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Gender of household head and the digital divide in South Africa's settlements

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ABSTRACT

In South Africa, female household headship is sometimes shown as an indicator of economic disadvantage. As a result, female-headed households (FHHs) are expected to have limited access to information communication technologies (ICTs). This study analyzed the concept of the digital divide by the gender of the household head in South African settlements based on South Africa's annual General Household Survey data sets from 2011 to 2014, and the 2011 South African Census data. Tetrachoric correlation coefficients were used to examine the relationship between the gender of household head and access to various forms of ICTs in South African settlements. The results of the study show that for some technologies, female household headship is more closely correlated to access to ICTs for FHHs in remote tribal rural areas compared to FHHs in the more developed or more accessible informal urban areas and formal rural areas. The study shows the confounding effect of the household's location of residence on the relationship between the gender of the household head and household access to ICTs in South Africa. The income of the household head rather than their gender is revealed as a major determinant of household access to ICTs.

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Introduction

Although there is an ongoing debate about the developmental role of information communication technologies (ICTs) in developing countries, various arguments have been raised with regards to their role as agents for women's empowerment (Islam and Slack, 2016; Komunte, 2015; Maphiri-Makananise, 2015). Studies have also shown that socio-economic disadvantages limit women's access and use of ICTs (Dlodlo, 2009; Klonner & Nolen, 2008; Nyatsanza & Chaminuka, 2014). Differences are also highlighted based on location of residence (Akca, Sayili, & Esengun, 2007; Suresh, 2016). In South Africa, female household headship is often used as an indicator of household economic disadvantages (Rogan, 2013; Rogan, 2014; Tibesigwa & Visser, 2015). Due to economic disadvantages, rural households, especially female-headed households (FHHs) are associated with limited access to various forms of ICTs and a greater experience of the digital divide.

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Gender differences in access to services are not always equally obvious. In a study of Msunduzi municipality in South Africa, Goebel, Dodson, and Hill (2010) established that FHHs in informal urban settlements face more challenges than in rural settlements because of the socio-economic challenges of urban life, such as unemployment and high living expenses. South Africa has a long history of labor migration by male workers to farms, towns, and cities, which resulted in FHHs constituting the largest proportion of households in deep rural places (Kossoudji & Mueller, 1983; O'Laughlin, 1998; Van Driel, 2011). Miller and Shrum (2011) show that even amongst the educated, women of all ages are less likely to use ICTs because of gendered expectations of work and family roles.

A study by the Swedish International Development Cooperation Agency (2001) found that due to the difficulties associated with measuring activities in the informal sector, careful consideration should be taken when using female household headship as an indicator of poverty or other disadvantages.

Very few studies have investigated the digital divide focusing on the gender of the household head. This paper reports on a study that was motivated by the need to understand the correlation between the gender of the head of household and the digital divide in the different types of South African settlements. We investigated household access to ICTs by the gender of the household head to provide an empirical basis for understanding the digital divide. Our study aimed to understand if there was indeed a relationship between household access to ICTs and the gender of the household head in the context of South African settlements. It is our intention to add to the discussion of the gender-based digital divide by providing empirical insight of the factors that decrease the digital divide and increase access to ICTs.

The digital divide in the South African context

Information communication technologies (ICTs) refer to hardware and applications that help people to access, retrieve, process, and exchange information (Wang, Hsu, Reeves, & Coster, 2014). ICTs refer broadly to mass communication media such as telephones, radio and television (International Telecommunications Union, 2009). According to Wang, Hsu, Reeves, and Coster (2014), ICTs are important at a personal and community level because they facilitate social contact (staying in touch with family and friends), economic transformation (management of business, increased business opportunities) and empowerment in life domains (opportunities for education and learning, opportunities for healthcare, participation in political processes, self-empowerment, entertainment) amongst others. Urbanization and the spread of Internet supporting infrastructure were found to be the most prominent components supporting access to the Internet and men were found to use the Internet more if they had completed secondary education (Birba & Diagne, 2012).

Theory of digital divide

Wilson (2006) and Bornman (2016) defines the digital divide as disparities in access to, distribution of, and use of ICTs. Factors contributing to the digital divide are: physical

access to ICTs, lack of skills and support, attitudinal barriers, and relevance of content (Bornman, 2016; Cullen, 2001; Dijk & Hacker, 2003).

Dijk (2005) and Pick and Sarkar (2016) outline the Theory of Digital Divide. The theory posits that positional and background differences lead to differential access in resources for an individual and consequently to inequalities in access to ICTs and subsequently inequalities of participation in the information society. J. B. Pick and Nishida (2015) explain that positional characteristics are social, economic, governmental, and societal openness attributes. Personal characteristics are indicators, which influence access and use of technology, such as a person's age, gender, well-being, knowledge, and skills level. Inequalities among combinations of personal and positional characteristics impact the amount of resources an individual has access to. These resources include time, material resources, social, cultural, and knowledge. Pick and Sarkar state that the access process steps are delimited in the theory as a circular process of motivation for access, access to material hardware and software, developing ICT skills, and gaining access to usage.

Scheerder, van Deursen, and van Dijk (2017) highlight in a recent article a shift in the Theory of Digital Divide from a 'first level divide' – which refers to access to the Internet and other ICTs – and a 'second level divide' – referring to Internet and ICT use skills – to a 'third level divide' in which tangible outcomes of ICT uses are highlighted. The third level of the divide refers to the expected benefits of Internet use that are economic, social, cultural, and personal.

