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GOVERNMENT ELECTRONIC SERVICES DELIVERY AND THE DIGITAL DIVIDE: THE CASE OF ANDHRA PRADESH, INDIA

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Abstract

Despite garnering world-wide appreciation for her contribution to information technology services, India has to contend with serious issues relating to the digital divide. Beginning with a study of the various dimensions relating to the digital divide conceptually, the role of government services delivery in electronic form and its interactions with the digital divide are examined with reference to the Indian state of Andhra Pradesh. Using data from the office of Electronic Services Delivery, the findings reveal that there is considerable demand for government electronic services from rural and urban citizens in Andhra Pradesh, which in many ways contribute to narrowing the digital divide. Such services include land registration, driving licenses, utility payments, grievances registration and religion-oriented services. Econometric estimations show that the entrepreneurial spirit and competency of service providers, both in the urban and rural hinterland of the state, have a statistically significant and positive relationship with the number of e-government transactions therein. Contrary to the intuitive expectation that digitalization would facilitate trade, this study, through some key findings from the recent demonetization, shows that under certain conditions of information technology infrastructure paucity, digitization can constrict trade. One way out is to encourage cashless payment systems, whose implementation dynamics are touched upon. Some managerial implications are highlighted.

Keywords: Andhra Pradesh, digital divide, electronic services, government, India

JEL Classification: O33, O38

Contents

1. INTRODUCTION

Information and communication technology (ICT) is an umbrella terminology to denote a wide array of devices (telephone, hotspot, smart phone), applications (online courses, management information systems that drive production in factory floors), technologies (high definition television, blue tooth) and the necessary hardware (telecommunication towers). By enabling effective communication and cutting across spatial and time barriers between people, governments and businesses, ICT has provided benefits to the world's underprivileged populations, especially the global south. The benefits range from increased incomes, improved health facilities and enhanced access to education and job opportunities, through higher engagement with, and use of government services (Fletcher et al., 2000; Singh, 2010), resulting in transparency and monetary savings for the citizens. Through scale economies, ICT has also enabled technologies like e-commerce to offer a wide variety of goods and services at accessible prices to the underprivileged population. However, the potential to benefit from ICT depends on its adoption, which varies considerably among the nations of the world. Access to ICT is one of the parameters for gauging societal development of a nation and is listed in the sustainable development goals for 2030 by the United Nations.

Research shows that high income economies have double the number of fixed telephone connections per capita than middle income economies, and eleven times those of low income economies. The low income economies had only 3.3 fixed telephone lines per 100 inhabitants. While high income economies had 68 Internet users per 100 inhabitants, middle income economies had 11, and low income economies had 5 (International Telecommunication Union, 2015). In summary, high income economies show greater penetration of digital technologies and ICT as compared to those of low income economies. On average, the world scores 62.99 out of 100 in access to ICT, indicating that there is scope for improvement.

In addition to the digital divide that exists among different nations as described above, there exists perceptible gaps in the adoption of and access to ICT among different population groups within the country due to determinants like location, education, income and age. "Digital divide" describes the gap that exists in access to and use of ICT. This access and usage is measured in terms of the number of fixed land line telephone connections per 100 inhabitants, or the number of mobile phone users per 100 inhabitants, or the number of Internet users per 100 inhabitants. The digital divide, and the resulting gap, can exist in access to use of ICT (measured by the spread of ICT tools, infrastructure and devices), in the ability to use ICT (measured by functional and digital literacy of the population), in actual usage (measured by metrics like number of online users at a given point in time, the number of Internet hosts, e-government and e-commerce level and usage) and in the impact of ICT use (as measured by economic returns) (Mark, 2003; Branko, 2005).

India is one of the under performers in providing ICT access to its population. As of 2014, India had only 18 people using the Internet per 100 inhabitants on average, though she had earned global acclaim for provision of ICT services (Kapur and Mathur, 2016). A significant digital divide exists amongst the country's different states. The number of telephone landlines per 100 inhabitants ranges from 44% (in Kerala) to as low as 4.2% (in Chattisgarh) (ICRA, 2009). With reference to Internet usage, approximately 70% of Internet users are from the 7 cities: Mumbai, Delhi, Bangalore, Hyderabad, Chennai, Kolkata, and Pune, while users from the other tier 2 and tier 3 towns contribute to 30% of Internet usage. Mobile penetration in rural India ranges from

3.1% (Uttar Pradesh) to 20.7% (Punjab), with a national average of 4.92%, and is way below the 43.9% average penetration in urban areas (Juxtconsult India online, 2013).

As noted earlier, the underprivileged population in the world in the global south has benefitted from access to ICT, especially through citizens' engagement with government electronic services. Such engagements have resulted in transparency, user convenience through multiple channels of service delivery, cost savings, reduction in corruption and higher citizen satisfaction.

The Indian state of Andhra Pradesh (AP) was one of the pioneers in launching citizen-centric services delivery in 1998 and has been in the vanguard of a slew of initiatives in refining and expanding this ICT initiative. An analysis of the government electronic services delivery and its ramifications on the digital divide within the state is attempted in the present study. The current literature on the digital divide essentially focuses on the nation as a unit, and so, most inferences apply to the nation as a whole. There seems to be no study that has examined the mutual interactions between government electronic services delivery and the digital divide, even at the country level. This study attempts to be more granular in its approach by examining the interactions between government electronic services delivery (termed "ESD – Meeseva" or "Meeseva" in this study) and the digital divide within the AP state. Specifically, the study aims to highlight the role played by government electronic services delivery in narrowing the digital divide and fostering trade and commerce, and herein lies its contribution.

