

RESEARCH PAPER

Fertility, electricity and television: is there a link? Evidence from Pakistan, 1990–2018

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Abstract

In 1960s Pakistan, every woman was giving birth to more than 6 children on average. In 2021, Pakistan still has the second-highest fertility rate in South Asia with every woman giving birth to 3.4 children on average. This paper uses four waves of Demographic and Health Survey data to empirically analyze trends in fertility in Pakistan between 1990 and 2018; accounting for wealth, education and locational differences, this paper looks at three additional pathways for reducing fertility: (i) electrification, (ii) access to TV and (iii) family planning commercials broadcast on television. Results show that electricity does not reduce fertility whereas access to television has a significant effect in reducing fertility rates. The content and evolution of Pakistani soap-operas are also discussed, and it is argued that the role models, the types of households and the messages conveyed by these soap-operas may represent strong pathways for the fertility decline.

Key words: Demographic health survey; fertility; Pakistan; pool regression; television

1. Introduction

“I dream of a Pakistan, of an Asia, of a world where every pregnancy is planned, and every child conceived is nurtured, loved, educated and supported” (Address by Benazir Bhutto, former prime minister of Pakistan, at the International Conference on Population and Development, Cairo. 1994)¹

“The television campaigns of yesteryears such as “*Kum bachchay khushal gharana*” (Fewer children, more prosperity) were very effective” (Prime Minister of Pakistan Imran Khan’s address to a symposium on population control, 2018)²

Many politicians and policymakers around the globe embrace family planning and consider technological progress along with access to electricity and ultimately exposure

¹<https://www.familyplanning2020.org/fr/node/3397> [Last accessed: September 15, 2021].

²<https://www.youtube.com/watch?v=l5lDPSQqhQE> [Original language, last accessed: September 15, 2021]

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to television an effective way for sharing modern ideas about family structure and composition (see quotes). Also, in the academic literature, we observe a lively debate about the nexus between access to electricity, the resulting exposure to modern media channels and the fertility rate [Grimm *et al.* (2015)]. Anecdotal evidence of the relationship between access to electricity and fertility is well-known. Electricity was cut in New York City and much of the northeast USA for over 10 hours in the late afternoon of November 9, 1965. Exactly 9 months after this blackout, so the story goes, births went (un)surprisingly up in several large hospitals in the area. Yet, Udry (1970) showed that the two events were only correlated without having any causal relationship. In the 18th century, Friedrich Wilhelm I of Prussia –in his attempt to improve the economic and military strength of the state– sent music bands to villages in those hours when it was still too early for couples to work and too late to go back to sleep. He hoped that this ploy would help him double the size of the Prussian army [Simon (1955)].³

Beyond anecdotes, the sign of the electricity-fertility link is rather ambiguous: electricity does reduce the costs of raising children because of improved household technologies, hence possibly increasing the number of children. But electrification may also improve labor efficiency, consequently, more children may be considered costly in economic terms. Put differently, the net effect is context specific [Basu (1998), Dinkelman (2011)].

Electrification may also have an indirect effect through television. The importance given by scholars to the television channel has increased over time; yet, empirical studies assessing the influence of television and broadcasted programs on fertility choices are still scant [Barber and Axinn (2004) and Dewi *et al.* (2018)]. They have gained momentum after the seminal contribution by La Ferrara *et al.* (2012) on the impact of soap-operas on family size in Brazil. Analyzing Brazilian census data, the authors show that Rede-Globo content –a television network that specializes in soap-operas– is associated with fewer children. Curiously, children born after Rede-Globo started beaming were more likely to be named after the main characters featured in the Rede-Globo soap-operas. Similarly, in response to the population explosion that Mexico experienced from 1940 (20 million inhabitants) to 1970 (50 million), the government collaborated with media giant Televisa to broadcast *Acompañame*, a telenovela which has a clear fertility message: small families live better and happier [Laveaga (2007)]. Family planning commercials represent another, even more direct way to influence fertility choices by encouraging the use of contraception and other family planning measures [Harbison and Robinson (1985)].

This paper investigates the link between electricity, television and family planning commercials on the one hand and fertility decision on the other for the case of Pakistan, a South Asian and predominantly Muslim country. Pakistan is an interesting case because it differs in culture from most countries for which the electricity-fertility nexus has been previously investigated. With a population of 207 million, Pakistan ranks among the top ten most populous countries in the world [Pakistan Bureau of Statistics (2017)]. In 1990, Pakistan had a population of 107 million, a fertility rate of 6 children per woman and an electrification rate of 95% in urban and 50% in rural areas; television ownership was 38%. Fast forward to 2019, the fertility rate has been halved while the population has increased to 216 million.

³By the end of Frederick William I's reign, Prussia's army counted 80,000 soldiers and it was considered the fourth-largest army in Europe despite Prussia having only 2.5 million inhabitants.

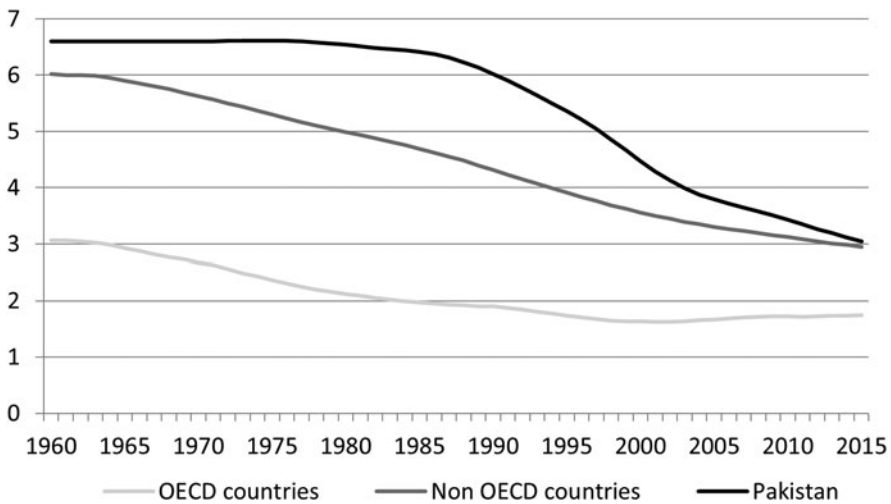


Figure 1. Total fertility rate in OECD and non-OECD countries and Pakistan, 1960–2019.
 Source: World Development Indicators.