ICT access in South Africa

Cellphone access and usage has been a growing and widely distributed mode of communication in South Africa (Aker & Mbiti, 2010; Brown, Cajee, Davies, & Stroebel, 2003; Tlabela, Roodt, Paterson, & Weir-Smith, 2006). A review by Tlabela et al. (2006), reports that cellphones were shown to be a more popular mode of communication than telephones. Access to telephones was higher in the predominantly urban provinces of Gauteng and Western Cape compared to the predominantly rural provinces of Eastern Cape, Limpopo, North West, Mpumalanga, and Northern Cape.

Household access to computers and the Internet studied by Tlabela et al. (2006) shows that only 13.6% of South African households had access to a personal computer in 2006. Unsurprisingly, the access was higher in the most urban provinces with households in the Western Cape Province being seven times more likely to have access to the Internet than households in the rural Limpopo Province. Tlabela et al. (2006) concluded that the most likely explanation for this phenomenon was that household Internet activity is more likely in high income earning households in urban areas. Another explanation was that Internet infrastructure is more easily available in urban environments.

Although women of all ages are disadvantaged in terms of access to ICTs, some studies have shown contrary findings. For example, Maphiri-Makananise (2015) found instances of studies done in South Africa and Mozambique where women own more cellphones than men or in Cameroon where women had more knowledge about the Internet than men. Although urbanization and gender are important determinants for

access to ICTs, studies which focus on the gender of the household head and access to ICTs by location of residence are very rare.

Household headship and access to ICTs

A household is an important unit for assessing well-being at a community level. The National Treasury of South Africa, the South African Local Governement Association [SALGA], and the South African Department of Cooperative Governance [SA CoGTA] (2012) use household units to allocate public funds through a proportion allocation based on poor households within a municipality. Statistics South Africa (2014) defines a household as 'a group of persons who live together and provide themselves jointly with food and/or other essentials for living, or a single person who lives alone. They generally occupy one dwelling unit for at least four nights of a week. The household head is defined in this context as the main decision maker or the person who owns or rents the dwelling place.

Female household headship is often used as an indicator of socio-economic disadvantage. In a study based on data from the South African Labor and Development Research Unit (SALDRU) and the KwaZulu-Natal Income Dynamics Study (KIDS), Posel (2010) explains that in South Africa, women household heads are marginally more likely to be the oldest person in their respective households. Posel argues that in South Africa, FHHs are considerably more likely to be economically vulnerable. Statistics South Africa (2011) in the Southern African Catholic Bishops' Conference (2012) further highlight that in the rural farming sector, women represent only 32% of the agricultural labor force. Despite the challenges faced by women, Posel cautions that although female household headship should be maintained as an identifier for economic disadvantage, this should not be generalized as not all FHHs are economically disadvantaged and not all male-headed households (MHHs) are economically leveraged.

Statistics South Africa Census 2011 data reveals that FHHs constitute the largest proportion of household heads in the country. Since women are more likely to be economically disadvantaged, the households they head are expected to be less likely to have access to ICTs. Posel (2010) outlines that women who have an influence on household purchases in rural South Africa are likely to use finances for family upkeep while male heads are inclined to purchase goods such as livestock and unperishables. Households, which are solely female-headed are likely to purchase both, hence suggesting that gender preferences influence the choice to purchase and ownership of household goods. Gender comparison of socio-economic characteristics by location done by Statistics South Africa (2013) have shown differences by location such as formal urban, informal urban, tribal areas, and formal rural areas with tribal and formal rural areas being more disadvantaged.

Separate studies on developing countries by Hilbert (2011) found that when controlled for existing inequalities, women are seen to embrace digital technology more enthusiastically than men. Gillwald, Milek, and Stork (2010) have shown that South African women are more likely to own cellphones compared to men. In contradiction, Novo-Corti, Varela-Candamio, and García-Álvarez (2014) posit that the gender divide can be explained by women's negative attitude towards new technologies. Such

divergent views do not aid in developing policies or a developmental agenda for ICT access.

To understand the digital divide more succinctly in South Africa, we needed to understand the digital divide in terms of the gender of the household head. Additionally, we felt it was important to understand the ICT access by geographical location in this context.

Method and data

By using the Theory of the Digital Divide and recognizing the change in focus from a first level to a third level digital divide outlined by Scheerder et al. (2017), this paper explains the link between the gender of the household head and access to ICTs in South African settlements. The following section outlines the method and data used in the study.

Tetrachoric correlation

Uebersax (2015) explains that Tetrachoric correlation is used to measure the strength of the relationship between two dichotomous variables. The correlation ranges from -1 to +1. A positive correlation is a relationship between variables in which the behavior of variables change in tandem, i.e., one variable increases as the other increases or decreases when the other decreases. A negative correlation exists when the change of variables is opposing, i.e., one variable increases and the other decreases, and *vice versa*. A detailed explanation of the Tetrachoric correlation can be found in Harris (2006).

In our study, 'no access to an ICT' and 'access to an ICT' are represented by 0 and 1 respectively, while a FHH and a MHH are also represented by 0 and 1 respectively. Thus, correlation values close to +1 reflect a strong relationship between access to ICTs and male household headship while a negative correlation reflects a strong relationship between female headship and access to ICTs. A correlation of 0 reflects no relationship between gender of headship and access to ICTs. The computed correlation coefficients are tested for significance at the 0.0001% level of significance. Employment status, education status, and the income of the household head are used to control for socio-economic differentials between MHHs and FHHs.

