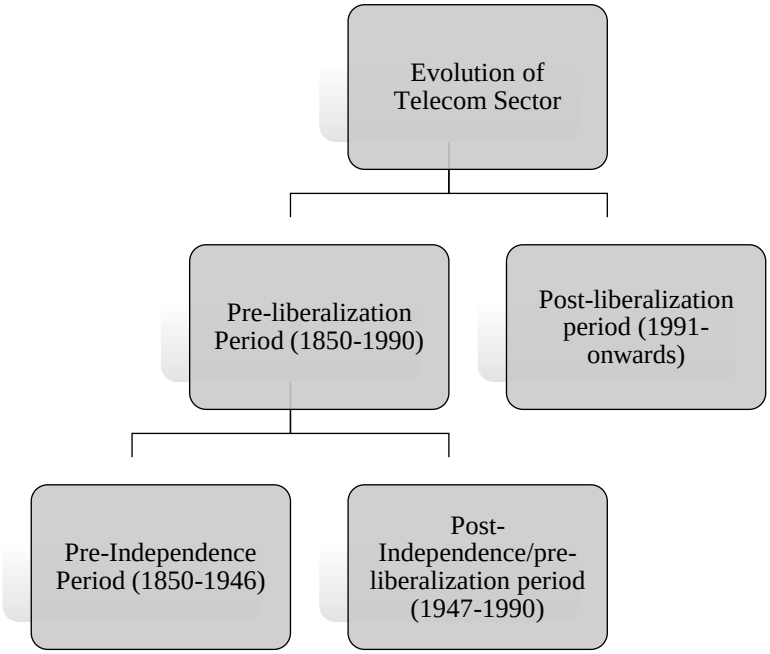
The paper has adopted the approach of providing NOFN connectivity from gram panchayat (GP) to household (HH) level using wired infrastructure. Calculating the benefits for 50 years, the present value of total benefits is around Rs. 69700 crores at a 5% discount rate, leading to cost-benefit ratio of 7.

2. Evolution of telecommunications in India

The evolution of telecom sector can be categorized as pre-liberisation period and post-liberisation period (Fig 1).

[6] Emerging Global Economic Situation, January 2014. See: http://finmin.nic.in/workingpaper/EmergGlobalEcoServiceSector.pdf
[7] Gram Panchayat (also known as village council): https://en.wikipedia.org/wiki/Gram_panchayat
[8] BBNL website; http://www.bbnl.nic.in/index1.aspx?lsid=577&lev=2&lid=471&langid=2 accessed on 14.5.2018

Fig 1: Evolution of telecom sector in India



Until the mid-1980's, the telecommunication sector in India was functioning as a government department. Mahanagar Telephone Nigam Limited (MTNL) was established in 1986 to provide telephone and telex services under a non-exclusive license in the two largest metropolitan cities of Delhi and Mumbai. In the same year, Videsh Sanchar Nigam Limited (VSNL) to provide the international long distance (ILD) services (Jain, 2002). The Telecom Commission was established in 1989 as an executive body under the Ministry of Communications with administrative and financial powers of the Government of India to deal with various aspects of telecommunications and to implement government policy in concerning telecommunications matters.

In October 2000, Department of Telecommunication Services (DTS) was corporatized and new entity was formed to provide the telecommunication services in the entire country, except Delhi and Mumbai. The first telecom policy came into existence in 1994 to liberalise the telecom sector by opening up of the telecom sector in basic services as well as value added services such as cellular mobile telephone services (CMTS), radio paging, and VSAT services. It also allowed participation of private companies in the telecom sector except national long distance (NLD) and international long distance (ILD) services.

During 1997-2000, two major agencies came into existence - Telecom Regulatory Authority Act was passed by the parliament and TRAI became an independent regulatory authority for the telecom sector in 1997 and the government created Telecom Disputes Settlement and Appellate Tribunal (TDSAT) in January 2000 with adjudication and dispute settlement power.

National Telecom Policy (NTP) – 1999, which opened the market for private players in all segments. The policy clearly recognized the need for strengthening the regulatory regime and restructuring the departmental telecom services into the public sector corporation so as to separate the licensing and policy functions from the government. After 2000, the Indian telecom sector has seen major significant policy reforms. The regulatory reforms in the telecom sector from 2000-2011 can be broadly classified into the following three phases:

- Phase 1 – 2000–2003: Telecom sectors were opened up to competition.
- Phase 2 – 2004–2007: Regulator encouraged competition and also set the stage for future growth.
- Phase 3 – 2008–2011: More choices were brought in for consumers in terms of technology and services.

To widen the reach of telephony services in rural India, the Universal Service Obligation (USO) policy came into an effect on 2002. Initially, USOF was established to provide the fundamental access to 'basic' telegraph services to people in the rural and remote areas at an affordable rate. In 2004, the Government of India approved the National Broadband Policy (as NTP – 2004) aiming at enhancing the quality of services through initiaves like e-education, tele-health, e-governance, information services etc. Prior to the implementation of NTP-2004, the broadband coverage was significantly low as compared to other Asian countries. The penetration of broadband, Internet and personal computers were at 0.02 per cent, 0.4 per cent and 0.8 per cent respectively during the time of implementation of policy (TRAI, 2003). Till 2004, there was no uniform standard for broadband access and connectivity. Internet access was available at various speeds in a range from 64 kilo bits per second to 128 kilo bits second. The high-speed Internet connection through broadband was introduced in the NTP-2004. After the introduction of NTP-2004, the scope of USOF was widened to provide the subsidy for enabling all types of telecom services, including broadband

connectivity, creating of infrastructure such as Optical Fibre Cable (OFC) in rural and remote areas (Department of Telecommunications, 2008-2009). The implementation of 3G technologies was introduced in wireless broadband by removing the wired line last mile bottleneck in 2010. The NTP -1999 acted as catalyst for growth in telecom sector. In February 2012, the number of telephone connections were 943 million as compared to 41 million in December 2001[9]. This resulted contribution of 3% to India's GDP, the demand for broadband Internet connectivity was increasing to accelerate the growth of the economic and social sectors. However, the expansion of telecommunications and broadband connectivity was yet slower in rural areas as compared to urban areas. The National Optical Fibre Network (NOFN) project by the Telecom Commission in June 2011 with a mission to create a robust middle-mile infrastructure for providing broadband connectivity to Gram Panchayats. A year later, the National Telecom Policy 2012 (NTP - 2012) was conceived with a vision 'Broadband on Demand' to leverage telecom infrastructure to enable all citizens and businesses both in rural and urban areas to participate in the digital economy, thereby ensuring equitable and inclusive development of the nation.

3. Fixed broadband and mobile broadband: Opportunities & Challenges

The telecom sector in India has witnessed healthy growth since 2000s. The teledensity, which was 12.9[10] as on March 2006, has reached to 92.8[11] as on March 2018. With 252 million internet users, India ranks third worldwide in terms of sheer total of people connected to the

[9] National Telecom Policy 2012; http://meity.gov.in/writereaddata/files/National%20Telecom%20Policy%20(2012)%20(480%20KB).pdf accessed on 14.5.2018
[10] TRAI annual report 2005-06; accessed on 25.5.2018
[11] TRAI annual report; March 2018; accessed on 25.5.2018

interent. Mobile broadband penetration is 16.8 percent in the country. However, the fixed broadband penetration in India is judy 1.4 percent[12]. The 3G based mobile broadband services in India are driven both by demand and supply of side factors. The introduction of new innovative services and applications, enhanced user experience and decreasing prices of 3G enabled handsets are key drivers for mobile broadband in India. Mobile broadband is contributing heavily to the growth of digital economy, however the household internet penetration in terms of wired broadband is still low. Challenges like the high cost of infrastructure including enormous amount of investment in 3G and 4G spectrums, lower and slower returns on investment, regulatory challenges and uncertainty prohibit telecom companies to expand in rural India.

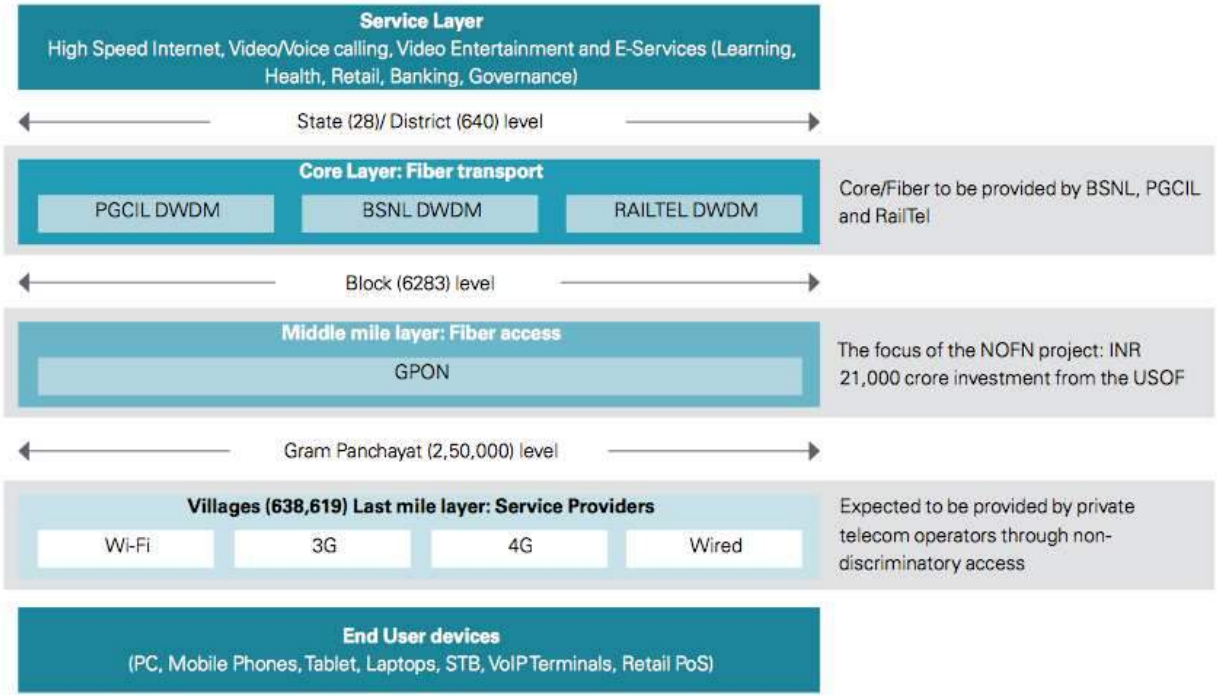
Another challenge is poor availability of backhaul connectivity. Unlike urban areas where OFC is largely deployed to provide the backhaul connection, about 80% of the rural BTS are on microwave system. Due to the lack of backhaul connectivity, only wimax and mobile broadband become possible solutions for providing internet connectivity in remote areas.