Nearly all the urban households had electricity and 87% of the rural citizens were connected to the grid; 60% owned a television. Several studies have pointed out that the early 1990s represent a turning point with respect to the fertility in Pakistan [Hakim *et al.* (2001)]. Figure 1 shows that the Pakistani fertility rate between 1960 and 1990 had decreased by less than one child per woman, which is in sharp contrast to the decrease of about three children in the next 20 years. The fertility rate in Pakistan is now on-par with the ones recorded, on average, in other non-OECD countries but higher if compared to OECD countries.

This paper aims at further disentangling the fertility transition in Pakistan by analyzing the observed macro trends with household-level micro data and linking the decrease in fertility to access to (i) electricity, (ii) television, and (iii) family planning commercials. We assess four waves of the Pakistan Demographic and Health Survey (PDHS) (1990, 2006, 2012, 2018) allowing us to set up a careful identification strategy that accounts for location (cluster) specific effects along with wave effects and individual characteristics. Yet, since the three channels we analyze are potentially endogenous we complement the fixed-effects model with an IV that is both feasible and valid. We identified the average yearly district-wealth level access to the respective channel (electricity/TV/family planning commercial) for four reasons: first, it captures an aggregate peer-level adoption effect. Second, it varies at the cluster level and across time. Third, it addresses the access-wealth nexus and fourth, it allows us to combine it with the fixed effects that capture structural and temporal aspects. The results show that across specifications electricity does not reduce fertility. In contrast, access to television has a significant effect in reducing fertility rates, which seems to operate to a large extent through family planning commercials broadcasted on television. We provide complementary qualitative evidence on the content and evolution of Pakistani soap-operas and we argue that the role models, the types of households and the messages conveyed by soap-operas may represent

strong pathways for fertility decline. We show that a similar conclusion cannot be drawn for the case of radio and radio-broadcasted family planning commercials.

The remainder of the paper is organized as follows: Section 2 briefly introduces the main findings from the literature on the relationship between electricity, television, and family planning commercials, on the one hand, and fertility outcomes, on the other. To contextualize our study, we introduce the Pakistani television industry in Section 3. In Section 4, we present the theoretical framework. The description of the data used in the empirical analysis is found in Section 5, followed by the presentation of the empirical strategy in Section 6. The results are discussed in Section 7. Section 8 concludes.

2. Literature review

At the end of the 20th century, several low-income countries still featured high population growth rates. Ever since, fertility rates have declined almost everywhere. Between 1996 and 2016, the fertility rate in South Asia declined from 3.8 to 2.5 children per woman. In Latin America and the Caribbean, it went from 2.8 to 2.1, in sub-Saharan Africa the decline has been from 6 to 4.8 children.

Understanding the causes and channels that trigger the fertility decline is a crucial element for introducing effective policies. In fact, family planning programs were often thought to be less successful in reducing fertility compared to their originally stated target [Caldwell and Caldwell (2002)]. In Pakistan, family planning programs were first introduced by Begum Saida Waheed, in 1951, who founded the Family Planning Association of Pakistan (FPAP) when her maid died during pregnancy. During its second five-year-plan (1960–1965), 1,589 family planning clinics with healthcare dispensaries, hospitals and maternal and child centers were set up. “Lack of motivation in the general masses, unsatisfactory arrangements for the distribution of contraceptives, inadequate education and information of the masses in family planning [...]” were identified as the main causes behind a low impact of the family planning program in Pakistan in those years [Ali and Zahid (1998)]. Only after a series of eight family plans, a fertility decline was finally recorded, and it coincided with changes in the socio-cultural role women had within the family. Pakistan’s “Population Policy”, introduced in 2002, proved to be not successful either, mainly due to the fact that it rested on the involvement and support of Imams but struggled with muted opposition [Brohi and Zaman (2017)]. On the other side, the Lady Health Workers Programme (LHWP) did contribute to a reduction in the fertility rate in Pakistan [Sultan *et al.* (2002), Khan and Wang (2021)]; launched in 1994 by Pakistan’s Ministry of Health, it provided doorstep family planning services through literate women who had undergone a 15-month training. By 1996, approximately 30,000 women were working under this program and 110,000 women in 2013 [Khan and Wang (2021)].

A scholarly consensus on the primary drivers of fertility decline does not exist. Pritchett (1994) argued that the family planning centers started off the fertility decline, while other scholars praised the roles played by family planning messages presented on television [Bongaarts *et al.* (1990), Casterline and Sinding (2000), Bongaarts (2006), Bongaarts and Casterline (2013)]. The electricity-fertility nexus is contested, too. From the neoclassical microeconomic tenets, electricity may substitute for child labor, thus increasing the net costs of raising children. If electricity increases the demand for skilled labor the related increase in the returns to education may incite parents to substitute away from a large quantity of children and spend

more on their “quality” [Dinkelman (2011), Barron and Torero (2014)]. Supply-side theories of fertility, in turn, predict that electricity boosts fertility, as it rises the quality of medical care which may reduce both fetal and child mortality [Easterlin and Crimmins (1985)]. However, existing evidence suggests that hoarding is only practiced as long as parents anticipate that some of their children will not survive until adulthood and overcompensate with high fertility [Sah (1991), Schultz (1997)]. The early studies on the electricity-fertility nexus –published in the 1980s– find a negative relationship [Herrin (1979), Harbison and Robinson (1985), Cornwall and Robinson (1988)]. More recent studies such as Potter *et al.* (2002) and Bailey and Collins (2011) confirm the negative effects electrification had on fertility for the case of Brazil and the USA. Burlando (2013) exploits the effect of a months-long power outage across electrified and non-electrified villages in Zanzibar and finds the lack of electricity to be positively related with fertility rates. Peters and Vance (2011) find contrasting effects for urban and rural areas of Côte d’Ivoire: electrification seems to decrease fertility for urban households.