The Data Sets: 2011 to 2014 GHS and 2011 South Africa Census

GHSs are conducted annually using a household survey questionaire, specifically designed to measure the living circumstances of South African households (Statistics South Africa, 2015). The focus of the survey is on household access to goods and services. The target population for the GHS consists of all private households in all nine provinces of South Africa (Statistics South Africa, 2014). The sample design of the GHS is based on a master sample, which uses a two-stage, stratified design with probability-proportional-to-size sampling of primary sampling units (PSUs) from within strata and systematic sampling of dwelling units (DUs) from the sampled PSUs on the second

stage. The survey uses approximately 20,000–30,000 households whose weighted estimate are representative of all South African households.

The 2011 South African Census was done by dividing the country into 103,576 enumeration areas (EAs). Each EA was allocated to an enumerator and the actual count began on the 9 October 2011. During the Post Enumeration Survey (PSU) (validation stage), enumeration areas (EAs) were selected to allow for the provision of estimates at national, provincial, urban (geographic urban), and non-urban (geographic type farm and traditional lands) though the estimates were more reliable at national and provincial level.

To study the effects of education, income, and employment, controlled data sets are used. These are derived by restricting the data to households whose head has a predefined level of education, income, or employment status.

Classification of South African areas in the GHS data sets and 2011 Census data

Statistics South Africa (2012b) specifies the four types of settlements into which South African areas are divided in the GHS data. The division is linked to the degree of planned and unplanned settlements (in the case of urban) and jurisdiction (in the case of rural settlements). The four broad settlement types are: formal urban, informal urban, tribal settlements, and formal rural settlements. Formal urban refers to planned urban areas. Informal urban refers to informal settlements or other unplanned settlements within a city. Tribal areas include areas where there is communal ownership of land as well as former homeland areas. Formal rural areas include commercial farm areas and small towns.

National Treasury of South Africa (2012) outline the municipal classifications used by SA CoGTA. The classification framework defines five types of areas. These are A (metropolitan areas), B1 (municipalities which are secondary cities), B2 (other municipalities within the urban core), B3 (commercial farming areas with significant urban populations), and B4 (communal land tenure and former homelands). Consequently, the areas defined as formal urban and informal urban areas by Statistics South Africa in the GHS data sets can be found in either the code A, B1, or B2 municipalities, formal rural areas are in B3 areas, and tribal areas in the B4 areas.

Results

Table 1 shows percentages of households with access to ICTs in the GHS data sets from 2011 to 2014 and the 2011 South African Census. The presentation is done by the gender of the household head and by settlement type. The four GHS data sets are necessary to establish a trend in ICT access over time and to verify consistency and authenticity of the results.

In Table 1, compared to FHHs, MHHs in formal urban areas, informal urban areas, and formal rural areas constitute the largest percentage of households in the four GHS data sets while FHHs in tribal areas have larger percentages in the four data sets (54.0, 54.8, 55.3, and 53.5%). Similarly, FHHs as opposed to MHHs have the largest percentage of household resident in B4 (communal lands and former homelands) in the 2011

Table 1. Percentage of households with access to Internet, telephone, cellphone, computers, television, and radio by the gender of household head (2011 to 2014 GHS & 2011 South Africa Census)

	2011 GHS		2012 GHS		2013 GHS		2014 GHS		2011 Census		
	Male	Female	Male	Female	Male	Female	Male	Female	Area	Male	Female
GENDER OF HEAD											
Formal urban	63.0	37.0	62.8	37.2	62.9	37.2	62.6	37.4	A	63.5	36.5
Informal urban	64.9	35.1	64.9	35.1	65.8	34.2	65.9	34.1	B1	62.1	37.9
Tribal areas	46.1	54.0	45.2	54.8	44.8	55.3	45.0	55.0	B2	58.4	41.6
Formal rural	72.1	28.0	75.4	24.6	75.4	24.6	75.0	25.0	B3	60.5	39.5
									B4	46.4	53.6
Overall	58.9	41.1	58.9	41.2	58.8	41.2	58.7	41.3	Overall	58.8	41.2
INTERNET											
Formal urban	19.3	10.8	19.0	10.1	19.5	9.5	20.5	10.8	A	15.6	10.6
Informal urban	0.3	0.1	0.8	0.2	1.2	0.7	1.6	1.7	B1	9.6	5.6
Tribal areas	1.1	0.5	1.2	0.9	1.4	1.1	1.9	1.6	B2	9.4	4.9
Formal rural	9.5	4.0	8.3	3.4	7.7	2.9	7.6	4.3	B3	6.5	3.2
									B4	2.5	1.3
COMPUTER											
Formal urban			34.4	21.5	33.2	21	36.1	22.2	A	34.6	26.9
Informal urban			4.1	1.7	5.1	4.2	6.1	3.4	B1	25.6	17.8
Tribal areas			6.4	3.9	7.7	4.7	8.4	4.7	B2	21.8	13.4
Formal rural			12.9	8.6	12.5	5.5	13.5	7.0	B3	17.1	9.8
									B4	9.1	5.6
CELLPHONE											
Formal urban	93.1	91.5	95.2	95.0	96.4	95.2	97.0	96.0	A	93.0	92.0
Informal urban	86.7	87.4	90.6	92.5	93.0	93.3	94.2	94.9	B1	90.7	89.9
Tribal areas	88.5	90.1	90.7	92.7	92.6	95.1	94.0	95.5	B2	87.8	87.2
Formal rural	82.0	85.0	86.6	82.9	88.6	88.9	91.7	87.8	B3	83.8	83.9
									B4	84.6	85.1
TELEPHONE											
Formal urban	27.3	20.8	24.6	20.8	22.6	18.0	21.8	16.8	A		
Informal urban	0.4	1.0	1.6	1.0	2.0	1.3	2.0	1.9	B1		
Tribal areas	1.1	0.9	1.5	0.9	1.7	1.4	2.4	1.8	B2		
Formal rural	10.7	7.5	8.0	7.5	6.7	3.0	8.5	4.3	B3		
									B4		
TELEVISION											
Formal urban	89.5	89.3	89.3	89.4	88.7	88.2	89.6	89.8	A	81.1	83.8
Informal urban	53.4	60.8	61.9	66.3	64.3	69.3	67.6	71.1	B1	77.2	79
Tribal areas	66.2	66.4	68.4	69.2	69.7	70.8	70.9	73.0	B2	73.2	74.4
Formal rural	57.3	49.9	55.3	50.1	61.3	62.9	59.7	55.1	B3	69.5	71.1
									B4	60.6	60.9
RADIO											
Formal urban	84.4	80.4	60.7	59.6	64.1	62.4	62.1	59.4	A	71.2	68.3
Informal urban	70.1	66.6	56.7	53.6	56.6	51.8	56.6	50.4	B1	72.2	68.7
Tribal areas	71.9	67.7	56.1	53.1	64.6	58.3	58.3	53.8	B2	69	64.6
Formal rural	71	67.5	58.1	55.9	70.7	51.8	63.7	55.6	B3	67	63.3