4. NOFN and the broadband infrastructure in India

Only 0.53% of India broadband connections were connected through optical fibre in 2010. In the same year, the TRAI released a report, recommending the growth of broadband in India. In October 2011, the government of India approved the scheme to set up NOFN aiming to provide broadband connectivity upto village council level. For this purpose, the government formed a Special Purpose Vehicle (SPV), named 'Bharat Broadband Network Limited' (BBNL) for the establishment, management and operations of NOFN. It was decided that BBNL would be wholesale bandwidth provider who would provide non-discriminatory access to the NOFN infrastructure to all service providers. It was decided that existing central public sector undertakings (CPSUs) will deploy the NOFN infrastructure and it will be funded by USOF. These CPSUs are BSNL (Bharat Sanchar Pvt. Limited), RAILTEL, the telecom arm of the Indian Railways, and Power Grid Corporation (Srinivasan, 2004). Accordingly, the work was split State-wise between BSNL, RailTel and PGCIL in the ratio of 70:15:15.

[12] https://telecom.economictimes.indiatimes.com/news/india-had-16-8-mobile-broadband-penetration-broadband-commission/60516269; accessed on 25.5.2018

Prior the implementation of NOFN, there was only 1.1 million Rkms (routes kilometers), covering the entire urban regions of the country and having limited presence in rural parts. BSNL accounted 60% of the fibre optic and was the only provider, which had point of presence in all the districts and 28,000 villages. NOFN was conceived as a project for connecting the state headquarter (SHQ) to district headquarter (DHQ) to block headquarter (BHQ) to gram panchayat. It was estimated that additional OFC of 301,000 route kilometers mainly from BHQ to the gram panchayats would be required (Mason, 2010).



Source: Adapted from 'Connecting India – Enabling Socially Inclusive Growth through National Broadband Network, Cisco, 2012'

The NOFN was rolled out in a phased manner at a cost of USD 4 billion (Srinivasan, 2014). Initially, the Telecom Commission approved a 3-phase implementation plan. The first 100,000 gram panchayats were to be covered in the first phase and to be finished by March 2014. However, the target was reduced to 50,000 GPs and to be covered by March 2015 (BBNL, 2015). The rest i.e. 150,000 GPs to be covered under phase-II by March 2015 (Srinivasan, 2014). However, the timeline for the first phase and second phase were extended a number of times. NOFN was reconceptualised and upgraded as BharatNet under framework of Digital India in 2015. PGCL was responsible for laying NOFN in 5 states, including Andhra Pradesh.

Since the rollout of NOFN in Andhra Pradesh, 601 GPs (1544 kms) are connected as on April 2018[13].

NOFN was largely envisaged as a governance project in which the GPs, the last tier of governace, would be seamlessly connected upwards to block, district and state level. However, the project also provides opportunity for last mile connectivity which means taking the connectivity from gram panchayats to household level and to connect institutions (such as schools, public health centres, government offices, etc) at district, block and panchayat level. The current study looks into the cost and associated benefits for providing household broadband connectivity using the existing infrastructure of NOFN.

5. Implementation Challenges of NOFN in India

Broadband networks have become an integral part of knowledge economy especially for those activities that rely on the provision of data transformation, particularly in service sector. It helps in bridging the digital divide and bringing the information at the doorsteps of the people. Before economic liberlisaton in early 1990s, the telecommunication sector was completetly under the control of the government. Post liberalization, the sector got the much needed investment boost as different private players also entered (Dossani, 2005) and were also helped by various policy initiatives of the government.

The genesis of the National Optical Fibre Network (NOFN) can be traced to a White Paper issued in August 2010 by the office of the Adviser to the Prime Minister on Public Information Infrastructure and Innovation headed by Sam Pitroda. The paper was focused on connecting the gram panchayats with the governance tiers at the state and central level and also tracking various schemes and policies and the lowest level. It envisioned of strengthening the administrative capacity of the panchayats by providing broadband connection and internet services to leverage public information infrastructure at the grassroots in rural India. One World Bank study reports that 1.38 percent increase in per capita GDP of developing economies for every 10 percent increase in broadband penetration. The paper stated that access to broadband services would lead to a wave of economic and social growth in India like the way spread of voice telephony in the 1980s. Comparing the advantages and

[13] BBNL website; http://www.bbnl.nic.in/index1.aspx?lsid=577&lev=2&lid=471&langid=1; accessed on 14.5.2018

disadvantages of Digital Subscriber Lines (DSL), cable models, and wireless technologies, it identified that optic fibre is best mode to bring internet to rural India, given their long-term sustainability and reliability.

Later on, the Telecom Regulatory Authority of India (TRAI) called for a national broadband policy in rural areas with a population count of at least 500 people on the internet connectivity grid. To enable this, the cabinet approved the creation of a National Optical Fibre Network (NOFN) to provide the broadband connectivity in panchayats providing funds through the Universal Service Obiligation Fund (USOF). A special purpose vehical (SPV) was formed, named Bharat Broadband Network Limited (BBNL) to implement, execute and monitor the program through three agencies – BSNL, RailTel and PGCIL (also known as PowerGrid). During the time of launch of NOFN, the proposed timeline for completion was two years during which incremental optic fibre covering 500,000 route km would be laid. After the change of the government in 2014, NOFN was remaned as BharatNet in 2015 keeping intact the main objective of connecting of 250,000 panchayats with broadband.

Challenges of deploying NOFN broadband

Lack of accountability

An expert committee while evaluating the project stated that BBNL was not so effective as an execution agency. The project was marred by a lack of accountability and delays in decision making because of excessive emphasis on cost controls, resuling in poor implementation.

There was no role of state governments, thus states were found to be aloof and not involved in active collaboration leading to delays and slow progress in the implementation. At sites where NOFN had been completed, repair and maintenance are in poor state due to lack of skilled staff. This has been compounded by erratic power supply and inadequate space to house and secure equipments and assets.

Delay in timeline

When the NOFN was launched as project under the aegis of the BBNL in 2011, the proposed timeline for completion was set two years. However, since then the timeline has undergone multiple revisions with the latest deadline pushed to December 2018. One of the main reasons for the delays is that BBNL has not been able to take decisions in an autonomous manner which slows down the process.

Increase in expenditure

The original budget for the project was INR 20,000 crores, which today stands at a recommended INR 72,000 crores. This year, the government has allocated INR 10,000 crores under telecom infrastructure.

Unavailability of affordable devices

Availability of compatible and affordable devices is a concern for improving the broadband connectivity in the country. Smartphone prices are coming down and the penetration is increasing continuously but still 71 percent feature phones in India cannot access high-speed Internet[14]. Similarly, in case of fixed broadband, the user need to purchase end user equipments like modems and splitters which adds to the financial burden of the household.

Lack of available content:

Most people in rural areas prefer content in local or regional language. As per the vernacular report 2013 by IAMAI[15], 45 million users access content in their local language, which is 36.8% of the active internet users. With diverse cultural and linguistic landscape in India, it is very difficult to provide relevant content in local languages. India's broadband network needs to offer affordable content that is relevant to the country's diverse population characterized by multiple languages, varying levels of literacy, income and inequitable availability of physical infrastructure.

Limited affordability:

The PC penetration in India is limited to ~9 million rural households whereas ~14 million can afford computers as they are above the estimated affordability level of 0.5 million annual family income[16]. The investment for deploying and maintaining OFCs and 4G along with the increasing spectrum charges are responsible for high broadband tariffs. The FTTH connection will incur more cost to the network providers and ISPs, which in turn will end up in high

[14] Press Release IDC, August 2014. See: http://www.idc.com/getdoc.jsp?containerId=prIN25045514

[15] The Vernacular Report 2013 by IAMAI, Times of India, January 2014. See: http://timesofindia.indiatimes.com/home/The-Vernacular-Report-2013-by-IAMAI-Internet-and-Mobile-Association-of-India-showed-45-million-users-access-content-in-their-local-language-which--accounts-for-36-8-of-the-active-internet-users-in-the-country-122-million-December-2012-/articleshow/29661677.cms

[16] Reduce IT hardware cost to increase IT penetration: MAIT, October 2013. See: http://www.cxotoday.com/story/reduce-it-hardware-cost-by-43-to-increase-it-penetration-mait/

tariffs. As India is a cost sensitive market, higher cost reduces the affordability making it difficult to increase the broadband coverage in rual parts of the country.