The role of the mass media in changing fertility behaviors has received attention more recently. Television not only affects fertility choices but also influences people’s consumption patterns, religious beliefs and socio-political views [Johnson (2001)]. Jensen and Oster (2009) show that after the introduction of cable television in rural India, the respect toward women by other family members increased. Recent studies on the role of television in developing countries such as Jensen and Oster (2009) focus on the content presented on television. La Ferrara *et al.* (2012) demonstrate that the expansion of soap-operas in Brazil contributes to the fertility decline and, in a similar vein, Banerjee *et al.* (2017) demonstrate that Nigerians exposed to a tele-serial on HIV/AIDS had an increased likelihood of getting tested for HIV.

3. The industry of television series in Pakistan

Television arrived in Pakistan in 1964 when the state-led Pakistan Television (PTV) was launched. Until the early 1990s, PTV enjoyed a near-universal monopoly over the airwaves. At the turn of the century, privately owned commercial channels were licensed. Consequently, during the 2001–2010 period the television spectrum expanded exponentially. On the one hand, the number of channels increased from 4 in 2003 to 89 by 2010 and, on the other, physical outreach expanded at an unprecedented pace.

In 2018 Pakistan, 98 television channels were fully functional including 38 in the entertainment category (music, sports, and kids’ channels). Television has emerged as the most important mass-media tool. Two-thirds of the population watch television, whereas the internet reaches only 20% of the people. One in five reads newspapers while there has been a 39% decrease in radio listening [Gallup (2018a)]. The situation was similar five years ago: 7% listened to the radio, 18% read newspapers but 73% spent time watching television [Orient (2013)]. On average, a Pakistani person spends 115 min per day watching television (Gallup, 2018a); women and those under the age of 17 spend more time watching entertainment channels while men watch news and sport channels [Gallup-Pakistan (2018b)]. The audience of news channels consists of two-thirds of men, entertainment channels (with the exception of ARY Digital) attract more women. For instance, the entertainment channels Hum, Urdu 1 and Geo Entertainment have, respectively, 61%, 56% and 54% of their audience constituted by women [Gallup-Pakistan (2019)]. This reflects the interest of women and girls in soap-operas.

Moreover, the slogan “*Kum bachchay khushal gharana*” (Fewer children, more prosperity) was promoted via family planning commercials in the mass media in the 1980s. From 1990s onwards, television has also featured contraceptive campaigns by state institutions such as provincial population welfare departments, as well as NGOs and manufacturers of contraceptives. The advertisements for contraceptive products have become more explicit; as an example, one advertisement features two prominent television actresses showing an intrauterine device while another one explicitly talks about menstruation. At the same time, campaigns to promote contraceptives have faced hostility by the Pakistani state. The Pakistan Electronic Media Regulatory Authority (PEMRA) –a federal body that regulates electronic media– banned all advertisements for contraceptive products in 2016 arguing that such campaigns exposed children to the subject of sex [Hashim (2016)]. However, the ban was lifted 3 days after criticism by the civil society. Now, commercials about contraception are only aired after 11 pm. Similarly, in 2013 PEMRA banned all television advertisements making reference to condoms. Not only advertisements and talk shows would discretely promote birth-control, contraception and the two-children policy, but even television series reinforce the two-child message. In what follows we briefly introduce the content of three famous and much-watched television series: *Alpha Bravo Charlie*, *Azar ki Aye Gee Barat*, and *Ishq-e-Mamnooh*.⁴

Aired in 1998 on PTV, action-thriller *Alpha Bravo Charlie* (ABC) was a huge success in terms of popularity [Ahmad (2015)]. ABC’s cumulative reach in 1998 was 91% (remained 66% when re-telecasted in 2006). The series revolves around three military officers: Kashif, Fraz and Gulsher. While Kashif and Fraz represent Pakistani elite, Gulsher comes from a humble background. Kashif is the son of a general and has another brother, Rashid, who is studying in the US. His fiancée is the only daughter of another general. Likewise, Fraz is the only child, and his father is a landlord. In the case of Gulsher, the series remains vague. However, a comical figure in the series, Rasaldar (Corporal), has 12 children and his fellow corporal Jaffari has 13 children. In short, the main characters representing Pakistani elite have a nuclear family with two children at most. In contrast, the working-class families have a dozen children.

The next television series under scan, *Azar ki Aye Gee Barat* (2009), aired on Geo Entertainment, was such a huge success that Geo aired three sequels in subsequent years [Gallup (2018a)]. This series depicts two upper-middle-class families: the Chaudhry family and the family of Ahmeds. Both families have two children and are connected through intermarriages. Most importantly, the life of the women in the serial is not restricted to the idiomatic four walls. Mrs Ahmed is a successful entrepreneur and Mrs Chaudhry, after a failed attempt to establish a business, joins politics and is elected as a member of the National Assembly.⁵ Likewise, most young women in the series have a lifestyle that can be described as “westernized” in the Pakistani context.

⁴It is important to flag that the plays reviewed here are just examples of the TV series offered in Pakistan and do not represent the whole spectrum of the TV series available in the country; the three series have been selected as they were not funded by the Ministry of Health.

⁵The character Mrs Chaudhry achieves a rare victory for a woman, as only 8 women have been elected on general seats in the parliament in the 2013 elections. There are 60 out of 342 seats in the Pakistan parliament, though, which are reserved to women.

The third series, *Ishq-e-Mamnooh* (Forbidden Love), aired on Urdu 1 in 2013, was a Turkish import and biggest ever success in terms of Television Rating Points (TRPs). It was the first-ever Turkish soap-opera aired in Pakistan. *Ishq-e-Mamnooh's* plot revolves around two core families, the families of Adnan Ziyagil, a widower, and Firdevs Yoreoglu, a widow. Adnan is a rich and successful entrepreneur living in a luxurious Istanbul villa by the shore of Bosphorus Strait and he has two children. He is attracted to Firdevs who has two young daughters, Peyker and Bihter. At Peyker's wedding, Adnan falls in love with Bihter and the two ultimately get married.