2. SOCIOECONOMIC ASPECTS OF ANDHRA PRADESH STATE (AP)

AP is the eighth-largest state in India, spanning 160,205 square kilometers, and is located in the southern part of India. The population of AP (2011 census) is 49,577,103 individuals, with a literacy rate of 67.44%. The per capita income (as on 31-3-15) is ₹90,517 (in nominal terms, registering a growth of 11.21% over 2013–14), and is above the nominal national average of ₹88,533 (One USD = INR 66.235[1]). The nominal gross domestic product (GDP) is ₹520,030 crores in the financial year 2014–15 and represents a growth of 12.03% over 2013–14 (Directorate of economics and statistics, 2015).

3. THE RATIONALE FOR INFORMATION TECHNOLOGY AS A GROWTH DRIVER

The IT and ITES sector contributed ₹1,692 *crores* to the GDP in the financial year 2014–15, implying that its contribution to the state GDP is 0.32%. Since 2015, AP has adopted capacity-building programs for its citizens and government officials in digital literacy, provided Internet connectivity to rural households through aerial fiber grids at affordable prices, and is implementing a state-wide enterprise architecture e-government project (the e-Pragati project) in its quest to achieve certificate-less governance.

[1] The symbols "₹" and INR represent the currency of India – the Rupee.

The government of AP firmly believes that information technology (IT) and IT enabled services (ITES) can enhance the quality of life of its citizens through improving the quality in health care and education, enhancing productivity in agriculture and manufacturing, generating employment opportunities and aiding economic growth. In line with this vision, the government has formulated the IT policy, the electronics policy, and the innovation and entrepreneurship policies based on four fundamental pillars of public administration, namely, human capital, infrastructure, incentives and good governance. Through harnessing IT in government (e-government), the state aspires to provide high quality public services with speed and transparency (Andhra Pradesh Information Technology Policy, 2014–20).

We now look at the features of the government electronic services delivery project, popularly called the "Meeseva" project in AP.

4. GOVERNMENT ELECTRONIC SERVICES DELIVERY (ESD – MEESEVA)[2]

The government electronic services delivery (ESD – Meeseva), administered by the office of the Director (ESD – Meeseva), a department under government of AP, with its headquarters at Vijayawada, offers 350 government-to-citizen (G2C) services across 35 government departments, and more than 200 business-to-citizen (B2C) services to the citizens across the 13 districts of the state through 5,990 common service centers (CSCs). The ESD – Meeseva originated as a pilot project in 1998, offering utility payment services to citizens in the capital city of Hyderabad. Headed by the Director, and assisted by three deputy directors (administration, technical, and finance), five engineers, and around 20 support staff, the ESD – Meeseva implements e-public services delivery in the public-private partnership mode. In each of the 13 districts of the state, the joint collector of the district functions as an additional director, ESD, thereby ensuring regional presence (Sundar and Venkataramanaiah, 2016).

The Director (ESD – Meeseva) selects private firms through open competitive bidding for managing the CSCs. The private firms, in turn, engage rural youths called village level entrepreneurs (VLEs) through a competitive process to run and manage the CSCs on a commission basis or through a franchisee model. The VLE must invest initially in computers and Internet connectivity. The Director (ESD – Meeseva) provides buildings (sourced from local bodies) and essential furniture. The revenues earned by the VLE through the sale of G2C and B2C services are shared between the office of the ESD – Meeseva, the concerned private firm(s), and the VLE through a tripartite agreement. As of the date of writing this paper, the ESD – Meeseva has rendered 76,684,422 (76.68 million) G2C and B2C transactions (indicator of the volume of electronic services) to the citizens of the state. The citizen has to pay a service fee ranging from ₹25 to ₹35 (US$ 0.45 to 0.6) per transaction, which would be shared between the ESD – Meeseva office, the concerned government department, the private firm and the VLE according to the terms of contract. Table 1 shows the details of the revenue sharing pattern between the stakeholders. As mentioned earlier, there are 35 government departments dealing with various state subjects (like revenue, registration and stamps, education, food and civil supplies, health and housing). In addition to the sharing mentioned above, the ESD – Meeseva office retains 3–5% of the revenues for meeting expenditure towards secured stationery certificate costs (Sundar and Venkataramanaiah, 2016).

[2] The content in Section 4 is extracted from Sundar and Venkataramanaiah (2016).

Table 1: Revenue Sharing Pattern of the Stakeholders in the Electronic Services Delivery (ESD – Meeseva) Project

Stakeholder Details	Revenue Share (percent)
The concerned government department	20–28
ESD – Meeseva office	4–28
Private partner	9–14
Village level entrepreneur	32–47

Source: Office of Director, Electronic Services Delivery – Meeseva, Government of Andhra Pradesh, Vijayawada.

It should be noted that the ESD – Meeseva office has entered into separate contracts with five different firms in the state for managing the CSCs in the state (the state is divided into four zones for the purpose, and the districts within the zones have been divided into rural and urban areas). Bids were invited zone-wise and then separately for the rural and urban areas, and each winning bid differed on the revenue sharing arrangements between the ESD – Meeseva, the private firms, and the VLE. Table 1 reflects this heterogeneous arrangement. For example, the revenue share of the ESD – Meeseva office varies between 4 and 28%. Likewise, the VLE is entitled to a share in the range of 35–47% of the revenues, depending on whether she or he is operating in the urban or the rural area, and depending on the zone.