6. Connecting Rural Households to NOFN via fixed line through NOFN

BharatNet was designed to provide scalable network infrastructure on a network infrastructure accessible on a non-discriminatory basis, to provide on demand, affordable broadband connectivity of 2 Mbps to 20 Mbps for all households and on demand.

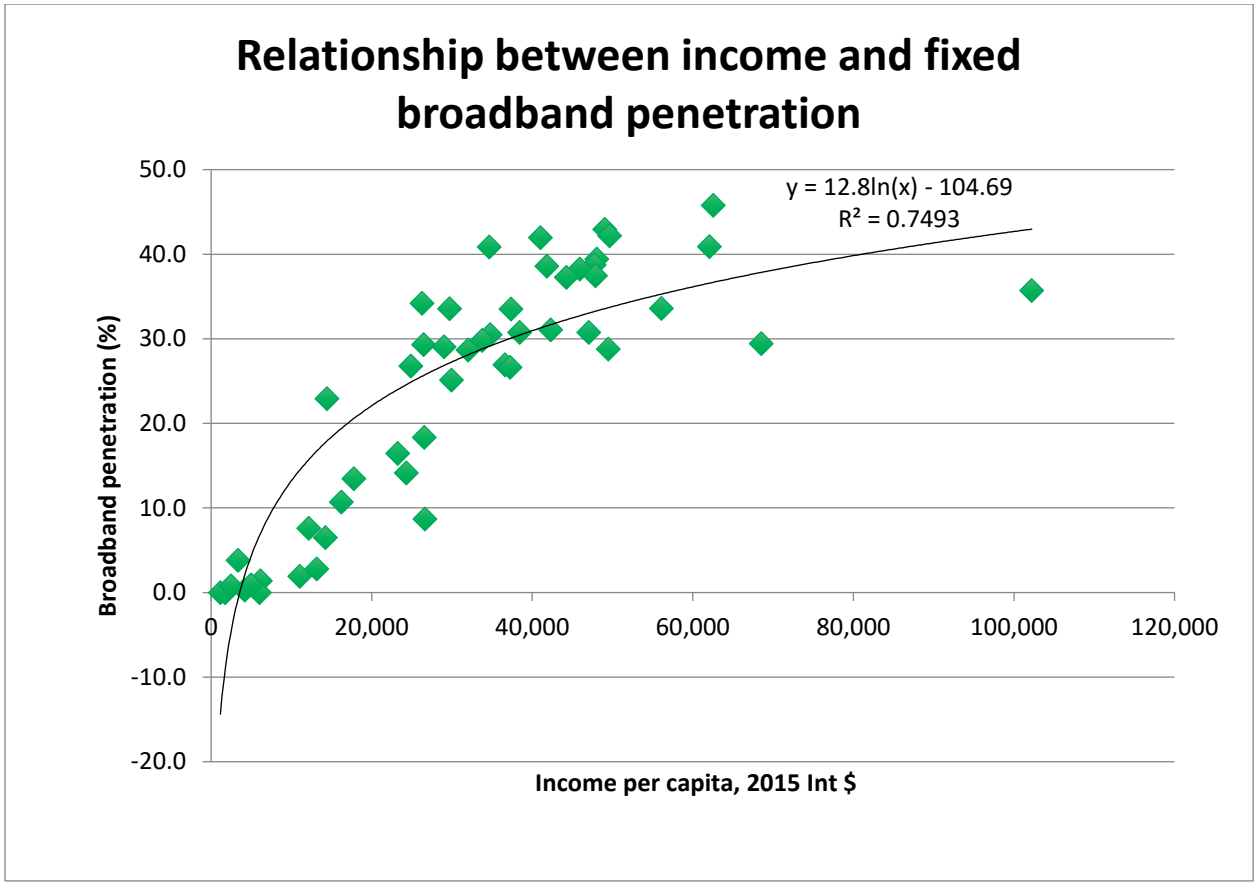
At the moment, fixed broadband penetration across the entire country is 1.4% (ITU, 2017). This low value is driven by a combination of supply factors (limited infrastructure to deliver fixed broadband), and demand factors (low income and the availability of substitutes such as mobile broadband). The intervention described here is to a) finalise the NOFN to connect GPs and b) facilitate accessibility to NOFN for rural households. These supply side actions should unlock latent demand for broadband in rural areas. Facilitating accessibility can be done in a number of ways, though perhaps the most feasible approach is to licence private enterprises to install and charge for household connections to NOFN. The government could consider subsidizing the cost for rural households.

Before describing costs and benefits, it is useful to describe the takeup of fixed broadband following the completion of NOFN. Demand for broadband, like any other good or service, is a function of income. Data on fixed broadband penetration and income were gathered for OECD and a selection of developing countries in 2015. The plot indicates a clear relationship between fixed broadband penetration and the log of income. It drives an equation:

$$Y= 12.8\ln(x) - 104.69$$

$$R^2 = 0.74929$$

This global, cross-sectional relationship is used to estimate growth of fixed broadband in Andhra Pradesh



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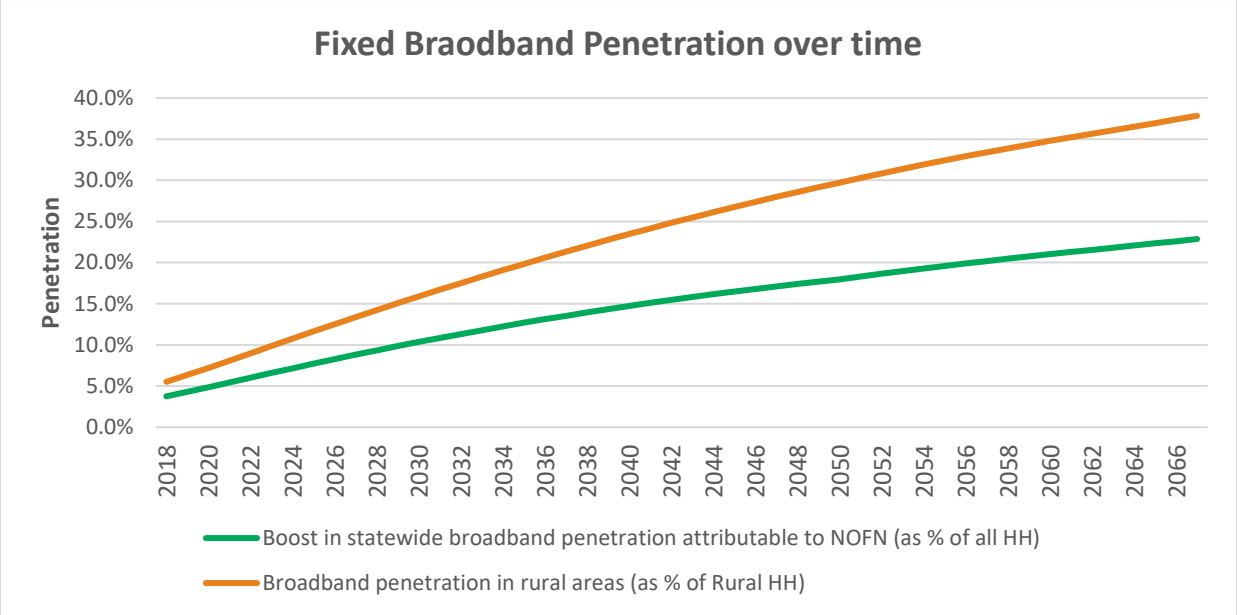
The NOFN is only delivered to rural areas, and so can only affect rural broadband penetration. To estimate uptake, we take the GSDP per capita projections provided by Andhra Pradesh Priorities project as well as the population rural, urban split of 68:32. Following UNDESA (2018) we assume that urban population will increase by 23% by 2050, such that by the middle of the century Andhra Pradesh will have a rural:urban split of 60:40. We further assume an urban-rural GDSP premium of 2. This allows us to calculate the approximate trajectory of rural penetration until 2067. By using the projected rural, urban splits we can also estimate the impact of NOFN on overall state-wide fixed broadband penetration. This is depicted in the figure below.



The results show that broadband penetration in rural Andhra Pradesh will increase to 38 per 100 rural households by 2067. Due to the falling share of rural population in the state, this will contribute to a statewide increase in penetration of 23 per 100 households. It should be noted that this figure is *incremental* to broadband penetration arising from urban areas. However this marginal impact is sufficient for calculating benefits of broadband (see below).

7. Calculation of Costs and Benefits

Costs

There are four categories of cost associated with this intervention 1) cost of connecting the remaining GPs; 2) cost to connect remaining households and ongoing maintenance; 3) upgrading the data centre cost to connect institutions (such as public health centre (PHC), schools, government agencies, etc) and 4) costs of accessing broadband services.

Cost of connecting from BHQ to GPs

In 2018, out of the total 12918 GPs only 601 were connected through NOFN in Andhra Pradesh[17]. Hence, 12317 GPs still need to be connected in the state. It is assumed the remaining GPs will be connected over three years. The average cost of connecting a GP to the

[17] BBNL website; http://www.bbnl.nic.in/index1.aspx?lsid=577&lev=2&lid=471&langid=1; accessed on 14.5.2018

NOFN nationwide is 0.3 crore. Applying this cost figure to the remaining GPs and assuming they will be connected over three years, delivers a cost of Rs. 1195 crores per year, for 2018, 2019 and 2020. The cost mostly covers the laying of fiber optic cable from the network to the GP. Operating costs of the NOFN are assumed to be 0.015 crore per GP connected. This is based on a total cost of Rs. 3639 crore to cover 250,000 GPs across the country.