A key feature of most Pakistani broadcast series is that the family size depicted there is smaller than the average Pakistani family; in addition, women represented in the series are more westernized and outgoing compared to the traditional image of a Muslim woman. Those clashes between real life and television-based life generated a plethora of criticisms as it was argued that Turkish produced series were perceived to be vulgar and obscene for the Pakistan standards [Sulehria (2018)].

4. Theoretical framework

Understanding the causes and channels that may trigger the fertility decline is a crucial element for introducing effective policies. Many attempts have been made to theoretically and empirically explain the causes of the decline in fertility in developing countries. While acknowledging such critical concepts as decoloniality [Mignolo and Walsh (2018)], our aim is not to mechanically apply Western development models on our case study. There is consensus that part of the decrease can be attributed to the rise in household income, improved literacy, the improved status of women, the decline in infant/child mortality, and the erosion of traditional authorities [Becker and Lewis (1973)]. Yet, there are examples where fertility declined even if those conditions did not materialize, and others where fertility did not decline despite the presence of these pre-conditions [Bongaarts (2006)]. For example, Spolaore and Wacziarg (2019) studied the fertility decline in Europe between 1830 and 1970, and highlighted the role played by linguistic affinities/distances across European countries. The authors argue that “fertility decline resulted from the gradual diffusion of new fertility behavior from French-speaking regions to the rest of Europe”.⁶

An additional social change that has received scientific attention in explaining the fertility decline is electricity. While electrification is associated with improved economic well-being, it also plays a key role in spreading mass media, particularly radio and television. Television, in turn, can be used to amplify family planning messages at a mass level. Thus, the three channels that we assess in this study as contributing factors to the fertility decline are (i) electricity, (ii) television and (iii) family planning commercials (Figure 2). The first channel, i.e. electricity, influences the costs of raising children since it replaces manual and time-consuming household chores with electric appliances. Moreover, electricity creates new business opportunities as well as alternatives to sexual activity, reduces the need for labor support from children and contributes to an amelioration of health care provision resulting in a decrease of child mortality.

This leads us to the second channel: television. The effect television may have on fertility outcomes derive from two sources. The direct impact is the exposure to the

⁶Spolaore and Wacziarg (2019) build on the initial data collection effort of the Princeton project. The project covered 775 regions of 25 European countries where 275 languages and dialects were spoken.

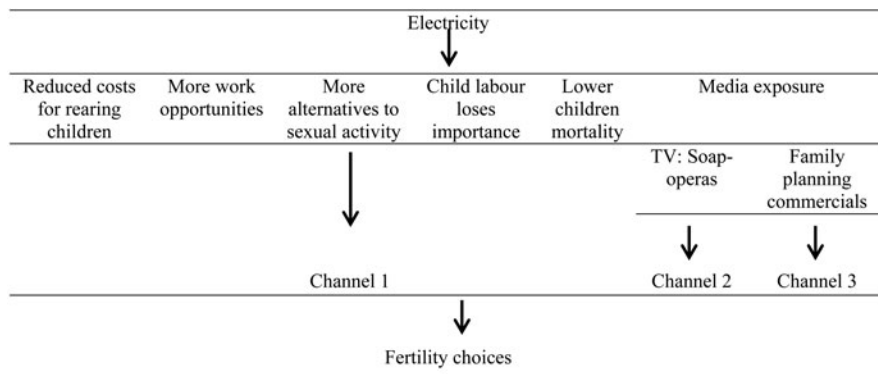


Figure 2. Links between electricity and fertility choice.

Notes: Authors' elaboration.

nuclear family and to emancipated women. Exposure to television changes the marginal utility of having children by broadcasting new lifestyles. La Ferrara *et al.* (2012) show that soap-operas influences women's fertility preferences. Moreover, exposure to soap-operas is also associated with female empowerment. According to the National Institute of Population Studies (2013) women living in a household without a TV tend to be more likely to justify their husbands' violent behavior than women living in a household with a TV. Put differently, the indirect impact of television is not exclusively linked to fertility. It represents a change in habits shaped by television content.

The third channel is represented by the family planning commercials. More information about family planning services helps to reduce unwanted births by addressing the unmet need for contraception and reducing unwanted fertility because of information on use and access to contraception [Bongaarts (1993)]. Thus, taken together we expect these three channels to have a non-negligible impact on fertility choices.

5. Data

The PDHS conducted four times in 1990–91, 2006–07, 2012 and 2017–18, have been deployed for our analysis. Particular importance –in the context of the four surveys– has been given to the collection of data on fertility levels [Tasciotti and Wagner (2018)]. The sample design adopted across waves is a stratified, clustered and systematic sample of households. The sampling frame consists of urban and rural areas of the four provinces of Pakistan, as defined in the population census available at the time of the different surveys. Thus, the dataset is representative of the country at regional, urban and rural levels.

We have complete information on 5,418 women in 1990–91, 8,123 in 2006, 7,437 in 2012, and 12,602 in 2017–18. Our sample includes mothers aged 15–49, i.e. all women who responded to the fertility questionnaire have at least one child. Childless women are excluded as data on their fertility choices is not available. Yet, this is not a concern for the study at hand since childlessness is hardly observed in Pakistan, in fact it is seen as a curse [Qamar (2018)] and only 5% of the women are childless

when reaching the end for their reproductive age [PDHS (2013)]. According to the literature, population-level childlessness has been stable over time, and reported to be between 2%, 4% and 5% in the period between 1980 and 2019 [Alam *et al.* (1983), PDHS (2013), Ahmed *et al.* (2020)].

We have individual-level background information about age and education. We complement the information about the woman with partner characteristics. We know the husbands' age, education, occupation status and whether he lives with his wife. Finally, we can classify all individuals in our sample into one out of five wealth categories based on their asset ownership and identify their location of residence as urban or rural.