Census data (53.6%). As would be expected, GHS data show that households in formal urban areas (both FHHs and MHHs) generally have the highest percentages with access to all forms of ICTs compared to households in other settlement types (i.e., under access to Internet in the 2011 GHS, 19.3% for MHH, and 10.8% for FHH compared to the other area percentages for the same year. The same pattern is observed for the other years). Contrary to expectations, the percentage of FHHs with access to all forms of ICTs in tribal areas are generally higher compared to the corresponding percentages in informal urban areas and in some cases formal rural areas except for access to telephones (for example, FHHs in tribal areas have higher percentages of 90.1%, 92.7%, 95.1%, and 95.5% with access to cellphones for the years 2011 to 2014 compared to FHHs in informal urban areas for the same years. A similar pattern is observed for access to television and computers). For all ICTs, both tribal areas and formal rural areas predominantly have higher percentages of FHHs with access than those of informal urban places.

Further examination of the data shows that over the four years, FHHs in tribal areas generally have larger percentages of households with access to television (66.2 vs. 66.4% for 2011, 68.4 vs. 69.% for 2012, 69.7 vs. 70.8% in 2013, and 70.9 vs. 73.0% in 2014) compared to the corresponding percentages for MHHs. A similar pattern is observed for access to cellphones (88.5 vs. 90.1% in 2011, 90.7 vs. 92.7% in 2012, 92.6 vs. 95.1% in 2013, and 94.0 vs. 95.5% in 2014). The main observation is that FHHs have greater access to television and cellphones than MHHs in tribal areas. A separate analysis shows that FHHs are less likely to have access to satellite television in all areas. A possible explanation could be the effect of income on access to television.

Table 1 also shows the percentage of households with access to ICTs by gender of household head in the 2011 Census data. In the two types of rural areas, B3 (commercial farm areas) and B4 (communal lands and former homelands), FHHs have larger percentages of households with access to television and cellphones compared to MHHs (i.e., 84.6 vs. 85.1% for cellphones and 60.6 vs. 60.9% for television). A similar pattern is also evident in the other types of areas except formal urban areas.

Correlations of the gender of household head and ICT access in the 2011–2014 GHS

Tetrachoric correlation was used to study the strength of the relationship between the gender of the household head and access to ICTs. Correlation coefficients were computed for data controlled for income, education, and employment statuses of household heads.

Table 2 presents the correlations between the gender of the household head and access to the Internet, computers, and cellphones for each type of location in the GHS data sets. The table presents the statistics for correlation (r_1), sample size (N_1) and p_1 (p-value) for the years. Similarly, the statistics r_2, N_2, and p_2 are given for the controlled data. Due to limitations in the number of observation in the GHS data, the control was done for household heads, who satisfied any of the three variables, i.e., household heads with at least one year of education, household heads employed on permanent basis, or receiving a monthly income of R5000. The table shows that tribal areas generally have weaker positive correlation values or more negative correlation values for

Table 2. Tetrachoric correlation coefficients of the gender of household head and household access to Internet, computers, and cellphones in the 2011, 2012, 2013, and 2014 GHS data