Cost of connecting from GPs to HH

There are 12,918 GPs and 17363 villages in Andhra Pradesh. Clearly not all villages will have a direct fixed line connection to NOFN. We first estimate costs to connect all non-GP villages to NOFN, and then households. The average kms to reach one village is 2.6 km; thus, the optical fibre cable (OFC) required to cover the remaining villages is 28782 km. We apply a unit cost of Rs. 500,000 per km based on reports by NOFN.

It is assumed that once the OFC reaches the villages, it needs to be spread across the village (underground or over electricity lines) using an additional 1km of cable. This thick line will carry proper bandwidth required by all households. Based on estimates of 17363 villages in the state, this implies 17363 kms of line are required. We apply a unit cost of Rs. 400,000 per km based on reports by NOFN.

Lastly, thin OFC connections branching out of the household level line will be required for all homes that want broadband. We assume that 15 meters (about 50 feet) of OFC will be required to connect each household from thick OFC line running through the street/electricity pole or the existing telecom tower. This thin line has a unit cost of Rs. 50,000 per km. Lastly, we include a cost of Rs. 1000 per household for a wifi-enabled modem.

The above calculations imply the cost of connecting one household using wired infrastructure is Rs. 3258. The operational cost for the last mile connectivity per household is assumed to be 5% of this cost, at Rs. 163.

Cost of upgrading the data centre

In BharatNet, to connect the institutions at district, block and gram panchayat, data centres were established at the district level. These data centres offer variety of services like application hosting, server hosting and managed services in a secure environment for

processing, storage and backup, networking, management and distribution of data (BBNL, 2015). As the NOFN will reach to household level, the data centres need to be upgraded to ensure enhanced scalability to meet business growth. Assuming that 8% of the total cost of data centre is required to upgrade the data centre every year to provide the connectivity at HH level. Considering the cost of maintenance will increase due to increase in inflation. The cost of upgrading the data cente will be Rs. 0.27 crore per year.

Cost of accessing broadband services

Recognizing the limitations of existing data, this intervention has used the data from the 68th round of the National Sample Survey to estimate the expenditure incurred by households on Internet services in 2011-12. This data comprises of the following components - laptop/telephone charges accruing to data; Internet expenses, device expenditure, and expenses on PC/laptop. The average per household expenditure incurred on the internet using wold bank inflation rate is Rs. 300.

Total undiscounted costs of the intervention are presented below. The largest costs are for maintaining the NOFN itself, making up more than 70% of the total, undiscounted costs. Given the long time horizon, discounting is important. At a 5% discount rate the costs are Rs. 10,179 crores over 50 years.

Costs of connecting NOFN to households until 2067 (figures in 2016, Rs. Crore)

Cost of connecting remaining GPs	3,586
Cost of connecting HHs	896
Operations cost for NOFN including data center upgrades	21,042
Operations cost for HH connections	1,298
Costs of accessing broadband	2,391
Total (undiscounted)	**29,212**

Benefits of connecting households through NOFN on GDP

There are several studies that demonstrate a connection between GDP growth and broadband penetration. The World Bank estimates that 10 percent increase in broadband penetration will lead to 1.38 percent increase in GDP growth on average for low/middle income countries, which is higher than the impact of mobile penetration on GDP growth

(KPMG & CII, 2013). Czernich et al (2011) using instrumental variable approach to control for endogeneity, identify a relationship of 0.9 – 1.5 percentage points (pp) increase in GDP for 10 percent increase in broadband penetration. Koutroumpis (2018) examining the impact of broadband on OECD countries, shows that increases in broadband adoption boosted GDP over a 15 year period by an average of 0.3% per annum. The relationship between broadband adoption and GDP boost was 1.4 pp for 10% increase in penetration. Finally Koutroumpis and Gruber (2011), analyzing the effect of mobile broadband, show a result of 1.1 pp increase in GDP growth for every 10 per cent increase in penetration. It should be noted that none of these papers are based on analysis of developing countries.

In this study we follow Koutroumpis (2018) as this is the paper with the most recent evidence. Using the relationship from that paper we estimate the annual boosts to GSDP arising from the pathway of fixed broadband growth across the entire state attributable to the NOFN. After three years the boost to GSDP is small, measured at only 0.02%. By 2035 the boost is 0.1%, by 2050 the boost is 0.2%, and by 2067 it is 0.3%. Note that these GDP jumps *accumulate and compound*, such that small boosts to GDP have significant benefits over a 50-year period. The incremental boost to GSDP is Rs. 112 crore by 2020, Rs. 2708 crore by 2035 and Rs. 23,925 crore by 2067. In GDSP per capita terms, the corresponding values are Rs. 20, 453 and 4329. Total benefits until 2067 equal 69,707 a 5% discount rate. The benefit-cost ratio (BCR) of the intervention is 7.

Summary BCR Table

Intervention	Discount Rate	Benefit (in Rs crore)	Cost (in Rs. crore)	BCR	Quality of evidence
Providing the NOFN connectivity from gram panchayat (GP) to household (HH) level using wired infrastructure	3%	133,861	14,352	9	Medium
	5%	69,707	10,179	7	
	8%	29,277	7,072	4	

8. Reference

Wolf, J. &. (2000). The Last Mile: Broadband and the Next Internet Revolution (1st ed.). Mcgraw-Hill.

Rao, B. (2001). Broadband innovation and the customer experience imperative. International Journal on Media Management.

Sprano, E. &. (2000). E-COMMERCE CAPABLE: COMPETITIVE ADVANTAGE FOR COUNTRIES IN THE NEW WORLD E-CONOMY: Competitiveness Review: An International Business Journal incorporating Journal of Global Competitiveness.

Qiang, C. Z. (2009). Economic impacts of broadband. Information and communications for development 2009: Extending reach and increasing impact. 35-50.

International Telecommunication Union. (2012). Impact of broadband on the Economy.

Jain, R. (2002). WLL, Governance, Corporatization, and Swansi- A Review of Institutional Developments", India Infrastructure Report. New Delhi: Oxford University Press.

TRAI. (2003). Accelerating Growth of Internet and Broadband Penetration. Telecom Regulatory Authority of India, New Delhi.

Department of Telecommunications. (2008-2009).

Srinivasan, P. V. (2004). National Optic Fibre Network of India: A position paper.

Mason, A. (2010). Deployment models and required investments for developing rural broadband infrastructure in India .

BBNL. (2015). Report of the Committee on National Optical Fibre Network (NOFN) .

KPMG & CII. (2013). Creating viable business models for inclusive growth through the National Optical Fiber Network.

Deloitte. (2014). Broadband:The lifeline of Digital India.

BBNL. (2015). Report of the Committee on National Optical Fibre Network (NOFN) .

PIII. (2010). Broadband to Panchayats: Empowering Panchayats & Rural India by democratising information through broadband. Public Information Infrastructure & Innovations, Office of Adviser to the Prime Minister, Govt. of India .

Kelly, T. a. (2012). strategies handbook. Washington: The World Bank. .

OECD. (2012). Broadband and the economy.

Dossani, R. (2005).

Koutroumpis, P. (2018). The economic impact of broadband: evidence from OECD countries .

Rajat Kathuria, M. K. (2016). Quantifying the Value of an Open Internet for India. ICRIER.

OECD. (2016). Economic and Social Benefits of Internet Openness: Background Paper. Directorate for Science, Technology and Innovation Committee on Digital Economy Policy.

Part 2

Benefit estimation of linking the remaining Mahatma Gandhi National Rural Employment Guarantee Act beneficiaries to Aadhaar though positive reinforcement

Andhra Pradesh Priorities
An India Consensus Prioritization Project

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Academic Abstract[1]

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is the largest rural employment guarantee program in the world which promise to provide minimum st 100 days ofwork to one member of the estimated 150 million rural households in the country. However, the programme has been under scanner for various implementation and service delivery issues from the beginning. One of the stated aims of the government for rolling out Aadhaar was to streamline the implementation of the current and future poverty eradication and various other social sector programs. Aadhaar has already been established and implemented in various government schemes. This paper examines the major costs and benefits of connecting the last group of unconnected MGNREGA workers to the Aadhaar scheme. It was observed that although there is a considerable cost involved in linking the remaining group of workers, the benefits are much higher. The analysis shows a positive benefit cost ratio of 11 at the 5% discount rate , with the benefits arising from reduced leakage and corruption.

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Policy Brief

Overview

India since its independence has spent billions of dollars through a range of subsidies and an array of targeted poverty reduction programmes. Its total expenditure on state social welfare schemes has increased from INR 28,199 crores in 1990 to INR 8, 99,157 crores in 2016 (Social sector expenditure of state 2014-2016, NITI Aayog). Among the key social welfare schemes initiated till date, the National Rural Employment Guarantee Act (NREGA)[2] has been the largest. Targeted at 42 percent of the total rural population of India in (2004-05[3]) living below the poverty line, the scheme has grown many folds with increase in the government budget expenditure from INR 35,711 crores in 2012 to INR 45,303 in 2016[4]. Currently the scheme has more than 2.5 crore registered workers[5].

NREGA was established to provide a legal guarantee of 100 days of employment in public works per year to at least one member in each of the rural households. It has yielded positive effects on income generation for below-poverty-line households. However, over the years, it has been criticized for alleged corruption, logistical failures and faulty administrative practices. Numerous cases of money being siphoned off via "ghost beneficiaries[6]" and duplicates[7] were identified as source of massive monetary leakages. This set the scene for the government to combine information and communication technology (ICT) with various anti-poverty strategies to ensure better implementation and reduction in leakages.