Table 1 presents the descriptive statistics of these background characteristics. Since the fertility history is conditional on age, we classified the women into age cohorts of 5-year intervals starting from the age of 15. Most respondents (22.9%) are between 25 and 29 years old followed by another fifth of the sample being between 30 and 34 years old. Across survey rounds the age distribution is coherent. On average, women tend to have 3 years of schooling yet the standard deviation is substantial (4.8) and we observe a considerable increase in the average years of schooling from 1.8 in 1990–91 to 4.3 in 2017–18. There is a considerable age difference between women and their male partners. The average age of the husband is almost 47 years, a difference that is constant across survey rounds, and husbands have spent twice as many years at school compared to their wives. Again, there is a positive trend in schooling, resulting in an additional 2 years of schooling on average for men between 1990–91 and 2017–18. Across survey rounds, almost all husbands are working (96%) and the majority (88%) co-reside with their wives, with a slightly decreasing trend over the years. On average 45% of the interviewees live in urban areas.

As outlined in the theoretical considerations we focus on three pathways for reducing fertility: (i) access to electricity, (ii) ownership of a television, and (iii) exposure to family planning on television. At the bottom of Table 1 and in Figure 3 we show the evolution of these three channels across survey rounds. Undoubtedly, there was a considerable increase in access to electricity from 1990–91 to 2017–18, with 90% of the households now having access to it compared to 73% thirty years ago. Television ownership experienced a sharp increase between 1990–91 and 2006 from 38 to 58%; the share of households owning a television has stabilized around 60% in 2017–18. While access to electricity and television ownership has been on the rise throughout the entire period under study, the share of households who watch family planning commercials was highest in 2006 (39%); in 2018 only 1 out of 5 households reports watching family planning commercials. In the 1990s family planning messages on television were prominent albeit not necessarily very explicit. In later years the advertisements became more explicit, which is reflected by the 2006 data. However, this trend reversed between 2006 and 2018 since the PEMRA became stricter and more critical about family planning campaigns. This reflects a general trend of increased religiosity in the country that disapproves of any form of birth control. Therefore, it is not surprising that in 2018 a smaller share of women indicate that they have ever heard about family planning on television compared to 1991.

In terms of outcomes of interest, we focus on realized fertility as contrary to desired fertility since the former is expected to respond most to social pressures. We consider (i) the crude birth rate, and (ii) the total number of children born alive. Other papers on the same topic tend to consider only one outcome; La Ferrara *et al.* (2012), for instance, assess the average number of live births among women of reproductive age. Jensen and

Table 1. Descriptive statistics of the background characteristics

| | Overall | | 1990-91 | 2006 | 2012 | 2017-18 |
|-----------------------------------|---------|-----------|---------|--------|--------|---------|
| | Mean | Std. Dev. | Mean | Mean | Mean | Mean |
| Realized fertility | | | | | | |
| Total number of children | 4.112 | 2.516 | 4.640 | 4.489 | 3.761 | 3.851 |
| Total number of children alive | 3.718 | 2.248 | 4.108 | 4.024 | 3.405 | 3.559 |
| Women's characteristics | | | | | | |
| Age categories | | | | | | |
| 15-19 years | 0.028 | | 0.033 | 0.026 | 0.033 | 0.025 |
| 20-24 years | 0.145 | | 0.143 | 0.133 | 0.196 | 0.125 |
| 25-29 years | 0.229 | | 0.231 | 0.205 | 0.290 | 0.209 |
| 30-34 years | 0.207 | | 0.195 | 0.188 | 0.241 | 0.205 |
| 35-39 years | 0.180 | | 0.170 | 0.180 | 0.157 | 0.197 |
| 40-44 years | 0.117 | | 0.131 | 0.139 | 0.062 | 0.130 |
| 45-49 years | 0.093 | | 0.098 | 0.129 | 0.020 | 0.110 |
| Years of education | 3.371 | 4.800 | 1.777 | 2.499 | 3.881 | 4.318 |
| Husband characteristics | | | | | | |
| Age of the husband | 46.730 | 14.015 | 46.215 | 46.843 | 45.727 | 47.470 |
| Years of education of the husband | 6.190 | 5.313 | 4.666 | 5.639 | 6.640 | 6.934 |
| Husband is working | 0.961 | | 0.975 | 0.960 | 0.974 | 0.947 |
| Husband is residing with wife | 0.875 | | 0.901 | 0.902 | 0.868 | 0.849 |

| Household-level characteristics | | | | | |
|--|--------|-------|-------|-------|--------|
| Living in urban area | 0.454 | 0.512 | 0.384 | 0.439 | 0.483 |
| Access to electricity | 0.877 | 0.732 | 0.863 | 0.908 | 0.914 |
| Ownership of TV | 0.556 | 0.380 | 0.581 | 0.579 | 0.603 |
| Heard about family planning on TV | 0.261 | 0.226 | 0.386 | 0.248 | 0.203 |
| Ownership of radio | 0.243 | 0.450 | 0.371 | 0.171 | 0.114 |
| Heard about family planning on the radio | 0.074 | 0.206 | 0.104 | 0.032 | 0.023 |
| Observations | 33,580 | 5,418 | 8,123 | 7,437 | 12,602 |

Note: Authors' calculation based on DHS surveys from 1991, 2006, 2012 and 2018.

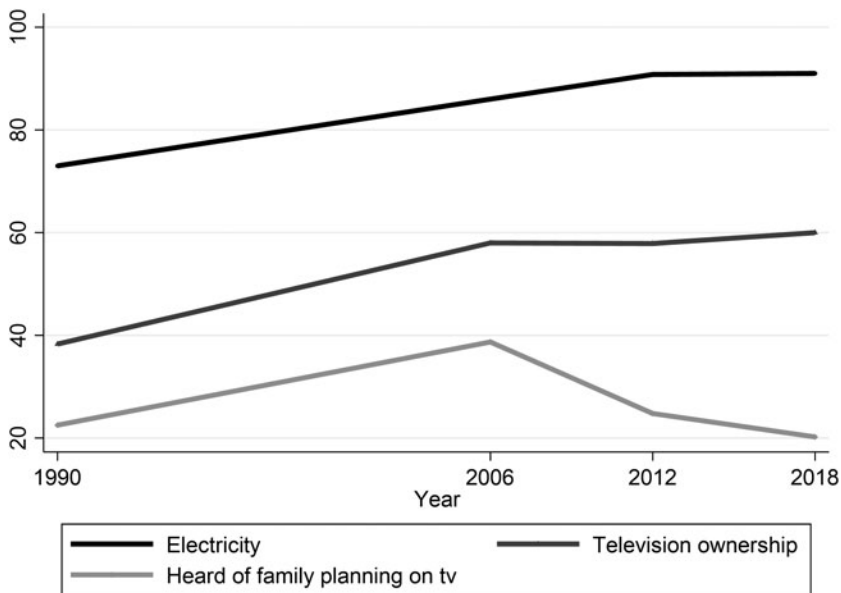


Figure 3. The channels of interest: evolution of electricity access, television ownership and having heard of family planning on TV (1990, 2006, 2012 and 2018).