The popular and high volume G2C and B2C services are offered through three service delivery channels – (a) CSCs, the common service centers, which essentially is the kiosk model; (b) online, where G2C and B2C services can be accessed, and availed of through an Internet connection; and (c) smart phones, through the mobile Meeseva app.

The ESD – Meeseva project has been chosen by the central government for country-wide replication and the ESD – Meeseva project has been a recipient of the Computer Society of India – Nihilent award 2012 (http://www.csinihilent-egovernanceawards.org/), the National e-Governance Award 2014 (http://nceg.gov.in/sites/nceg.gov.in/files/list_of_awards.pdf), the Skoch order of merit award 2015 and 2016 editions (http://www.skoch.in/), and the Digital Trailblazers Award, 2016.

Table 2 shows the earnings of the VLE in the state for the financial years 2011–12 to 2014–15, and indicates a measurable contribution of the ESD – Meeseva initiative to the gross domestic product (GDP). The ESD – Meeseva project has created a class of grass-roots entrepreneurs (the VLEs) and invested them with social status and earning potential. Each VLE, on average, earned ₹8,462 per month in the financial year 2014–15. The ESD – Meeseva project employed 4,565 VLEs in 2014–15, which implies that the VLE in the state earned ₹386.3 crores during the year. Documentary evidence and the author's enquiries reveal that, on average, the VLEs spends 90% of their income on food, clothing, and other basic necessities. This consumption of goods and services by VLEs is a contribution to the GDP.

Further, the ESD – Meeseva office has earned ₹105,49,193 (₹10.5 million) as revenue in the financial year 2014–15. As Table 1 shows, 20–28% of these revenues are ploughed back into the concerned departments, which maintains the data and owns the government processes for delivering the public service in electronic form. Assuming an average investment of 24%, this implies a transfer of ₹25.32 million to the various government departments by the ESD – Meeseva office in the financial year 2014–15. Enquiries with the concerned heads of departments reveal that the departments use

these funds for various public welfare activities, aligning with the mandate of the department, including hardware and software infrastructure for sustaining the electronic delivery of public services. This government spending also contributes to the GDP (Sundar and Venkataramanaiah, 2016).

5. ESD – MEESEVA AND THE DIGITAL DIVIDE

Where does India stand with reference to ICT usage? The United Nations International Telecommunication Union (2014) has developed an ICT index for 166 nations of the world, and India is ranked at 129 in this list, implying low levels of ICT access and usage (International Telecommunication Union, 2014). The ranks for individual states within India are not mentioned.

In the present study, the number of electronic transactions recorded in the CSCs (Meeseva kiosks which are spread across the state) is taken as a measure of digital literacy. Citizens approach a CSC to apply for a caste certificate, a ration card, or pension, which requires engaging online with a government functionary, typically referred to as a G2C service. Alternatively, the citizen may want to pay her phone and electricity bills, pay insurance premiums or book a movie ticket, which are termed as B2C services. The VLE facilitates this process and, as explained earlier, receives a commission, depending on the nature of the service. A higher number of such G2C and B2C transactions indicates that the inhabitants are aware of and avail themselves of such electronic services, which implies a higher level of digital literacy. On the other hand, low transaction volumes of G2C and B2C services imply lower levels of digital literacy.

In this study, a *mandal*, the lowest unit of revenue administration, is considered the unit of analysis. A district is subdivided into two or three revenue divisions, and each revenue division is further subdivided into 10–12 *mandals*. A *mandal* comprises a group of 15–20 revenue and forest villages, and a geographically and demographically dominant village would have a *grampanchayat*. There are 13 districts, 686 *mandals*, 12,992 *grampanchayats*, and 5,000–5,400 forest villages in AP. In Table 3, the socioeconomic characteristics of the 13 districts are presented. In view of the amorphous nature of villages with *grampanchayat* and forest villages, the *mandal* is taken as a unit of analysis, as mentioned earlier.

Assuming a normal distribution of population and functional literacy at the *mandal* level and a strong positive correlation between functional and digital literacy, one would expect that the average number of electronic transactions for G2C and B2C services recorded in the CSCs of the *mandal* for a specific time period would be fluctuating around an average, without noticeable skews.

Table 3: Socioeconomic Characteristics of the Districts in Andhra Pradesh State

Serial. No.	District	Number of Revenue Divisions	Number of Mandals	Population (2011 census)	Area (square km.)	Population density	Percent of Urban to Rural	Literacy Rate*	District GDP** (₹ Crores)	Per Capita Income (₹)**
1	Ananthapuramu	5	63	4,081,148	19,130	213	28.07	63.57	34,487	75,463
2	Chittoor	3	66	4,174,064	15,152	275	29.50	71.53	30,359	64,816
3	East Godavari	7	64	5,285,824	10,807	413	24.85	70.50	43,759	75,977
4	Guntur	4	57	4,887,813	11,391	429	33.81	67.40	41,346	78,762
5	Krishna	4	50	4,517,398	8,727	518	40.81	73.74	46,018	89,398
6	Kurnool	3	54	4,053,463	17,658	229	28.35	59.97	25,505	57,311
7	Prakasam	3	56	3,397,448	17,626	193	19.56	63.08	29,966	81,516
8	Sri Potti Sriramulu Nellore	5	46	2,963,557	13,076	227	28.94	68.9	25,529	78,537
9	Srikakulam	3	37	2,703,114	5,837	463	16.16	61.74	15,877	52,701
10	Visakhapatnam	4	43	4,290,589	11,161	384	47.45	66.91	54,454	109,800
11	Vizianagaram	2	34	2,344,474	6,539	359	20.94	58.89	15,748	60,178
12	West Godavari	4	46	3,995,742	7,742	470	20.24	74.32	35,114	78,345
13	Y.S.R. Kadapa	3	50	2,882,469	15,359	188	33.97	67.30	21,229	66,015
Total		50	686	49,577,103	160,205	–	–	–	419,391	–
Average		–	–	7,082,443	–	3121	26.62	67.44	59,913	69,201