ICT-based biometric technology for unique identification such as Aadhaar was seen as a promising tool, as the high rate of illiteracy made it difficult to deploy other traditional methods of authentication. Financial inclusion and social protection provided the basis for

[2] NREGA was renamed as Mahatma Gandhi National Rural Employment Guarantee program (MGNREGA) in 2009. The study has used the two terms interchangeably

[3] https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16603 accessed on 9th May 2018

[4] source: Financial statements for the years 2012-13, 2013-14, 2014-15, 2015-16 and 2016-17 on the MGNREGA dashboard
Note: Data extracted on January 2, 2018

[3]http://mnregaweb4.nic.in/netnrega/app_issue.aspx?lflag=eng&fin_year=2017-2018&source=national&labels=labels&Digest=cT/J7ChEq5LOfEr0AmsuAQ accessed on 9th May 2018

[6] Ghost Beneficiaries: People who have either died or migrated to other villages, however their name and details still remain in the government record and these details are misused by middlemen to siphon off money.

[7] Duplicates: One person getting money twice for the same work

using Aadhaar in social welfare payments. This paper evaluates the benefits of linking those MGNREGA beneficiaries yet to be connected to the Aadhaar scheme in Andhra Pradesh. .

Currently, there are 80 lakhs active NREGA workers in Andhra Pradesh, and 79 lakhs have an Aadhaar number (however only 65 lakh use it with DBT[8]).

AP embarked on the mass collection of biometric data for Aadhaar in 2013 along with other states. According to the government, Aadhaar has the potential to enhance the effectiveness of India's social protection programmes in three ways[9]; First, by increasing transparency in spendings in the service delivery system. Second, it will help in plugging leakages in the system by removing duplicate transactions and middlemen. Finally, it will also reduce the delay in payment by integrating DBT with the beneficiaries' account[10].

Intervention: Connecting the last section of the unconnected to the NREGA workers to Aadhaar

This intervention analyzes the costs and benefits of transition from cash payment of MGNREGA wages to payment to the beneficiaries' bank/post office account linked to Aadhaar. Although 99 percent of the active MGNREGA beneficiaries have Aadhaar numbers only 82 percent receive their payments in their respective bank accounts[11].

This intervention targets the last one percent of the population who are not linked to Aadhaar and those who are linked to Aadhaar but not linked to DBT for year 2017-18. A multi-year projection model is built on the basis of re-occurring benefits for the next 15 years. This includes linking new workers to the scheme, training and back-end linking of cards, etc. The primary benefit is reduction in leakages.

The study proposes that the government should use positive reinforcement to link the remaining beneficiaries to the Aadhaar- NREGA initiative. This can be done by providing incentives such as early release of pending salaries to the new Aadhaar enroller and to those

[8] Direct Benefit Transfer or DBT is an attempt to change the mechanism of transferring subsidies launched by Government of India on 1 January 2013. This program aims to transfer subsidies directly to the people through their bank accounts.
[9] http://stateofaadhaar.in/wp-content/uploads/State-of-Aadhaar-Full-Report-2016-17-IDinsight.pdf
[10] http://stateofaadhaar.in/wp-content/uploads/State-of-Aadhaar-Full-Report-2016-17-IDinsight.pdf
[11] Author's own calculations

who link their Aadhaar to their bank accounts. Andhra Pradesh has approximately 3,00,000 muster rolls pending for payment[12]. While the proposed intervention will not require any additional cost to the government, a small tweaking in the approach would motivate the workers to get an Aadhaar card.

Implementation Considerations

Vast body of literature illustrates a positive relationship between accesses to formal financial services and economic prospects for poor individuals and communities. By bringing all MGNREGA workers under the fold of a formal institution via Aadhaar and MGNREGA seeding, it is estimated that the leakages in the scheme will be reduced by 20 percent (Economic Survey, 2011-12). The total cost of the intervention is estimated to be INR 35 crore, incurred in the first year.

Aadhaar as an initiative has been criticized by a lot of social scientists in recent years. Issues related to right to privacy and life (Khera, 2016) have been extensively raised. A variety of issues related to failure of proper authentication due to malfunctioning of the biometric machines in the field and non-availability of adequate connectivity have also been highlighted (Khera, 2013, 2017).

The current analysis has been carried out on the basis that the Aadhaar scheme has been implemented at an expense of Rs. 8,800 crores and is currently in use. This paper is an attempt to understand if investing a little more in the existing system can help improve benefits accrued in the long term. It estimates the incremental costs and benefits of bringing the unconnected workers into the system and the prime benefit will be reduction in leakages which are primarily due to incidence of ghost beneficiaries[13] and deception [14](Khera, 2011). Evidence suggests that up to 20%[15] of MGNERGA allocated funds are lost to leakages. The

[10] http://mnregaweb4.nic.in/netnrega/monthwise_delay_report.aspx?lflag=eng&fin_year=2017-2018&source=national&labels=labels&Digest=cT/J7ChEq5LOfEr0AmsuAQ accessed on 9th April 2018

[13] Ghost cards : card existing and names of non-exiting/dead beneficiaries

[14] Deception: Deception is when middlemen open and operate bank accounts on behalf of the registered worker; they then withdraw inflated wages from the account; pays the worker his/her due and pocket's the inflated amount.

[15] Economic Survey of India 2017

total savings from declining leakages from this intervention are estimated at INR 57 crores per year over 15 years.

Cost and Benefit

Costs

There are three categories of costs associated with this intervention. The first cost is bringing the remaining one percent of workers under the Aadhaar scheme, approximately one lakh under the scheme. The cost per person of this is estimated at INR 328 per person, including private costs of time and travel. The total cost of this component is 3.7 crore.

The second cost is linking those with Aadhaar, but without DBT, so that they can receive payments directly into their bank accounts. The cost per person of this is INR 163. With 15 lakh workers requiring linkage to DBT, the cost of this component is 24.6 crore. The total one-off cost for this intervention is Rs. 33 crores.

The recurring costs towards procuring biometric devices, its maintenance and connectivity have been calculated on a yearly basis at Rs. 2 crore in the first year, projected downwards for likely counterfactual growth in Aadhaar enrolments. The total cost of the intervention is Rs. 47 crores over a period of 15 years at a 5 percent discount rate.

There are other real and perceived costs of expanding the Aadhaar system. Privacy has been stated as one of these major social costs in various literatures discussing Aadhaar. However, the costs estimated in these deliberations are primarily individualistic and uncertain. We do not include potential privacy costs in this analysis and only note that the benefits of this intervention represent a 'minimum hurdle' for which privacy costs must exceed to render the intervention ineffective.

Benefits

Cutting down leakages is the key benefit of Aadhaar discussed in this paper. It estimates the gains from reduction in two types of leakages a) leakages due to duplicity in the system b) leakages due to deception[16]. Leakages due to extortion by middlemen or collusion due to

[16] Discussed in Khera 2016; leakages due to deceit takes place when middlemen open and operates account on behalf of laborers , they withdraw the inflated wages from the banks pay workers their due and pocket the remaining.

labour and middlemen and sharing inflated wages have not been included as Aadhaar will not have any impact in checking such practices. Using the findings of Muralidharan et al (2016) which assess a 41% reduction in leakage from the intervention, the total benefit works out to be 57 crores in the first year, rising each year by 3.2%, adjusting the expected real growth rate in MNREGA wages. The total benefit over 15 years would amount to Rs. 504 crores at a 5 percent discount rate.

Another perceived social benefit of having a mandatory bank account is that it would induce a habit of saving amongst the workers. This will also give the women workers more authority over the manner in which they choose to spend their income. However, this particular benefit is not included in the current analysis. The analysis also excludes the benefits of Aadhar in availing any other services that are currently being offered by the state.

The Benefit-to-Cost Ratio (BCR) of this intervention is 11 at a 5% discount rate for 15 years.

Intervention	Costs (in Rs. crores)	Benefits (in Rs. crores)	BCR
Linking the last section of the unconnected MGNREGA population to Aadhaar	47	504	11

Introduction

Social welfare spending in rural India are administered through number of central and state government programmes, MGNREGA being one of them. This is a complex scheme, with programme components involving a wide range of institutions and stakeholders and affecting a range of potential (intended and unintended) economic and social outcomes (3ieimpact, 2017). Andhra Pradesh has been one of the top performers in MGNREGA among the larger states in terms of total number of active workers (80.6 lakh) and participation rate of women (42.3 lakh) in 2017–18. Out of the current total active workers in MGNREGA in the state, 79 lakh have Aadhaar numbers. Thus, the total numbers of workers yet to be enrolled in Aadhaar are around one lakh. Of the 80 lakh active workers, 14 lakh are not covered under the direct benefit transfer (DBT) which would have enabled transferred their wages directly to their Aadhaar linked bank or post office account.

This paper draws on the results from a large-scale cluster-randomized control trial on the effects of linking smart cards – a biometric precursor to Aadhaar - to MGNREGA payments in Andhra Pradesh. The RCT Andhra Pradesh study had estimated that leakages declined by 41 percent post the reorganization of the payment system toward direct transfer and biometric card-linked payments. This led to an increase in MGNREGA beneficiaries' earnings by 24 percent, without augmenting the government budget (Murlidharan, Niehaus et al. 2016).

The current study attempts to compute the costs and benefits derived from bringing the above-mentioned section of unconnected MGNREGA workers under the Aadhaar-MGNREGA initiative through a cost benefit analysis.