Note: Authors' calculation based on DHS surveys from 1991, 2006, 2012 and 2018.

Oster (2009) study the probability of pregnancy. Assessing two related fertility indicators allows us to present a more complete picture of the evolution of fertility choices and their determinants over time and to study whether any found impact is mutually reinforcing and coherent across outcomes.

Figure A.1 (in the Appendix) gives an overview of how the crude birth rate and the number of children being alive changed over time and across categories of age. The figure highlights some trends that are worth to be pointed out. The average number of children per woman exhibits a slow but consistent decline, which is in line with national trends [National Institute of Population Studies (2013)]. The difference between the total number of children ever born and the total number of surviving children diminishes over time with the exception of women aged 35 and older in the year 2012. These statistics indicate the availability of better health infrastructure and a decrease in child mortality over time [National Institute of Population Studies, (2013)]. Importantly, these micro-level data are consistent with the macro-economic data presented in Figure 1. After having established these co-moving trends, i.e. of a reduction in fertility and an increase in access to energy and TV (and to a lesser extent in family planning commercials, rather stagnating), we now set up a multivariate model aiming at identifying whether there is a relationship.

5. Empirical model

One of the main methodological problems affecting this type of research is the difficulty in assessing the causal effect between electricity, television and family planning advertisements on the fertility choice. In other words, establishing a causal effect is technically challenging with the data at hand since we rely on a repeated cross-section.

We adopt a two-fold strategy; first, we employ age-cohort, time and location-specific effects to address the structural aspects that feed into the decision-making process about fertility. We complement the multi-level fixed effects analysis with an IV analysis that treats our three channels as being endogenous. As IV we employ the average yearly district-wealth level access to the respective channel. We opted for the construction of a time-varying district-wealth specific instrument to be able to jointly account for all structural effects that we have already in the fixed-effects model. We employ an IV to address the concern that an omitted variable affects both the number of children and the use of new technology, i.e. electricity and TV ownership as well as exposure to family planning commercials. We opted for the average yearly district-wealth level access to the three channels (electricity, TV, family planning commercials) as instrumental variables as they represent peer-group effects. The peer group is constituted by the wealth quintile, as we expect individuals to compare themselves mainly within their wealth group. This is also what we observe in the data; within the same district, the richest households are the first adopters whereas those in the lowest wealth quintile are the latest adopters. The peer group adoption effect -i.e. the aggregate effect- triggers individual adoption and ultimately individual exposure to the new technology. Please note that aggregate adoption of the technology itself is not directly related to individual realized fertility. It is for that reason that we focus on realized fertility and not on fertility perceptions. In the context of realized fertility, we consider the aggregate measure of adoption within a peer group to be a valid instrument. It reflects the stage of diffusion across wealth quintiles. By contrast, it does not directly determine a single couples fertility realizations, i.e. their actual number of children. We argue that aggregate peer-level adoption only triggers individual adoption leading to individual exposure. It is this individual exposure that has the potential to affect long-held, individual perceptions and ensuing fertility realizations. Thus, by purging individual exposure from aggregate peer-level adoption we can causally attribute the effect of electricity, TV and family planning commercials on realized fertility conditional on the other covariates. Importantly, this instrument takes economic conditions into account and allows us to differentiate by economic groups. Since we also include wealth group-specific effects directly as control variables in the main analysis, we capture both, the direct wealth effect and the access to energy-wealth nexus [compare La Ferrara *et al.* (2012)]. Our choice of instrument was further motivated by Fisman and Svensson (2007) and Jain (2021) who set up a similar IV approach in the context of firm bribery payments and ICT adoption, respectively. A similar line of argument is also made by Bertschek and Niebel (2016) and Michaels *et al.* (2014) who set up their models in the context of firms. Like the other studies, we consider the instrument valid because of the different levels of aggregation, i.e. the *average group level* adoption versus the *individual* realization of the outcome.

Since our outcome variables are count variables, we implement a Poisson model. For consistent estimation, we only have to impose that the conditional mean is correctly specified [Wooldridge (2010)]. Thus, we define the conditional mean for every women i , living in household h , in enumeration area e , at time t as follows (equation (1)):

$$\begin{aligned} E(\text{Fert}_{i\text{het}} | \text{Chan}_{\text{het}}, \text{Ind}_{i\text{het}}, \text{Hub}_{i\text{het}}, \text{HH}_{\text{he}}, \lambda_e, t_t) \\ = \exp(\alpha_0 + \alpha_1 \text{Chan}_{\text{het}} + \alpha_2 \text{Ind}_{i\text{het}} + \alpha_3 \text{Hub}_{i\text{het}} + \alpha_4 \text{HH}_{\text{het}} + \lambda_e, t_t) \end{aligned} \quad (1)$$

where $\exp(\cdot)$ refers to the exponential function, $Fert_{i_{het}}$ denotes one of the two fertility outcomes we study (children ever born, children born alive). The three channels ($Chan_{het}$) under study are first separately and then pair-wise tested. In addition, all specifications include the following individual characteristics ($Ind_{i_{het}}$): age categories and years of education. The husband characteristics ($Hub_{i_{het}}$) are age, education, whether he is working and whether he co-resides with his wife. The household-level characteristics (HH_{het}) consist of the wealth categories and the urban location indicator. In addition, we control for location-specific effects (λ_e) referred to as enumeration areas and for survey-year specific effects (t_t). Note that the location-specific effects are a key component in our set-up since they allow us to indirectly account for the topography of the different places and their geographic location.⁷ The remaining error term is clustered at the enumeration area level since we expect the error terms to be correlated within areas as individuals living close to each other are likely to be exposed to the same shocks and the same unobservable conditions.