Source: Socioeconomic survey 2016–17, Planning Department, Government of Andhra Pradesh; Andhra Pradesh Economy 2014, Directorate of Economics and Statistics, Government of Andhra Pradesh.

* Percentage of literates to population ages 7 and above.

** The District Gross Domestic Product (GDP) and the real per capita income pertains to FY 2012–13.

In the study, the G2C transactions of all the 686 *mandals* in AP for the period 1-10-15 to 30-9-16 is analyzed. This period is recent and covers a government business year, accounting for tourist inflows, school and college examinations, and vacations within the state. For the twelve month period, the average number of G2C transactions recorded in the *mandals* is 25,912 (with a monthly average of 2,879 G2C transactions). The number of G2C transactions in 485 *mandals* (71% of the total number of *mandals*) of the state were below this average. Only nine *mandals* breached the 100,000 transaction mark for the time period under consideration, with Visakhapatnam (urban) *mandal* recording the maximum number of transactions (301,991). The least number of G2C transactions (274 G2C transactions) were recorded in Ramachandrapuram *mandal* of Chittoor district. Ten *mandals* did not cross even the 1000 transactions mark for the nine month period, of which 6 *mandals* are in East Godavari, the district with one of the highest functional literacy rates. The distribution of transactions, district-wise, is indicated in Table 4. In summary, these results present a skewed distribution, implying a certain degree of digital divide.

Table 4: District-wise Government-to-Citizen (G2C) Transactions for the Period 1-10-15 to 30-09-2016

Serial No.	District	Total G2C Transactions for the Period 1-10-15 to 30-9-16
1	Ananthapuramu	2,361,197
2	Chittoor	1,489,230
3	East Godavari	1,056,769
4	Guntur	1,929,992
5	Krishna	1,205,302
6	Kurnool	1,583,241
7	Prakasam	1,415,631
8	Sri Potti Sriramulu Nellore	1,232,051
9	Srikakulam	1,084,741
10	Visakhapatnam	1,136,557
11	Vizianagaram	766,115
12	West Godavari	1,167,942
13	Y.S.R. Kadapa	1,313,904
Total		17,742,672
Average		1,364,821

Source: Office of Director, Electronic Services Delivery – Meeseva, Government of Andhra Pradesh, Vijayawada.

Further analysis reveals that citizens did not use all the 350 electronic services on offer in a proportionate manner. 30–35 electronic services accounted for 85% of the total volume of transactions recorded in the 12-month period considered in this study. Specifically, the top five G2C services which the citizens demanded in the urban areas and used are (i) application for land registration and its corrections; (ii) application for income certificate; (iii) food ration card application; (iv) temple *darshan* ticket booking; and (v) application for birth certificate. Similarly, the top five B2C services which the citizens used are (i) electricity bills payments; (ii) vehicle tax payments; (iii) property tax payments; (iv) driving license slot bookings for test rides; and (v) payment of traffic fines. In the rural areas, too, the pattern of demand for G2C services by the citizens was similar, though the volumes were low. Approximately, urban citizens accounted for 60% of the total number of G2C transactions, and rural citizens accounted for the

remaining 40%. With reference to B2C transactions, urban citizens accounted for 85% of the total number of B2C transactions and rural citizens accounted for the remaining 15% (ESD – Meeseva office records).

This analysis reveals that rural and urban citizens in the state are aware of electronic services offered by the Government through the ESD – Meeseva office and have made use of the services in a range of life cycle events, spanning land records, payment of utility bills and temple *darshan* bookings. This indicates an acceptable degree of digital literacy, at least in the urban areas of the state.

Records show that several CSCs in the rural areas have transacted low volumes of electronic G2C transactions. It may be noted that several such *mandals* are not easily accessible and abut remoter forest villages. For example, Maredumalli *mandal* in East Godavari district, which is located in the forest tribal agency areas, recorded 535 transactions for the 12-month period. Despite the low volume of transactions, it is interesting to note that inhabitants of this *mandal*, generally considered socially and economically backward, are aware of electronic services and have used these services for their welfare.

Property tax payments and applications for land records and birth certificates form the bulk of citizens' requests during the 12-month period of this study. Traditionally, the departments concerned with these services are considered to be corrupt, where citizens were compelled to pay unreasonable and illegal rents to government officials to use these services prior to the ESD – Meeseva project. Rendering these services online through the ESD – Meeseva project has removed this layered corruption to a large extent, which may have resulted in cost savings and improved citizens' satisfaction levels. The proliferation of such advantages would incentivize even functionally illiterate citizens in rural areas to approach the CSCs in their proximity to use these services. Such forces may eventually help reduce the gap in the digital divide.