		INTERNET				COMPUTER				CELLPHONE			
		Urban Formal	Urban Informal	Tribal	Rural Formal	Urban formal	Urban Informal	Tribal	Rural formal	Urban formal	Urban Informal	Tribal	Rural formal
2011	r_{2011}	0.2250	0.2234	0.1569	0.2477					0.0706	-0.0202	-0.0546	-0.0726
	N_{2011}	8193284	1281146	3881371	706700					8151408	1279297	3881027	706204
	p_{2011}	0.0000	0.0000	0.0000	0.0000					0.0000	0.0000	0.0000	0.0000
	r_{2011}	0.2171	0.2104	0.1473	0.2291					0.0604	-0.0467	-0.1120	-0.0646
	N_{2011}	7964565	1205027	3191816	670473					7919964	1204458	3190100	669439
	p_{2011}	0.0000	0.0000	0.0000	0.0000					0.0000	0.0000	0.0000	0.0000
2012	r_{2012}	0.2382	0.2735	0.0718	0.2463	0.2345	0.2231	0.1499	0.1340	0.0107	-0.0722	-0.0796	0.0933
	N_{2012}	8483918	1433821	3942903	692621	8392332	1428297	3897106	689917	8477119	1436577	3944573	696557
	p_{2012}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	rho_{2012}	0.2322	0.2685	0.0512	0.2315	0.2268	0.2163	0.1213	0.1095	-0.0195	-0.0634	-0.1528	0.1239
	N_{2012}	8230452	1369666	3270053	652426	8145113	1364983	3230702	651453	8227501	1372422	3270409	656362
	p_{2012}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	r_{2013}	0.2689	0.1064	0.0631	0.2620	0.2251	0.0538	0.1553	0.2502	0.0848	-0.0115	-0.1281	-0.0093
	N_{2013}	8817327	1482683	4073256	653597	8740259	1479291	4029993	646617	8857820	1491574	4089458	655373
	p_{2013}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009
	r_{2013}	0.2627	0.0982	0.0463	0.2464	0.2178	0.0430	0.1441	0.2633	0.0693	-0.0301	-0.1967	-0.0453
	N_{2013}	8595768	1432334	3469551	626026	8519589	1428942	3435131	618466	8636214	1441225	3483678	627222
	p_{2013}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	r_{2014}	0.2462	-0.0166	0.0400	0.1631	0.2469	0.1610	0.1853	0.2088	0.0818	-0.0355	-0.0899	0.1297
	N_{2014}	9169922	1537022	4186092	678911	9111475	1535318	4159647	674973	9184244	1539530	4193994	679959
	p_{2014}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	r_{2014}	0.2403	-0.0281	0.0475	0.1507	0.2396	0.1538	0.1833	0.1955	0.0623	-0.0557	-0.0126	0.1113
	N_{2014}	8960316	1488811	3599587	653759	8901469	1488132	3577521	649821	8974082	1491319	3605682	654807
	p_{2014}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trend (r_i)													
*Trend (r_i)													

Data are controlled for education, income, or employment status to compare male and female household heads of the same income level, education status, and current employment status. Each household head is considered to have attained education if they have attained at least one year of primary education. An income value of R5000 per month for the household head is used to control the data for income disparities. The value is taken as an average monthly income for the years 2011–2014. It is derived from an average annual household head income of R55920 in Statistics South Africa (2012a) for the African population group, who are the lowest earning population group. The controlled coefficients are presented in the grey rows. All correlation values are significant at the 0.0001% level of significance.

'access to Internet' and 'cellphones' respectively. Formal urban areas generally have more positive (r is closer to $+1$) correlations for all three ICTs in comparison to tribal rural areas. The positive correlation indicates a stronger relationship between household access to ICTs and male household headship.

In Table 2, after controlling for employment, income, or education, a slight reduction in the correlation values in favor of FHHs can be identified. Although the correlations show that MHHs are more likely to have access to ICTs, the correlations are more positive for urbanized areas and for formal rural areas (see sparkline graphs). The

correlations observed for access to cellphones are generally skewed in favor of FHHs, particularly after controlling the data. The trend graph shows stronger positive correlations for 'access to the Internet', particularly throughout the four years for formal urban areas and formal rural areas. The converse relationship is evident for the tribal rural areas (see sparkline graphs). For access to cellphones, formal urban and tribal areas show more consistently negative correlations (see sparkline graphs). The trend of the correlations for Internet access decrease over time for informal urban, tribal rural areas, and formal rural areas, and the trend for formal urban areas reflects a constant pattern. The trends for access to computers and access to cellphones reflect no clear pattern. However, the correlations calculated for access to cellphones are more negative, particularly for tribal rural areas, especially when the data are controlled.

Table 3 shows the correlations for the gender of the household head and access to telephone, television, and radio in the South African GHS data. Again, the statistics *r*, *N*, and *p* are presented for the studied years and each type of area. Correlations for access to television are skewed in favor of FHHs (negative correlations) for informal urban settlements and tribal areas compared to formal rural and formal urban areas. After controlling for differences in employment, income, or education, the analysis in Table 3 shows smaller positive or more negative correlation values for informal urban areas and tribal areas. The analysis shows differences in the level of the gender digital divide in different types of places and contrary to expectations, the divide is generally more skewed in favor of MHHs in formal urban and formal rural areas compared to the more rural or remote areas. The trends shown for access to telephone are more consistently positive for formal urban areas and formal rural areas. The trends increase over time for formal urban areas. For all the communication media, informal urban areas and tribal rural areas appear to have lower correlations for the years studied.

Correlations of the gender of household head and ICT access in the 2011 Census data

Figure 1 shows the correlation between household access to the Internet by the gender of the household head when the data are uncontrolled and controlled by the variables education, income, and employment status individually, and by all three variables at the same time. When the data are not controlled, the correlation values for access to Internet (within the house or outside the house) are weak for households in all types of areas. However, the correlations are more positive for access to the Internet at home (within house only). Hence, there is a weak gendered relationship for Internet access within and outside the home unit and MHHs are more likely to have access to home Internet.