In the IV estimation, we complement the above set up with the average yearly district-wealth level access to the respective channel as an instrument. On top of the instrument being motivated by the existing literature, it is also motivated by earlier studies about Pakistan that established a relationship between income and access to electricity [Gellerson (1982), Majid (2013)]. In turn, we abstain from using a time-fixed IV such as distance to the capital. Due to the topography of the country the electricity provision is de-centralized, some areas are provided with hydro-electric power, and the placement of these does not depend on the distance to the capital but natural conditions.⁸ Similarly, the nuclear power plants are distributed all over the country.⁹

The challenge with a two-stage Poisson model is that the variance-covariance estimator in the second stage has to account for the estimates from the first stage. To circumvent a two-stage procedure we employ the control-function estimator of the Poisson model. The approach combines the moment conditions from the two stages in a single GMM estimator making adjustments to the second stage variance-covariance estimator redundant [Newey (1984), Wooldridge (2010)]. Moreover, the control function estimator of the Poisson model augments the original model with an estimated term that controls for the endogeneity of the respective fertility channel under study. We refer to it as ρ . The coefficient estimate associated with the control term measures the strength of the endogeneity. When the fertility channel is exogenous, then the coefficient associated with this control term is zero. Importantly, since we have a time-varying IV that also varies within enumeration areas, all other control variables as specified for the basic Poisson model are kept in the two-stage model as well to allow for a comparison of the models based on the covariates.

One downside of applying the Poisson model is that the coefficient estimates are not directly interpretable as marginal effects. We have to calculate the incidence rate ratio,

⁷Pakistan has an extremely varied topography. The lowest point of the country is at sea level, the highest is 8,611 m, the K2 mountain. The Himalayas stretch through the entire north part of the country. Moreover, the country relies to a large extent on hydro-electric power that is generated where the environmental conditions allow it and not necessarily in the capital.

⁸Locational information can be found here: <https://nepra.org.pk/Policies/Hydel%20Potential%20in%20Pakistan.pdf> [Last accessed: September 3, 2021].

⁹Details on the location of nuclear power plants are provided here: <https://world-nuclear.org/information-library/country-profiles/countries-o-s/pakistan.aspx> [Last accessed: September 3, 2021].

which depicts the relative risk. We obtain the incidence rate ratio by applying the exponential function to the Poisson coefficient.

6. Results

Our main results are presented in [Table 2](#). Columns 1 and 2 present the fixed effects results, Columns 3 and 4 the IV results. Panel A introduces the findings for the impact of electricity on realized fertility. For the fixed effects model, we find a positive impact on both the total number of children born and those being born alive suggesting that electricity reduces the costs of raising children. Yet, when accounting for the endogeneity of electricity with the IV model we identify a negative albeit statistically insignificant effect suggesting that the provision of electricity per se did not influence fertility choices ([Table 2](#), Panel A, Columns 3 and 4). As can be seen from the first stage results of the IV procedure, the instrument identifies our endogenous variable precisely and the coefficient associated with the control term ρ indicates that access to electricity is indeed endogenous and renders the fixed effects results invalid. Taken together, the results indicate that in principle parents are aware that modern technologies such as electricity increase the demand for skilled labor thus increasing the returns to education and spurring the demand for “quality children” and thus inducing the desire to have fewer children. But in practice parents do not seem to manage the fertility transition in a direct response to access to this modern technology.

We now turn to the television channel (Panel B of [Table 2](#)). Across specifications, we identify a negative relationship between television ownership and fertility. Yet, the fixed effects results are smaller in absolute terms and not statistically significant. Only when we account for the endogeneity of television ownership, we identify a statistically significant and negative relationship. The magnitude of the effect is largest in absolute terms for the number of living children suggesting that television ownership reduces the total number of children alive by about 6.4% $[(1-\exp(-0.066)) \times 100, p\text{-value} \leq 0.01]$, and the total number of children born alive by about 6.2% $[(1-\exp(-0.064)) \times 100, p\text{-value} \leq 0.05]$. These small differences between the two fertility measures suggest that the results are internally coherent. Put differently, if access to television was further increased from 60.3% ([Table 1](#), access in 2017–18) to 100%, i.e. by 39.7 pp, a further decline of 0.1 $(=0.397 \times 0.064 \times 3.559)$ of a child could be achieved. This is a fair contribution to the fertility transition given that the 2017–18 number of children per woman was 3.559 ([Table 1](#)) on average.

Further note, that the first-stage IV results support the findings. The instrument has high predictive power and the control term indicates the endogeneity of television ownership. Thus, the findings suggest that there might be some links between television ownership, the broadcasted soap-operas that depict small families as ideal and realized fertility. Yet, we cannot directly attribute the fertility reducing effect stemming from television ownership to the aired soap-operas since we do not have any information whether the households under study were indeed watching these series. It could also be the case that the women under study are heavily influenced by religious programs. In Pakistan, there are currently 38 television channels offering pure entertainment programs and 10 channels with a more religious content [[Abbas and Sulehria \(2020\)](#)]. However, the former channels have most of the audience (60%) while the latter genre has an audience share of less than 10%, with this trend holding true since 2004 [[Abbas and Sulehria \(2020\)](#)].

Table 2. Poisson regression results

| | Poisson | | Poisson IV | |
|-----------------------------|----------------------------|----------------------------------|----------------------------|----------------------------------|
| | Total # of children (1) | Total # of children alive (2) | Total # of children (3) | Total # of children alive (4) |
| Panel A: Electricity | 0.047*** | 0.056*** | -0.025 | -0.016 |
| | (0.013) | (0.012) | (0.031) | (0.027) |
| First stage | | | | |
| IV for electricity | | | 1.004*** | 1.004*** |
| | | | (0.004) | (0.004) |
| ρ | | | 0.097*** | 0.095*** |
| | | | (0.033) | (0.031) |
| Observations | 33,593 | 33,593 | 33,593 | 33,593 |
| Panel B: Television | -0.003 | -0.002 | -0.064** | -0.066*** |
| | (0.008) | (0.008) | (0.031) | (0.029) |
| First stage | | | | |
| IV for television | | | 0.996*** | 0.996*** |
| | | | (0.004) | (0.004) |
| ρ | | | 0.075** | 0.081*** |
| | | | (0.033) | (0.030) |

| | | | | |
|--|-----------------|-----------------|------------------|------------------|
| Observations | 33,592 | 33,592 | 33,592 | 33,592 |
| Panel C: Heard of family planning on TV | -0.012** | -0.012** | -0.066*** | -0.085*** |
| | (0.006) | (0.006) | (0.027) | (0.025) |
| First stage | | | | |
| IV for family planning | | | 0.991*** | 0.991*** |
| | | | (0.008) | (0.008) |
| ρ | | | 0.063** | 0.081*** |
| | | | (0.028) | (0.027) |
| Observations | 33,853 | 33,853 | 33,853 | 33,853 |