The high demand for temple *darshan seva* tickets (in Sri Venkateshwara Swamy temple, Dwaraka Tirumala, and Sri Veera Venkata Satya Narayana temple, both in the East Godavari district), which can be applied for online in CSC kiosks and through the mobile phone app, reveals yet another facet of electronic services delivery in narrowing the digital divide. While demand for online tax payments, utility bills payments and applications for driving licenses through the ESD – Meeseva reflects a certain amount of user sophistication in terms of digital and functional literacy, the citizens demanding temple *darshan seva* tickets form a demographic subpopulation who may not be as functionally and digitally literate. Demand for government electronic services pertaining to temple *darshan* tickets from religion-oriented citizens, who may not be functionally and digitally literate, reveals the pervasive influence of the ESD – Meeseva project in narrowing the digital divide.

Building on the IT backbone of ESD – Meeseva, which interacts continuously with all the departments of the government to deliver electronic services to citizens, a portal termed "Meekosam" has been designed, where rural and urban citizens can register their grievances online through an Internet connection (this portal was inaugurated in April 2015) and seek redress from concerned government officials. The grievance redress process is governed by strict service level agreements, which includes a daily penalty of ₹50 on erring government officials of some departments. Since updates on a registered complaint are routed through short messaging services (SMS), the Meekosam project relies on a strong mobile phone penetration. Over the past 17 months, 60.65 *lakhs* grievances have been registered in the Meekosam portal, and 58.61 *lakhs* grievances have been resolved by government officials, implying a redress

rate of 90.4% (ESD – Meeseva office records). This reasonable success of Meekosam project reflects a high degree of mobile phone penetration in the rural areas of the state, where studies reveal that penetration rates are approximately 85% as of 2016. This evidence also implies that the ESD – Meeseva project has made some inroads in closing the digital divide.

6. DETERMINANTS OF THE DIGITAL DIVIDE

Using data from the ESD – Meeseva and the Chief Commissioner of Land Administration (CCLA) office for the period 1-10-15 to 30-9-16, this cross-sectional study attempts to pinpoint some determinants of the digital divide in AP. The ESD – Meeseva office has an authoritative data bank of *mandal* level e-transactions pertaining to the various departments in AP, while the CCLA office is the source of socioeconomic characteristics of the population at the *mandal* level. Table 5 reports the descriptive statistics of the *mandal* data employed in the study.

Table 5: Summary Statistics for the Mandal-wise Data of Andhra Pradesh State

Parameter	Mean	Standard Deviation	n =
Number of realized e-services transaction per mandal for the period 1-10-15 to 30-9-16*	25,912	24,816	686
Number of Common Service Centers (CSCs) per mandal as on 30-9-16*	8	8	686
Number of Government institutions that offer e-services to the public per mandal as on 30-9-16*	32	22	686
Population per mandal** (as per 2011 census of the Registrar General of India)	74,782	13,381	686
Sex ratio (number of women per 1000 men)**	996	437	686
Percentage of rural population to total population per mandal**	71.3	8.81	686
Percentage of urban population to total population per mandal**	28.7	8.8	686
Percentage of child population to total population per mandal**	10.6	0.78	686
Literacy rate [men] per mandal (Number of male literates to total number of male population aged six years of age and above)**	74.5	3.42	686
Literacy rate [women] per mandal (Number of female literates to total number of female population aged six years of age and above)**	59.12	7.29	686
Literacy rate per mandal (Number of literates to total population aged six years of age and above)**	67.4	5.04	686

Source: *Office of Director, Electronic Services Delivery – Meeseva, Government of Andhra Pradesh, Vijayawada. **Statistical Abstract of Andhra Pradesh 2015, Directorate of Economics and Statistics, Government of Andhra Pradesh, Central Ground Water Board, Government of India, and the Census, 2011 conducted by the Registrar General and Census Commissioner of India.

For econometric estimation, the ordinary least squares (OLS) model is used in the study. An assumption of the model used here is that the errors are homoskedastic, serially uncorrelated, and are normally distributed, thereby implying that OLS yields the best, linear, and unbiased estimators. R is used for econometric estimation.

The population model is specified as follows:

$$\textit{Total e-transactions in the mandal per year} = \beta 0 + \beta 1 * \textit{number of Meeseva centers in the mandal} + \beta 2 * \textit{population in the mandal} + \beta 3 * \textit{urban service provider 2} + \beta 4 * \textit{rural service provider 2} + \beta 5 * \textit{rural service provider 3} + \beta 6 * \textit{rich mandal} + \beta 7 * \textit{number of government institutions that offer e-services in the mandal} + u... \quad (1)$$

The dependent variable in (1), "total e-transactions in the *mandal* per year", is the *mandal*-specific realized number of e-services transactions during the period 1-10-15 to 30-9-16. This metric is assumed to be a quantitative indicator of the level of digital literacy of the population in the *mandal*. A higher number of realized e-transactions in the *mandal* may imply that the population therein are more digitally literate, technologically savvy and prefer the digital mode when using public services, while a lower number of e-transactions may imply that the population, on average, may not have the awareness and inclination to use e-public services, indicating relatively lower levels of digital literacy. As discussed in Section 5, the number of realized e-transactions in the CSCs vary between 274 (in Ramachandrapuram *mandal*) and 301,991 (in Visakhapatnam *mandal*) during the period 1-10-15 to 30-9-16. This study makes a reasonable assumption that higher levels of digital literacy imply narrower levels of the digital divide at the *mandal*- and the state-level. This assumption implies that the digital divide is narrower in Visakhapatnam *mandal* relative to Ramachandrapuram *mandal* for the period referenced in the study.