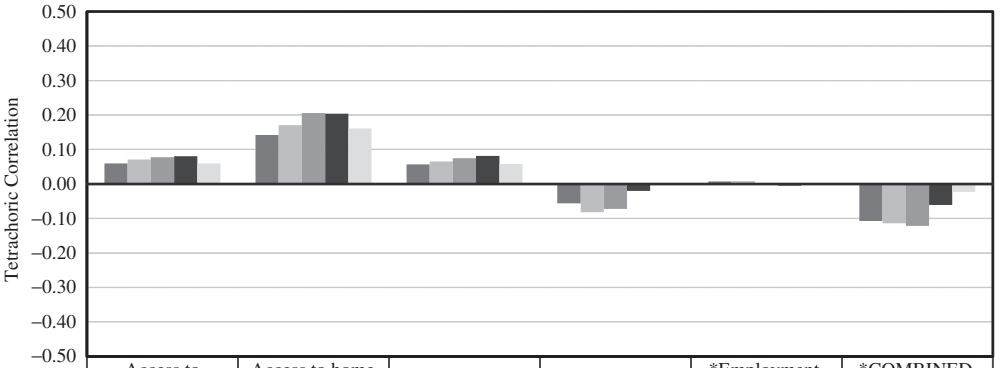
After controlling (access to home Internet) for education status (*Education), the correlations marginally reduce but remain positive. Income has the greatest individual impact on the correlation with the effect of the control creating negative correlations. Therefore, after controlling for income, FHHs are more likely to have access to the Internet for all the areas. The largest reductions are observed for B4 (communal lands and former homelands) and B1 (municipalities with secondary cities) areas while A (metropolitan areas) and B3 (commercial farm areas) areas have the lowest reductions.

Table 3. Tetrachoric correlation coefficients (uncontrolled and controlled) of the gender of household head and access to telephone, TV, and radio in the 2011, 2012, 2013, and 2014 GHS data

		TELEPHONE				TELEVISION				RADIO			
		Urban formal	Urban Informal	Tribal	Rural formal	Urban formal	Urban Informal	Tribal	Rural formal	Urban formal	Urban Informal	Tribal	Rural formal
2011	r_{2011}	0.1277	-0.1960	0.0432	0.1173	0.0066	-0.1152	-0.0032	0.1101	0.0952	0.0599	0.0753	0.0592
	N_{2011}	815549	1277441	3879748	705150	8184874	1283726	3886774	708347	8116474	1272634	3868276	703390
	p_{2011}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	rho_{2011}	0.1232	-0.1774	0.0337	0.0947	0.0049	-0.1279	-0.010	0.0740	0.0863	0.031	0.0634	0.0270
	N_{2011}	7922906	1201319	3189734	668922	7955406	1207611	3195283	672121	7889651	1196511	3180247	667662
	p_{2011}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2012	r_{2012}	0.1005	0.0196	0.0087	0.1083	-0.0039	-0.0728	-0.0141	0.076	0.0176	0.0475	0.0472	0.0330
	N_{2012}	8464131	1432555	3924252	694283	8456968	1437451	3934316	694609	8526352	1441568	1441568	698233
	p_{2012}	0.0000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	rho_{2012}	0.0093	0.0089	-0.0215	0.0857	-0.0138	-0.0637	-0.0322	0.0830	0.0171	0.0412	0.0508	0.0437
	N_{2012}	8211393	1369943	3252831	654088	8205983	1373296	3262235	654911	8267755	1377413	3282343	657761
	p_{2012}	0.0000	0.0117	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2013	r_{2013}	0.0989	0.0948	0.0588	0.2092	0.0142	-0.0839	-0.0204	-0.0256	0.0286	0.075	0.1043	0.2902
	N_{2013}	8787224	1477805	4055894	654541	8760799	1480961	4034468	647158	8865364	1493206	4092452	655373
	p_{2013}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	r_{2013}	0.0927	0.0926	0.0548	0.1903	0.0069	-0.0836	-0.0374	-0.0300	0.0277	0.058	0.1072	0.3262
	N_{2013}	8566213	1427476	3453383	626970	8538318	1430612	3438726	619007	8642452	1442857	3484759	627222
	p_{2013}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2014	r_{2014}	0.1127	0.0178	0.0719	0.1954	-0.0070	-0.0618	-0.0389	0.0693	0.0439	0.0954	0.0709	0.1224
	N_{2014}	9123665	1527112	4156530	672859	9121539	1531737	4165738	675297	8796474	1489605	4059473	661121
	p_{2014}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	r_{2014}	0.1071	0.003	0.068	0.1833	-0.0191	-0.0621	-0.0471	0.0410	0.0425	0.0902	0.0713	0.1351
	N_{2014}	8916530	1478901	3573861	647707	8914870	1483526	3584129	650145	8593238	1442508	3495074	635969
	p_{2014}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trend (r_i)													
*Trend (r_i)													

Data are controlled for education, income, or employment status to compare male and female household heads of the same income level, education status, and current employment status. Each household head is considered to have attained education if they have attained at least one year of primary education. An income value of R5000 per month for the household head is used to control the data for income disparities. The value is taken as an average monthly income for the years 2011–2014. It is derived from an average annual household head income of R55920 in Statistics South Africa (2012a) for the African population group, who are the lowest earning population group. The controlled coefficients are presented in the grey rows. All correlation values are significant at the 0.0001% level of significance.