The costs of the intervention are estimated at Rs. 47 crores, and are expected to reap benefits in reduced leakages worth Rs. 57 crore in the first year alone. This benefit is assessed against the natural rate of Aadhaar enrolment in the absence of the intervention and is extrapolated over a fifteen-year period. The total benefits accrued are estimated at Rs. 504 crores at a 5 percent discount rate, yielding a benefit-to-cost ratio of 11. Given the large amount regularly spent on poverty reduction programs in India, this provides a significant opportunity to reduce corruption and leakages.

India's tryst with poverty alleviation schemes

Earlier the central government used to provide poverty alleviation schemes only during national calamities like famine, flood or drought (3ie working paper 27, 2016). In the colonial period too, labour programmes became popular as a means of famine relief. In 1972, after the famine, the Employment Guarantee Scheme (EGS) was introduced in Maharashtra. This was a demand-driven, bottom-up employment scheme meant to provide the rural dwellers the legal right to demand work from the state. The pro-poor targeting of the EGS, although considered highly effective in the early years, steadily declined in its performance as the government raised the wage rate, to meet the minimum wage in 1988 (Gaiha 2000). As the wages started increasing, even the non-poor started demanding work, consequently the budget soared, corruption seeped in and the actual poor were being excluded.

In 1993-94, Employment Assurance Scheme (EAS) was launched by the Union government. The poor administration and implementation of the EAS encouraged gross irregularities and the programme could not achieve its target as 5 percent of the targeted group got employment. In 2001, EAS was revised and repackaged into Sampoorna Grameen Rozgar Yojana (SGRY); a unique feature about this scheme was that it paid half of the wages in food grains.

While the government has spearheaded a number of programs and claimed that the incidence of poverty declined from over 50% in the 1950s to 26% in the late 1990s (NCAER, Working Paper 169), currently at least 32 percent still live below the international poverty line.

Targeting rural development and for productive engagement of the under-employed, surplus and unskilled labor force, the government of India initiated one of its most ambitious projects the National Rural Employment Guarantee program (NREGA) by the act of parliament in 2005. It was "*unlike any other wage employment programme in its scale, architecture and thrust bottom-up, people centred, demand-driven, self-selecting, rights-based design is distinct and unprecedented*" (NREGA operational guideline, 2013). The act provided at least 100-day guarantee to every poor household in the country whose adult member volunteered to be a part of the program. It was a mandate for the government to provide employment to the all those who were willing to work. If the state, for any reason, was unable to provide 100

day of employment in a financial year, it was obliged to pay unemployment allowance at a prescribed rate. This self-targeting mechanism of beneficiary selection was expected to help overcome the problems of targeting, since a large percentage of poorest of the poor and marginalized sections of the rural people is expected to seek employment under the scheme. The act also incentivized the state to provide employment, as 100 percent of the unskilled labour cost and 75% of the material cost of the programme is borne by the center (Operational Guidelines, 2013). Although, there is widespread awareness about the scheme, especially after the first round of social audits were conducted (Aiyar & Samji, 2009), there is far less awareness among rural dwellers that it is their right to get employment on demand.

In spite of NREGA being a demand driven open-to-all programme, its outreach and coverage is still low. Since its inception, massive corruption through leakages in the system and delay in payments have been criticized. It was observed that the wages were delayed by serveral days/months. Middlemen within the system siphoned money, thus depriving the genuine beneficiaries. This failure to implement the program appropriately can be attributed to widespread corruption, logistical failures and faulty administration.

Given the inefficiencies and historical weakness of the Panchayati Raj institutions in the states, in 2008, the central government made it mandatory for wages to be paid into bank and post office accounts, instead of cash payments through the Panchayat. This led to a sharp reduction in corruption due to inability of the middlemen to siphon off money from the chain. NSSO data suggests that between 2007–08 and 2011–12 wage corruption declined from 44–58 percent to 22–32 percent for the country as a whole (Imbert and Papp 2015). These administrative botches set the tone for India to combine information and communication technology with the anti-poverty policies; through the Direct Benefit Transfer scheme, the government sought to provide economic security and protection from adverse shocks to the poor. To address these problems Aadhaar came into the picture in 2010; the aim behind introducing Aadhaar was to remove financial leakages in the form of identity duplications embedded in the system, through biometric authentication.

Aadhaar enabled Payment System (AePS)

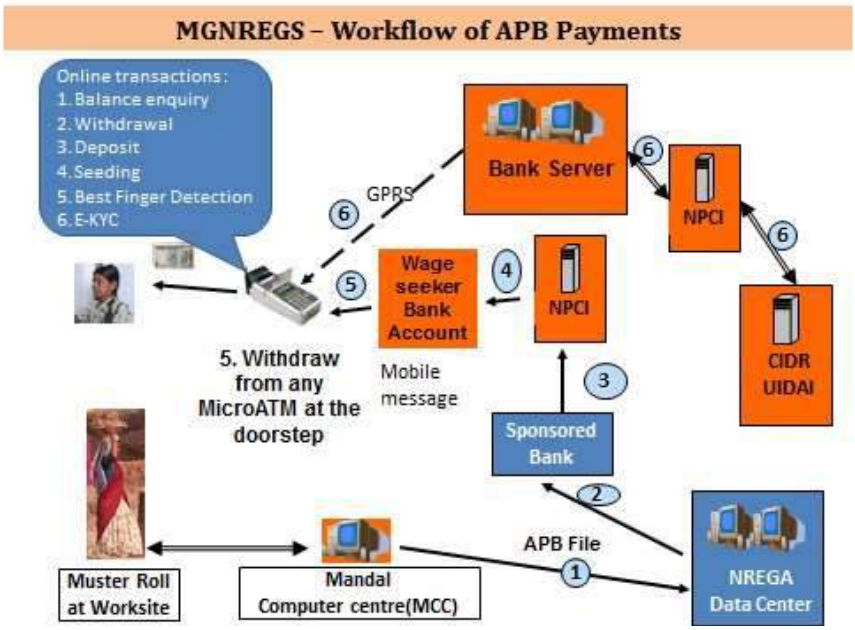
In areas where the penetration and network of banks and post offices is weak, Project Implementation Agency (PIA) disburses wages in cash. This is mostly done only with prior

intimation to the ministry and approval of the state governments. If PIA is other than Gram Panchayat (GP), the GP is accountable for disbursement of cash payments. A payment committee is constituted and all cash disbursements are made in the presence of this Committee.

With an aim of restructuring this government service delivery system in various social welfare schemes, reducing fraud and duplicity, the Indian government initiated the Direct Benefit Transfer scheme (DBT) in January 2013. In 2014, DBT was introduced in MGNREGA along with Aadhaar to facilitate wage payment. The program was an attempt to change the mechanism of transferring wages directly to the people in their bank accounts. Its primary aim was to bring transparency and check pilferage of funds (DBT website, 2018).

Through Aadhaar enabled Payment System (AePS), the MGNREGA payments are credited to the bank accounts of the individuals utilizing the database of job cards and fund transfer orders from MGNREGA server. The funds are then disbursed through Micro ATMs through AePS of the wage seekers. Further, for wage seekers who do not have the bank accounts, accounts are opened at their doorstep under eKYC mode through micro ATMs (DBT website, 2018).

Currently there are 65 lakh MGNREGA beneficiaries who avail DBT, to get their wages directly into their bank accounts in Andhra Pradesh. This accounts for 82 percent of the MGNREGA beneficiaries for Andhra Pradesh (MIS MGNREGA, 2017-18). Pre-existing bank account, Aadhaar number and seeding of Aadhaar in beneficiary database and bank accounts are the pre-requisites to avail benefits under the program. The system requires each Aadhaar number to be linked to one account (or joint account) in which the wages and all other benefits will be credited. Payment outlay is be made through banking correspondents or Branch Post Offices based on biometric authentication using a biometric machine. The machine is enabled for the worker to access the details of the wage payments made and the amount standing to his/her credit by means of a mini statement. All details of wage payment through Bank/ Post Office are being recorded in the job card (MGNREGA operational guideline, 2013).



Source: DBT website, www.dbtbharat.gov.in

There has been a steady increase in the number of MGNREGA workers in Andhra Pradesh enrolled in the Aadhaar scheme and the number has exponentially grown from 55 percent in 2014-15 to 99 percent in 2017-18 (MIS, MGNREGA). Getting paid directly in their respective Aadhaar-linked bank /post office account through direct benefit transfer would ensure no interference of middlemen and reduce the private opportunity cost of travelling from village to the panchayat office, losing a day's wage (if working elsewhere at that time) in-order to collect pending payments.

Connecting the last section of the unconnected MGNREGA population to Aadhaar

Diversion of funds through ghost beneficiaries and inflated fake work records has been a key problem with the implementation of MGNREGA since its inception. In 2008, the government mandated opening bank accounts so that the wages can directly be transferred to the respective account of the beneficiaries. Data collected from Andhra Pradesh among other states[17]showed that a great deal of fraud related to making fake job cards and improper maintaining of muster roll (Chauhan et al., 2009). Using the data from Economic Survey

[17] Bihar, Gujarat, Madhya Pradesh, Rajasthan, Tamil Nadu , Uttar Pradesh and West Bengal

(2016-17), the financial leakages due to duplicates and deception were calculated at 20 percent.

Government is currently enforcing Aadhaar as a tool to access government entitlements, intimidating people by issuing threats of revoking social security entitlements (Aadhaar mandatory for MGNREGS work from April 2017[18]). The benefit and cost ratio calculated below finds that it is indeed beneficial for the MGNREGA workers to get their Aadhaar number and link it with their bank account. This will result in costs of Rs. 47 crore and recurring benefits averaging Rs. 48 crore per year over fifteen years. The benefits are based on the gains from leakages and do not account for any other social benefits.