Conceptually, digital literacy and the digital divide are not equivalent, but have several overlapping contours, which becomes clear when one examines their definitions. While "Digital divide" describes the gap that exists in access and use of ICT among different population groups within and across countries (see Section 1), "Digital literacy" refers to the ability of persons to use digital tools and ICT to access and analyze digital resources to create new knowledge, communicate, and engage in social action with other people (Ng, 2012). Dissecting further, Eshet-Alkalai (2004) specifies five types of literacies that are enveloped within digital literacy: (a) photo-visual literacy, which is the ability to read from visuals; (b) reproduction literacy that describe skills in re-combining new and preexisting materials into new products [such as with cut and paste]; (c) branching literacy that indicates the ability to navigate hypertexts in a nonlinear manner to access the required information; (d) information literacy, which is the ability to think critically and analyze the web-based information; (e) socio-emotional literacy, which depicts the skills required for engagement in social media, online banking and purchasing, and avoiding social media predators and cyber frauds. VLEs and citizens require and display varying degrees of photo-visual, reproduction, branching, information and socio-emotional literacy levels in their interactions with each other in public services delivery. As mentioned earlier, it is assumed that a higher proportion of digitally literate individuals (measured through a proxy like the realized e-transactions in CSCs) tends to reduce the gap between the digital divide at the *mandal* level.

What institutional and economic factors influence the people at the *mandal* level to use e-public services, in lieu of approaching the concerned departments physically and using services in person? How does the improved availability and accessibility of e-public services to the citizenry impact trade, commerce, and business? This study attempts to answer these questions in this section.

The number of CSCs offering G2C services in the *mandal* may have a positive influence on the quantity of e-transactions for public services. Under the existing government rules, one CSC is being permitted for a population of up to 5,000 in the state. Depending on the terrain and other geographical factors, the district administration has the flexibility to open additional CSCs to serve a population of less than 5,000, too, depending on the commercial viability. In the OLS model, the total number of CSCs in the *mandal* is expected to have a positive relationship with the dependent variable. As mentioned earlier, there are 686 *mandals* in AP, and under the government of India-aided CSC 1.0 project (2007–2017), every *mandal* is served by at least one CSC kiosk with the mandated number of G2C and a varying number of B2C services. On average, a *mandal* is served by about 8 CSCs. There are no *mandals* that are not served by CSCs in the state.

The state government of AP introduced the supporting legislation to implement the CSC 1.0 project in 2007 to provide web-enabled e-government services in the rural areas of the state. Additional legislation was introduced to provide legal sanctity to digital signatures of government functionaries and to levy prescribed user charges from citizens using e-services from CSCs in the state. Since these laws applied to the CSCs in all 686 *mandals* within AP, with a more or less uniform impact on the provisioning and demand for e-public services, regulatory policies governing the introduction and management of e-services for the citizens are not treated as a variable in this study to avoid issues relating to endogeneity.

The population in the *mandal*, representing the human capital, is also expected to have a positive relationship with the dependent variable. Low population densities, especially in the forest agency tracts (example, Mummidivaram *mandal* in East Godavari district with a population of 19,507), may require minimal e-public services. A CSC presence therein, mandated by government policy, may generate just enough demand for a break-even in such *mandals*. On the other hand, *mandals* with higher population densities (example, Guntur *mandal* with a population of 779,289), may generate a high demand for e-public services because its citizenry is endowed with relatively higher disposable incomes, higher education levels and higher material needs, as compared to citizens from *mandals* with low population densities.

As explained in Section 4, the ESD – Meeseva office employs multiple service providers to operate CSCs through franchisees in the urban and rural areas. Specifically, urban service provider 1 is assigned the urban areas in the *mandals* of the East Godavari, Krishna, Srikakulam, Vishakapatnam, Vizianagaram, and West Godavari districts, while urban service provider 2 is assigned the urban areas in the *mandals* of the Anathapur, Chittoor, Guntur, Kurnool, Potti Sriramulu Nellore, Prakasam, and Y.S.R. Kadapa districts. This is coded as a categorical variable to capture the effects in (1).

Similarly, the ESD – Meeseva office employs three service providers [rural service provider 1 (the Ananthapur, Chittoor, Potti Sriramulu Nellore and Y.S.R. Kadapa districts), rural service provider 2 (the East Godavari, Guntur, Kurnool, Prakasam, Srikakulam, Vishakapatnam and Vizianagaram districts), rural service provider 3 (the Krishna and West Godavari districts) and represented as a categorical variable] to operate CSCs through VLEs in the rural areas. The quality, reputation, and the entrepreneurial spirit of the service provider may encourage citizens to visit CSCs more often for various requirements. For example, some of the rural service providers, besides offering the 350 G2C services, also offer a heterogeneous bouquet of B2C services (like online movie ticket booking, mobile phone top ups, insurance premium payments and bus and air ticket bookings, in addition to the utility payment services), which provide more earning opportunities to the VLEs, as compared to the other rural

service providers in the *mandal*. Further, urban service provider 2 is a comparatively smaller firm with a decade of exposure to e-government business, while urban service provider 1 has more exposure in financial and data management services, but with minimal exposure to e-government business.