Figure 2 shows the correlation between access to household computers and the gender of the household head. Again, income has the largest individual effect on the correlations. The combination of the three control variables neutralizes the gender effect as all correlations reduce to values between 0 and 0.1, even though the slightly positive correlation values are statistically significant and thus constitute a substantial difference. Income and education show the greatest individual effects in reducing correlation values. The combined effect of the three variables shows the greatest decrease in code A



	Access to Internet	Access to home Internet	*Education	*Income	*Employment Status	*COMBINED EFFECT
A	0.0596	0.1418	0.0567	–0.0560	0.0073	–0.1074
B1	0.0707	0.1709	0.0655	–0.0814	0.0079	–0.1137
B2	0.0779	0.2057	0.0746	–0.0728	–0.0024	–0.1221
B3	0.0801	0.2038	0.0813	–0.0199	–0.0049	–0.0609
B4	0.0593	0.1613	0.0575	–0.0027	0.0018	–0.0233

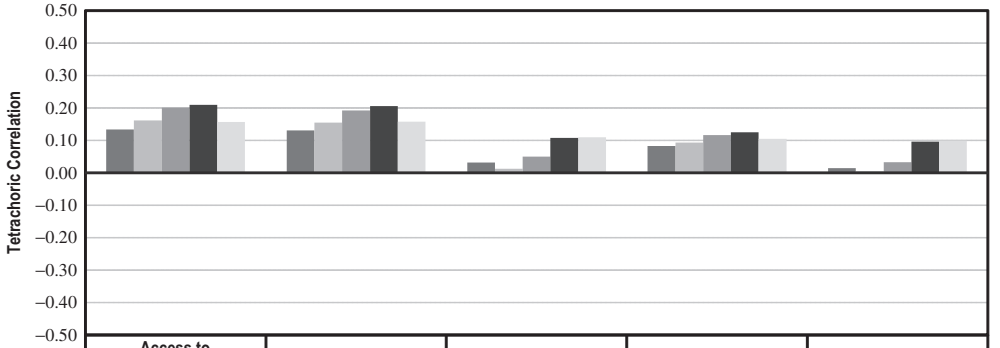
Figure 1. Tetrachoric correlation coefficients of household access to Internet by the gender of household head in the 2011 South African Census data. Access to Internet referees to access anywhere in the household or outside. *Represents variable used as a control on household access. Data are controlled for education, income, and employment status to compare male and female household heads of the same income level, education status, and current employment status. Each household head is considered to have attained education if they have attained at least one year of primary education. An income value of R5000 per month for the household head is used to control the data for income disparities. The value is taken as an average monthly income for the years 2011–2014. It is derived from an average annual household head income of R55920 in Statistics South Africa (2012a) for the African population group, who are the lowest earning population group. All correlation values are significant at the 0.0001% level of significance.

(metropolitan areas), B1 (municipalities with secondary cities), and B2 (other municipalities within the urban core) areas.

Figure 3 shows the correlations for cellphone access by the gender of the household head. All correlations fluctuate between 0.10 and and -0.10 even for uncontrolled data. Hence, the variations of access to cellphones by gender are minimal because access to cellphones is generally high and less determined by gender. However, in terms of individual effect, employment status shows the greatest effect as correlations reduce to negative values after controlling for employment.

Discussion

GHS data show that tribal areas, communal lands, or former homeland areas, which are more remote and rural, generally have weaker or negative correlation values compared to the more developed formal rural places (consisting of small towns and commercial farmlands) and in some cases, informal and formal urban settlements. This suggests that the pattern of a gender-based digital divide is generally positively correlated in favor of MHHs in urban areas, formal rural areas, and informal settlements compared to tribal, communal, and former homeland settlements, which are in remote rural areas.

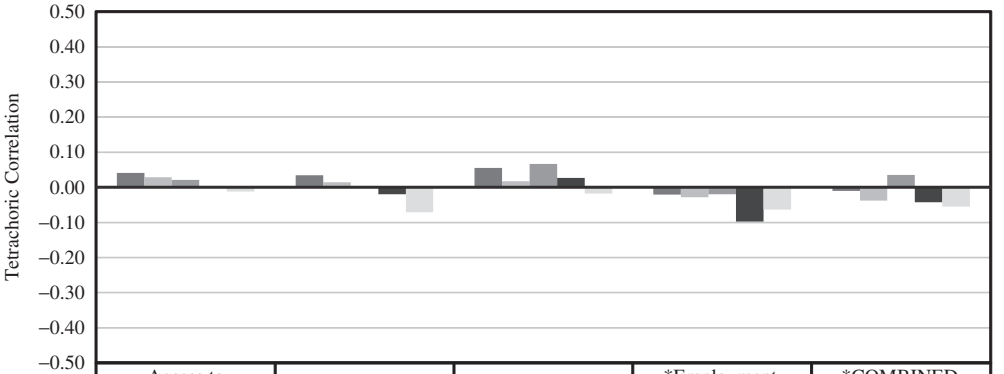


	Access to Computer/Laptop	*Education	*Income	*Employement Status	*COMBINED EFFECT
A	0.1334	0.1303	0.0312	0.0825	0.0140
B1	0.1615	0.1542	0.0124	0.0934	0.0046
B2	0.2007	0.1923	0.0503	0.1166	0.0322
B3	0.2091	0.2059	0.1075	0.1245	0.0960
B4	0.1561	0.1575	0.1095	0.1042	0.0988

Figure 2. Tetrachoric correlation coefficients of household access to computers by the gender of household head in the 2011 South African Census data. *Represents variable used as a control. Data are controlled for education, income, and employment status to compare male and female household heads of the same income level, education status, and current employment status. Each household head is considered to have attained education if they have attained at least one year of primary education. An income value of R5000 per month for the household head is used to control the data for income disparities. The value is taken as an average monthly income for the years 2011–2014. It is derived from an average annual household head income of R55920 in Statistics South Africa (2012a) for the African population group, who are the lowest earning population group. All correlation values are significant at the 0.0001% level of significance.