Thus, the government should resort to positive reinforcement to persuade the remaining group to get their individual Aadhaar number and then link it to their bank accounts. Positive reinforcement techniques have worked previously in case of Sarva Shiksha Abhiyan through which the proportion of girls in the age group 11 to 14 years who were out of school has also declined from 11.2 per cent in 2005 to 5.9 per cent in 2010 (Planning Commission's Approach Paper (2012-17).

Similarly, positive reinforcement techniques, like, faster clearing of previous month's MGNREGA wage arrears for those who get a new Aadhaar card linked to their bank account, can become stimuli in motivating those who do not have Aadhaar to get one. This intervention will not create a dent on the already budgeted MGNREGA funds; however will just require a preferential payment option to be included in the scheme. It may be mentioned that for the current financial year 2017-18, there are 2, 96,444 number of muster rolls pending for payment (MGNREGA MIS, 2018).

Calculation of Costs and Benefits

Baseline

Both costs and benefits are assessed against the predicted increase in Aadhaar enrolments in the absence of the intervention. At the time of writing this paper, 51.6 million Aadhaar cards

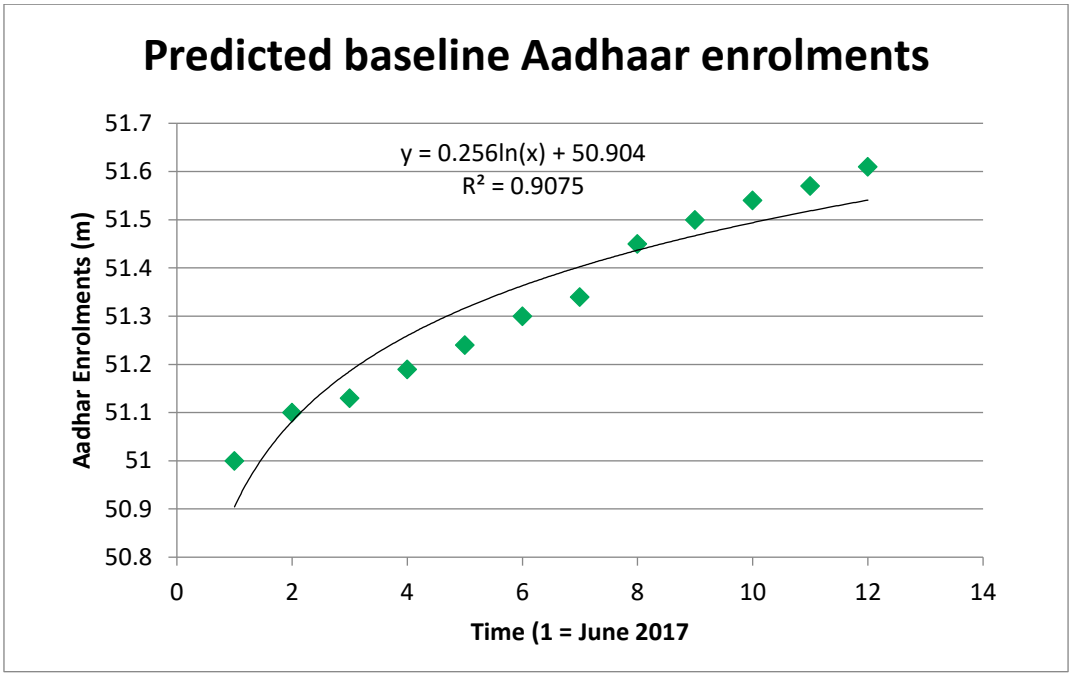
[18]//economictimes.indiatimes.com/articleshow/56402579.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

had been issued against a total population of 53 million. This suggests 97 percent of the population have Aadhaar cards. Monthly data for Aadhaar enrolments is only available from June 2017 to May 2018 (UDAI website). Given that state and nation-wise rollouts are towards the tail end of the process, it seems reasonable to model the remaining uptake as a log function.

Monthly data is regressed against natural log of time, where 1 = June 2017, 2 = July 2017 etc…. The function form and coefficients are depicted below.

Equation: $y = 0.256\ln(x) + 50.904$

$R^2 = 0.9075$



This function is used to predict baseline Aadhaar enrolments for 15 years, against which recurring costs and benefits are assessed. It is assumed that the intervention would result in complete linking of all MGNREGA workers to the Aadhaar system.

Cost

There are three categories of cost associated with this intervention: i) cost of enrolling MGNREGA workers onto Aadhaar and ii) ensuring those with new Aadhaar cards enable DBT payments and iii) recurring costs of biometric devices and maintenance, and connectivity . It is to be noted that these costs are assumed incurred within the existing biometric direct

payments system established for MGNREGA. Hence, much of the capital costs have already been incurred, and only a representative proportion of ongoing costs have been attributed to this intervention.

Cost of enrolling new NREGA workers to Aadhaar

For a NREGA worker to get a new Aadhaar card, he/she will have to travel to the enrollment center. This can be estimated as his personal opportunity cost of a) Rs. 205 in lost wages while going to the center for enrollment and b) Rs. 50 travel cost of commuting to the center. There will also be a public cost to the government. This cost calculated from the UIDAI budget sheet (2018). The total expenditure from 2012-17 was INR 8800 crores, this was divided by the total number of registered users 1,209,541,111 to get the per person normalized cost. The per-person cost of getting an Aadhaar is INR 73 in government costs and private costs are INR 255 for a total unit cost of INR 328. This cost is then multiplied to the total number of workers to be added in the scheme for Andhra Pradesh, which is one lakh, to arrive at he total cost. The calculations yield a total one-off cost of Rs. 3.7 crores.

Cost of seeding: linking new and old Aadhaar number to NREGA

Seeding is a process to facilitate removing duplicate/fraudulent identities. It is the process of linking individual Aadhaar number to the beneficiary lists of various government programmes, such as NREGA in this case. The cost of seeding is computed based on the personal cost incurred by the citizen in order to link his/her Aadhaar to MGNREGA scheme and multiplying it to the total active MGNREGS workers to be given DBT (to be linked to bank accounts i.e. 15 lakh workers).Oopportunity cost of traveling to the center I(half a day's wage) are accounted for (INR I63). The total cost for this component is estimated to be INR 24.5 crores. The unit cost calculations for this component is given in the table below.

Cost of Aadhaar	Estimated cost in AP
Direct cost per person to govt	
Total Country budget (Crores)	8,794
Number of people registered	1,209,541,111
Direct cost per person to govt	**73**
Cost application	
Cost of time (1 x daily wage)	205
Cost of travel	50
Total cost	**328**
Cost of seeding	
Direct Cost	10
Cost of time (half day)	103
Cost of travel	50
Cost of seeding	**163**

Source: Author's calculation

Recurring cost of Devices

The cost of adding new devices and maintaining the old ones has been calculated assuming that the working life of the machines is three years. Number of device needed is estimated based on the assumption that one village will have at least one biometric machine. There are 16158 villages in AP as of May 2018, assuming 1/3rd of the machines will need to be changed every year, the total biometric devices purchased by the state are estimated at 5386.

Assumptions for the calculations are presented in the table below. Each device is assumed to cost Rs. 12,255, with maintenance charges running into Rs. 500 per year. The connectivity cost has been calculated at a rate of Rs. 1,788 per year. The model attributes 15 / 80 = 19% of the ongoing replacement, maintenance and connection costs to the intervention. This represents the proportion of new recipients under the Aadhaar-based payment schemes relative to the total. The recurring cost of the intervention is thus estimated at Rs. 2 crore in the first year, while declining against counterfactual assessment thereafter.

Cost of Devices	
Total biometric devices purchased by the state in last one year	5386
Biometric Device Cost (Rs./device)	12255
Biometric Maintenance cost (Rs. Per device per year)	500
Connectivity Cost (Rs. per device per year)	1788
Total device cost (Rs crore/year)	2

Thus, the total cost of linking the remaining NREGA workers to the Aadhaar- NREGA initiative is Rs. 47 crores over 15 years.

Benefit of curbing leakages

The benefits of this intervention rest upon the work of Muralidharan, Neilhaus and Sukhtankar (2016). That paper assessed the effects of a large-scale randomized rollout of linking 'smart cards', the predecessor to Aadhaar in Andhra Pradesh, to the payment of NREGA wages. The results of that study show that beneficiary households earned 24 percent more, while spending 20 percent less time collecting and receiving payments 6-10 days sooner than the controlled households. Estimated leakage reduction was 41 perceent. The results of the study are strengthened by the fact that it was a large scale exercise, including 157 sub-districts and affecting 19 million people and implemented by the state government. This provides robust evidence that similar effects are likely to replicate at scale, a common concern with randomized controlled trials, typically conducted with relatively small sample sizes and by NGOs.

For this analysis we focused only on benefits due to plugging of leakages. This is because the paper by Muralidharan, Neilhaus and Sukhtankar (2016) identifies that the time-savings and payment processing benefits, likely due to the re-organization of the payments system from government agents across state, district and mandal levels to banks and local customer service providers hired to execute payments at the last mile. Given that this part of the re-organization has already occurred, and affects even those who are not linked to Aadhaar, we cannot claim these benefits from the intervention suggested.

However, for leakages, it seems clear that the biometric identification and the DBT, the direct nature of the payment, are responsible for leakage reduction. The intervention addresses

two types of leakages: Leakage due to duplication and leakage due to deception. NREGA was mostly criticized for poor implementation, lack of accountability and transparency in the system that lead to consequent issues of corruption. In-order to make best use of the resources and optimize the welfare program and to bring fairness and transparency in wage payments, it was decided that the wage disbursement agency should be different from the agency implementing the wage payments. Thus, it became mandatory for the payments to be made through individual or joint savings accounts of workers, unless exempted. However, to ensure greater financial inclusion and to increase the outreach of the banking sector, RBI had permitted banks to use intermediaries as Banking Correspondents (BCs), to conduct banking business as agents of the banks at places other than the bank premises.