Ananthapur, Chittoor, Kurnool and Y.S.R. Kadapa districts in the Rayalaseema region are economically disadvantaged, due to geographical reasons like rugged terrain, scanty rainfall and the resulting aridity. Relatively low levels of economic development in the *mandals* of the districts from Rayalaseema region may not enthuse its citizens to adopt e-government public services in a big way, as compared to the population from the more prosperous regions. This may also discourage the service providers from opening up more CSCs in the Rayalaseema region. Thus, the variable "rich *mandal*" is included in (1) as a categoric variable to account for this influence.

The number of government organizations in the *mandal* that have adopted IT for their business processes and offer some or all of their services electronically may be a pull factor for the citizens and thus increase the number of e-government services transactions in the *mandal*. Government departments, like forests and environment, economics and statistics and the legal department, may have minimal public interface at the *mandal* level, and so, little to offer by way of e-public services, as compared to land revenue, transport, and commercial taxes departments. Hence, the variable "Government departments in *mandal* that offer e-government services" is expected to have a positive relationship with the dependent variable.

The independent variables used in the regression are explained in Table 6.

Table 6: Independent Variables Used in the Model

Independent Variables	Definition of Variable
Number of Meeseva centers	This variable refers to the total number of Meeseva centers in the mandal offering G2C services to the citizens
Population	This refers to the total population of the mandal, based on 2011 census
Urban service provider	There are two urban service providers, who employ franchisee agents in urban areas of the mandals in AP to offer G2C services to the citizens; this is coded as a categoric variable, with urban service provider 1 being the reference variable
Rural service provider	There are three rural service providers who employ village level entrepreneurs in the rural areas of the mandals in AP to offer G2C services to the citizens; this is coded as a categoric variable, with rural service provider 1 being the reference variable
Rich mandal	The rayalaseema districts comprising kadapa, chittoor, kurnool, and anathapur are economically backward, due to geographical reasons like scanty rainfall and aridity; this is coded as a categoric variable (reference category is poor mandal)
Number of publicly funded organizations	This refers to the number of Government organizations in the mandal that have adopted IT for their business processes and offer some or all of their services electronically

6.1 Predictors of Digital Literacy

Table 7 reports the results of the estimation of the model in (1). The number of CSCs offering G2C services has a significant effect. *Ceteris paribus,* for every increase of a CSC unit in a *mandal*, the number of e-government transactions is predicted to increase by approximately 1,447 per year (significant at the 1% level). This is economically significant, too. Since a CSC offers about 350 G2C services and a varying number of B2C services, depending on the service provider, more CSCs would enable a higher number of e-transactions in the *mandal*, subject to commercial viability of the CSCs, as assessed by the service provider.

Table 7: Predictors of Digital Literacy in the Mandal

Dependent Variable: Total e-Transactions in the Mandal per Year	
Number of Meeseva centers	1,447***
	(88.3)
Population	0.1405***
	(0.0012)
Urban service provider 2	–14,890***
	(1,670)
Rural service provider 2	–1,963***
	(1,661)
Rural service provider 3	–4,627*
	(2,476)
Rich mandal	275.4
	(166.3)
Number of Government institutions offering e-services	30.68
	(36.69)
Intercept	9,735
	(1,436)
Observations	685
R-squared	0.6734

Note: "***" 0.001, "*" 0.10. Standard errors in parentheses.

As expected, human capital has a positive association with digital literacy. All things being the same, if the population in a *mandal* increases by 100 individuals, the number of e-government transactions is predicted to increase by approximately 14 on a yearly basis (significant at the 1% level). Population influx and migration at the *mandal* level can happen due to factors like job-related displacements, tourism, births and deaths. It may be noted that even functionally literate individuals must also possess an inclination to adopt digital technologies to use services relating to government, leisure and other life cycle events.

The entrepreneurial ability of the urban service providers has a significant and positive effect on digital literacy at the *mandal* level. All else being equal, CSCs operated by urban service provider 2 are predicted to have 14,890 fewer e-government transactions per year, as compared to urban service provider 1 (significant at the 1% level). As noted earlier, urban service provider 1 has significant exposure in financial and data management technologies and may have offered more privileges and financial offerings for citizens availing G2C services in the *mandal*, which may have encouraged more B2C services. Drawing on her expertise in financial management technologies,

urban service provider 1 partnered with mobile wallet companies to offer attractive incentives and discounts to users using G2C and B2C services.

A similar trend is discerned in the case of rural service providers. *Ceteris paribus,* CSCs operated by rural service provider 1 are predicted to have 4,627 more e-government transactions per year, as compared to rural service provider 3. The result is, however, statistically significant at the 10% level. Rural service provider 1 has been associated with the ESD – Meeseva project since inception, and her knowledge of the operational terrain in e-government is immense as compared to the other rural service providers. Rural service provider 1 also offers attractive incentives to users and a wide range of B2C services that projects some of their kiosks in the rural areas as a "one stop shop" for all the citizen's needs.

Other factors, like geographical backwardness of districts and the number of government organizations offering e-government services, do not have a significant effect on the digital literacy of the population in the *mandal*.