GHS and Census data reflect that FHHs are more likely to have access to television in tribal areas and informal urban areas than MHHs even before controlling the data for employment, income, and education. This means that independent of employment, income, and education, FHHs are more likely to have access to a television in the most rural and under-resourced areas. The digital divide – if measured by access to a TV alone – would therefore not be found in rural FHH. Whilst Posel (2010) stated that female household heads are less likely to purchase permanent household goods, the greater likelihood by FHHs to own a television seems to suggest that this is no longer the case.

Additional analysis done on GHS data showed that MHHs were more likely to have access to satellite television compared to FHHs. A possible explanation is that access to satellite television for FHHs could be limited by lower income levels. In general, comparisons done for all ICTs produced weak or negative correlations for tribal areas, showing that ICT access is more skewed in favor of FHHs in tribal areas compared to FHHs in formal rural areas, informal urban areas, and formal urban settlements. Possible explanations are that FHHs in tribal areas have the advantage of lower living expenses while in urban places, they experience the added challenge of higher living expenses, which impacts their ability to own household goods. For formal rural areas, Southern African Catholic Bishops' Conference (2012) explain that women represented



	Access to Cellphone	*Education	*Income	*Employment Status	*COMBINED EFFECT
A	0.0407	0.0341	0.0551	−0.0209	−0.0101
B1	0.0283	0.0146	0.0172	−0.0281	−0.0380
B2	0.0211	0.0013	0.0666	−0.0196	0.0357
B3	−0.0011	−0.0193	0.0271	−0.0971	−0.0426
B4	−0.0122	−0.0705	−0.0182	−0.0636	−0.0548

Figure 3. Tetrachoric correlation coefficients of household access to cellphones by the gender of household head in the 2011 South African Census data. *Represents variable used as a control. Data are controlled for education, income, and employment status to compare male and female household heads of the same income level, education status and current employment status. Each household head is considered to have attained education if they have attained at least one year of primary education. An income value of R5000 per month for the household head is used to control the data for income disparities. The value is taken as an average monthly income for the years 2011–2014. It is derived from an average annual household head income of R55920 in Statistics South Africa (2012a) for the African population group, who are the lowest earning population group. All correlation values are significant at the 0.0001% level of significance.

only 32% of the agricultural labor force and hence are likely to have lower income to purchase and own household ICTs.

Analysis of both, the GHS and Census data, confirms that income has the largest impact on household access to the Internet when the data are controlled for income, employment status and the education status of the household head (for all types of areas studied). In the Census data, the greatest change in correlation occurred for communal lands and former homelands, which consists of areas that are generally perceived to be the most remote and underdeveloped. When comparing household access to computers, the income control produces minor changes in favor of access for FHHs compared to the controls done for household Internet (again income produces the greatest individual decrease in both cases). This suggests that access to income is a major driver to accessing household Internet. Similarly, controlling for household access to cellphones does not produce major changes. Household access to cellphones is not affected by income levels for either gender and this may be linked to mobile communication being the most easily accessible form of technology throughout the country (Statistics South Africa, 2012c).

Although the GHS and Census data sets used different place classification criterion, the results from both data sets indicate that FHHs have better likelihood of access to

television in tribal areas and informal urban settlements compared to MHHs. The data also suggests that access to ICTs for FHHs is mainly limited by the income of the household head. In sum, the household head gender digital divide is generally much more skewed in favor of MHHs in formal urban areas, informal urban areas, and formal rural areas compared to the more remote communal (tribal) rural areas. Thus, for the South African context, there is a clearer consistent pattern as male household headship is more closely associated with access to ICTs in more urbanized areas than in rural areas.

Conclusion

The study has shown that in terms of household access to ICTs, FHHs in tribal areas are more likely to have access to ICTs compared to those in informal urban places. The findings suggest that FHHs in tribal rural areas are more likely to have access to some forms of ICTs than FHHs in formal rural areas. It is likely that households in tribal areas are only limited by lack of infrastructure such as poor network coverage and lack of access to telephones or Internet access rather than by a gender-based unwillingness to access technologies.

Compared to MHHs, FHHs lag behind in terms of access to modern ICTs such as the Internet and computers. The differentials are, however, explained by income disadvantages. Regardless of location, education, and employment, FHHs are generally more likely to have access to television compared to MHHs. However, MHHs are more likely to have access to satellite television, which is linked to income differences. Income has empirically been determinant as the major differentials between ICT access for FHHs and MHHs.

In summary, the conventionally accepted notion that the gender digital divide of household headship is always skewed against FHHs in South African rural areas has been clarified. FHHs in the more remote and less developed tribal areas are statistically more likely to have access to some ICTs compared to FHHs in some of the more urbanized and less remote areas. The study points to the relevance of income inequality as a determinant of gender disparities of access to ICTs.

The study has also shown the interplay of factors as they determine access to ICTs as stated in the Theory of Digital Divide. A confounding effect of the location of residence, in particular the socio-economic challenges associated with urbanization, was identified.

Further studies should consider using multivariate analysis for a deeper understanding of the relationship between the gender of household head and household access to ICTs by household location of residence. Additionally, research should also focus on tangible outcomes of ICT access as defined by the Theory of Digital Divide.

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Disclosure statement

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