The benefits assessed through this model presumes that most of the MGNREGA workers have bank / post office / BC accounts and thus focuses only on those workers who are not yet linked to the DBT scheme.

As seen in the table below, total wage expenditure is the sum of the actual expenditure and payment due on unskilled wages which amounts to INR 3646 Crores. Percentage of leakages as per 2016-17 Economic Survey is 20 percent, expected reduction in leakages due to Aadhaar enabled DBT (reduction in duplication and deceit) is 41 percent (Murlidharan, Neihaus et al, 2016) of 20 percent.

Benefits of reduction in Leakage in Andhra Pradesh	
Total wage expenditure (2015-16) (Rs Crore)	3646
% of leakage in MGNREGA (2016-17)	20%
Expected reduction in leakage due to Aadhaar enabled DBT	41%
Benefits of reduced leakage (Rs crore)	57

Source: Author's calculations

Thus the gain from reduced leakages for total active MNREGS workers to be provided DBT (19%) is INR 57 crores. We escalate this number at the real growth in MNREGA wages over the last 10 years, or 3.2%. Assuming a 15 year time horizon this leads to total benefits of Rs. 504 crores assuming 5 percent discount rate (see summary table).

BCR Table

Summary Table

Intervention	Discount rate	Benefits (in Rs. crores)	Costs (in Rs. crores)	BCR	Quality of Evidence
Linking the last section of the unconnected MGNREGA population to Aadhaar	3%	578	49	12	
	5%	504	47	11	
	8%	418	45	9	Strong

Conclusion

The proposed intervention to link the remaining MGNREGA workers with Aadhaar through positive reinforcement is seen as measure to make optimal use of the already invested public money in the Aadhaar framework. Although the derived BCR ratio of 11 is a positive indication towards adoption of Aadhaar, there is still a profound need to do a cross sectional analysis of the Aadhaar framework to understand its complexities.

There is also an urgent need to improve the monitoring and implementation system as Aadhaar as a number will not be able to solve most of the existing indecent practices in the system. These include leakage due to corruption, inefficiencies in the system and other technical issues associated with biometric authentication failure.

There are several unaccounted costs and benefits in this analysis, out of which two require further mention. Privacy advocates have raised concerns about Aadhaar, citing for example, discomfort over the government holding a large database of citizen information that could be misused. Alhough this is a legitimate concern, the estimation of this cost is beyond the scope of this paper. The current benefits represent a minimum hurdle over which privacy costs must jump to render the intervention ineffective.

Another aspect that has been omitted is the general-equilibrium effects of the intervention. A working paper by Muralidharan, Neihaus and Sukhtankar (2018) suggests that the aforementioned smart card analysis had significant spillover effects to non-treated regions. Hence the benefits calculated in this paper have been underestimated to the extent that this intervention would also lead to spillover benefits.

References

"Economic Survey 2016-17." Department of Economic Affairs, Ministry of Finance, Government of India, 2017.

"MNREGA Dashboard: At a Glance." Ministry of Rural Development, Government of India. Accessed May 9, 2018. http://mnregaweb4.nic.in/netnrega/all_lvl_details_dashboard_new.aspx

Abraham, Ronald, Elizabeth S. Bennett, Noopur Sen, and Neil Buddy Shah.State of Aadhaar Report2016-17.Report.IDinsight.

Afridi, F. and Iversen, V., 2014, April. Social audits and MGNREGA delivery: Lessons from Andhra Pradesh. In India policy forum (Vol. 10, No. 1, pp. 297-341). National Council of Applied Economic Research.

Bhatia, R, Chinoy, SL, Kaushish, B, Puri, J, Chahar, VS and Waddington, H, 2016. Examining the evidence on the effectiveness of India's rural employment guarantee act, 3ie Working Paper 27. New Delhi: International Initiative for Impact Evaluation (3ie)

Businesstoday.in. (2013). Mid day meal scheme makes a great difference to school enrollment. [online] Available at: https://www.businesstoday.in/magazine/cover-story/mid-day-meal-scheme-on-school-enrollment/story/190746.html [Accessed 22 Apr. 2018].

DEV, S. and RAO, P. (2002). POVERTY ALLEVIATION PROGRAMMES IN ANDHRA PRADESH - AN ASSESSMENT. (Sponsored by Planning Commission, Government of India). [online] CENTRE FOR ECONOMIC AND SOCIAL STUDIES. Available at: http://planningcommission.nic.in/reports/sereport/ser/stdy_pvrty.pdf [Accessed 25 Apr. 2018].

Dréze, Jean. 2011. "Employment Guarantee and the Right to Work." In The Battle for Employment Guarantee, edited by Reetika Khera. New York: Oxford University Press.

Eprints.lse.ac.uk. (2018). Empowering wageseekers? The computerisation of India's NREGA in Andhra Pradesh. [online] Available at: http://eprints.lse.ac.uk/74693/1/blogs.lse.ac.uk-

Empowering%20wageseekers%20The%20computerisation%20of%20Indias%20NREGA%20in%20Andhra%20Pradesh.pdf [Accessed 11 Apr. 2018].

Imbert, Clément, and John Papp. 2015. “Labor Market Effects of Social Programs: Evidence from India’s Employment Guarantee,” American Economic Journal: Applied Economics 7 (2): 233–63.

Khera, R. (2011). The UID Project and Welfare Schemes. [online] Economic and Political Weekly. Available at: http://www.epw.in/journal/2011/09/perspectives/uid-project-and-welfare-schemes.html [Accessed 25 Apr. 2018].

Khera, R. (2013). A 'Cost-Benefit' Analysis of UID. [online] Economic and Political Weekly. Available at: http://www.epw.in/journal/2013/05/commentary/cost-benefit-analysis-uid.html [Accessed 16 Apr. 2018].

Khera, R. (2013). On the NIPFP Response. [online] Economic and Political Weekly. Available at: http://www.epw.in/journal/2013/10/discussion/nipfp-response.html [Accessed 18 Apr. 2018].

Khera, R. (2017). Impact of Aadhaar on Welfare Programmes. Special Articles. [online] EPW, pp.Vol. 52, Issue No. 50, 16 Dec, 2017. Available at: http://www.epw.in/journal/2017/50/special-articles/impact-aadhaar-welfare-programmes.html [Accessed 12 Apr. 2018].

Kulkarni, A. (2018). Union Budget 2018: Highest funding allocated to MGNREGA in 2017, yet, 56% wages were delayed. First Post. [online] Available at: https://www.firstpost.com/business/union-budget-2018-highest-funding-allocated-to-mgnrega-in-2017-yet-56-wages-were-delayed-4324809.html [Accessed 16 Apr. 2018].

Ministry of Finance (2017). Universal Basic Income: A Conversation With and Within the Mahatma. New Delhi, p.200.

Ministry of Rural Development (2013). MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE ACT, 2005 (MAHATMA GANDHI NREGA) OPERATIONAL GUIDELINES 2013 4th Edition. New Delhi: Department of Rural Development, pp.3-5. 69-70.

NITI Ayog (2015). Social Sector Expenditure of States Pre & Post Fourteenth Finance Commission (2014-15 & 2015-16). New Delhi: Niti Ayog, pp.5-9.

Planningcommission.nic.in. (2002). 9th Five Year Plan (Vol-2) [Vol1-Index] - [Vol2-Index] << Back to Index Poverty Alleviation Programme Poverty Alleviation in Rural India: rogrammes and Strategy. [online] Available at: http://planningcommission.nic.in/plans/planrel/fiveyr/9th/vol2/v2c2-1.htm [Accessed 25 April 2018].

Rbi.org.in. (2015). Reserve Bank of India - Publications. [online] Available at: https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16603 [Accessed 13 Apr. 2018].

Supriya Garikipati (2008) Agricultural wage work, seasonal migration and the widening gender gap:evidence from a semi-arid region of Andhra Pradesh, The European Journal of Development Research, 20:4, 629-648

Muralidharan, Karthik, Paul Niehaus, and Sandip Sukhtankar. 2016a. "Building State Capacity: Evidence from Biometric Smartcards in India: Dataset." American Economic Review. http://dx.doi. org/10.1257/aer.20141346.

Uidai.gov.in. (2018). Aadhaar Dashboard. [online] Available at: https://uidai.gov.in/aadhaar_dashboard/index.php [Accessed 14 May 2018].

As a new state, Andhra Pradesh faces a bright future, but it is still experiencing many acute social and economic development challenges. It has made great strides in creating a positive environment for business, and was recently ranked 2nd in India for ease of doing business. Yet, progress needs to be much faster if it is to achieve its ambitions of becoming the leading state in India in terms of social development and economic growth. With limited resources and time, it is crucial that focus is informed by what will do the most good for each rupee spent. The Andhra Pradesh Priorities project as part of the larger India Consensus – a partnership between Tata Trusts and the Copenhagen Consensus Center, will work with stakeholders across the state to identify, analyze, rank and disseminate the best solutions for the state. We will engage people and institutions from all parts of society, through newspapers, radio and TV, along with NGOs, decision makers, sector experts and businesses to propose the most relevant solutions to these challenges. We will commission some of the best economists in India, Andhra Pradesh, and the world to calculate the social, environmental and economic costs and benefits of these proposals

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