The F-statistic for the overall model specified in (1) is 199.5 on 7 and 677 degrees of freedom, and thus the overall model is jointly significant. This means we reject the null that the independent variables have no effect on the dependent variable in (1). The R-squared reported for (1) is 0.6734, implying that approximately 33% of the variations in the dependent variable of the model specified in (1) is not explained. Thus, other factors like literacy levels of the population may have to be included in this model.

6.2 Effect of Digital Technologies on Trade

6.2.1 Positive Effects

Econometric estimations reveal (see Section 6.1) that the entrepreneurial spirit and competency of service providers, both in the urban and rural areas of *mandals*, have a statistically significant and positive relationship with the number of e-government transactions therein. In addition to providing the mandated popular G2C services, the service providers also offer several B2C services, like insurance premium payment services, mobile phone top ups, utility payments, air, train, and bus ticket bookings, movie tickets booking, fund transfer services and Xerox copying services, to augment their income and incentivize the franchisees and the VLEs.

For this purpose, some of the service providers have commercial agreements with firms selling point-of-sale (POS) machines and e-wallet firms like Paytm, Freecharge and Mobikwik, which, in turn, offer attractive incentives to citizens using these services. Thus, the CSC centers in *mandals* with high population densities foster an ecosystem that is conducive to the rapid development of businesses in the transport, leisure and tourism, entertainment, electronics and telecommunication and financial technology spaces.

6.2.2 Negative Effects Mediated by Demonetization

Digital technologies can also have a crippling effect on trade and economy in the absence of appropriate IT infrastructure-readiness. Some evidence in support of the argument can be inferred from the recent and sudden decision of the government of India to demonetize 500 rupees and 1,000 rupees notes of the Mahatma Gandhi series and declare these notes as illegal tender on 8-11-16. This constitutes a field experiment and affords a window to study the effects of demonetization on the nation's economy.

The sudden demonetization sucked out approximately rupees 15.46 *lakh crores* of these high denomination notes, constituting a staggering 86% of currency in circulation in the Indian economy. The government allowed the citizens to surrender and exchange the invalidated 500 and 1,000 rupee notes in banks, subject to some verifications, until 31-12-16. The purported objective of this sudden demonetization of high denomination notes, the government claimed, was to reign in black money (defined as any money income for which taxes imposed by the government and other public authorities have not been paid[3]), filter out counterfeit currency notes, and combat terrorism. Policy makers assumed, perhaps rightly, that terrorism is being funded by the parallel economy (estimated to be about 20% of the GDP) through black money (Guruswamy, 2017).

Sundar (2017) describes the adverse impact of the demonetization on the common man and the general economy and critically reviews the efforts of the government of AP to address the currency shortage issues faced by the citizens. In response to the problems created by demonetization, the government gave a massive push to cashless payment systems through digital tools, despite the apparent paucity of the required IT infrastructure. For example, CSCs were advised to install point-of-sale (POS) machines, and digital wallet firms (like Paytm) were encouraged to introduce cashless payment systems in all citizen-government interfaces in the state, which include fair price shops, government liquor shops, bus station depots, roadside shops, agriculture markets, and fertilizer markets. Sundar concludes that hidden charges (like the merchant discount rates levied by the banks on business establishments) and the high costs of POS machines discouraged businesses and citizens from opting for cashless payment systems, after sufficient currency was pumped back into the economy after four months of economic turmoil.

7. MANAGERIAL IMPLICATIONS AND CONCLUSION

Often, it has been observed that the government officials in the lower rungs have resisted digitization of their work processes due to factors like uncertainty associated with technology, loss of rent, and lack of knowledge in information technology. This has somewhat affected the pace of e-government services delivery in ESD – Meeseva. What could be done to bridge this digital divide? The government, in its quest to address this issue, distributed 98,000 Tablet PCs to the *mandal*- and district-level government functionaries working in welfare departments (like agriculture, land revenue, and fisheries) and facilitated training in their usage by roping in students of engineering colleges during the year 2015-16, due to a paucity of training faculty. The response of engineering students and their faculty has been lukewarm, perhaps due to lack of incentives and their own course curriculum pressures.

The central government has evolved a digital literacy program to impart basic and advanced digital literacy to urban and rural households, self-help group workers and fair price shop owners in AP. Approximately 30,000 beneficiaries have been trained so far under this program. The state government needs to play a more active role in pushing this initiative forward.

[3] Ministry of Finance, Government of India (2012). *Black Money,* (p.2), accessed online http://www.finmin.nic.in/reports/WhitePaper_BackMoney2012.pdf

The findings from this study show that the government electronic services delivery (via the ESD – Meeseva project) has somewhat reduced the digital divide in access and usage by citizens from the urban and rural areas in AP from two fronts. Firstly, the nudge to the citizenry from the service providers through their entrepreneurial spirit has been empirically documented in this study. Secondly, demonetization-induced initiatives (installation of POS devices in ESD – Meeseva kiosks and offering G2C and utility payment services online) have encouraged the citizens to use digital tools for public services in ESD – Meeseva.

The ESD – Meeseva is now planning to further scale up its CSCs kiosks in all the *gram panchayats* (12,992 *gram panchayats* in AP), which, in turn, may have ripple effects in fostering innovative B2C transactions. The ESD – Meeseva model, as evolved in AP, thus holds considerable potential to narrow the digital divide within the state. This holds lessons for states, especially in the north-eastern region in India, where the digital divide is more perceptible. Replication of the ESD – Meeseva in such states would go a long way in addressing issues related to the digital divide.

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