Note: All specifications include year-specific wealth effects, year-specific age cohort effects for the women under study, the age of the husband, years of education for both women and men, district-specific effects, whether the husband is working, whether the husband is residing with the woman; whether the family resides in an urban area, and year fixed effects. The standard errors are clustered at the district level. Across specifications, there are 166 districts. ***/**/* indicates statistical significance at the 1/5/10% level. ° The IV for electricity is the average district-wealth access to electricity by year; the IV for television is the average district-wealth access to television by year; the IV for family planning is the average district-wealth level of family-planning info provided by TELEVISION by year.

In turn, what we can test for is whether the respondents have watched family planning commercials on TV since for these we have information on actual exposure. It is for the reason of content attribution that we include this third channel in our analysis. While we acknowledge that family planning commercials are not soap operas, we argue that any impact we identify for this most direct channel also reinforces the possibility for the television channel working more in general through soap operas. We present findings about the exposure to family planning messages on television and fertility outcomes in Panel C of [Table 2](#). This last channel shows indeed the strongest impacts suggesting that women are susceptible to concepts of family planning and modern family structure.

Having heard about family planning on television is associated with fertility reducing effects across both fertility indicators and specifications. While the effect is fairly small in the fixed effects set-up, i.e. a reduction of roughly 1% [(1-exp(-0.012)) × 100] is found for both fertility indicators, the effect is substantially larger once we account for the endogeneity of watching family planning commercials on television. The IV specification identifies a reduction of 6.4% [(1-exp(-0.066)) × 100], in the total number of children born and a reduction of 8.2% [(1-exp(-0.085)) × 100] in the number of children alive. Both effects are precisely identified (p -value ≤ 0.01). More importantly, the potential of family planning commercials seems not be reaped. In 2017–18 only 20.3% of the respondents reported having watched family planning commercials on TV ([Table 1](#)). Thus, assuming that all women could be reached implying an increase of 79.7 pp, a further decline in the number of children born alive of 0.2 (=0.797 × 0.082 × 3.559) of a child could be achieved. This is twice the contribution to the fertility transition as compared to the “naïve” television effect hinting at the potential of targeted interventions that present modern families. From an empirical point of view, in both cases, the adopted IV approach is supported by the first stage results. The findings suggest that the identified family planning channel is meaningful in transmitting fertility pressure and that explicit family planning messages on television were successful in contributing to a fertility decline in Pakistan.

Note that complementary evidence is provided by a study conducted on family planning practices among married women in the district of Khairpur, Pakistan [Ali and White (2005)]. The authors show that it is indeed the effective outreach of mass media that impacts fertility choices, especially those of women with low levels of education. More than 70% of the women interviewed for the study reported to have seen or listened to family planning messages on television and/or radio and that the media have been a successful channel for reaching large numbers of people. Therefore, the authors advocate for a more rigorous use of television as a future effective way of dissemination of family planning messages. The fact that this is now ruled out by the religious leaders provides further suggestive evidence about the strength of television in diffusing new models of the family.

Yet, so far we have only looked at the three channels separately. To assess the robustness of our findings, in [Table 3](#) we present the results when we look at the pair-wise effects of the three channels on fertility. In Panel A of [Table 3](#) we combine the channels electricity and television. We do not observe any substantial shifts in the relationships identified in [Table 2](#). In fact, the lack of a relationship between electricity and realized fertility is reproduced while at the same time the negative and statistically significant impact of television ownership on the total number of children born and those alive is confirmed. Again, the first stages precisely identify

Table 3. Results for the joint inclusion of multiple channels

| | Total # of children (1) | Total # of children alive (2) | | Total # of children (3) | Total # of children alive (4) |
|------------------------------------|----------------------------|----------------------------------|--|----------------------------|----------------------------------|
| Panel A: Electricity | -0.011 | -0.001 | Panel B: Television | -0.051 ⁺ | -0.049* |
| | (0.030) | (0.027) | | (0.031) | (0.029) |
| Television | -0.062** | -0.066** | Heard of family planning on TV | -0.052* | -0.071*** |
| | (0.030) | (0.029) | | (0.027) | (0.025) |
| <i>First stages</i> | | | <i>First stages</i> | | |
| <i>First stage for electricity</i> | | | <i>First stage for television</i> | | |
| IV for electricity | 1.006*** | 1.006*** | IV for television | 0.996*** | 0.996*** |
| | (0.004) | (0.004) | | (0.004) | (0.004) |
| IV for television | -0.007** | -0.007** | IV for family planning on TV | 0.003 | 0.003 |
| | (0.003) | (0.003) | | (0.004) | (0.004) |
| ρ | 0.081** | 0.078** | ρ | 0.064* | 0.066** |
| | (0.032) | (0.030) | | (0.033) | (0.031) |
| <i>First stage for television</i> | | | <i>First stage for family planning on TV</i> | | |
| IV for electricity | -0.002 | -0.002 | IV for television | 0.004 | 0.004 |
| | (0.003) | (0.003) | | (0.006) | (0.006) |
| IV for television | 0.997*** | 0.997*** | IV for family planning on TV | 0.991*** | 0.991*** |

(Continued)

Table 3. (Continued.)

| | Total # of children (1) | Total # of children alive (2) | | Total # of children (3) | Total # of children alive (4) |
|--------------|----------------------------|----------------------------------|--------------|----------------------------|----------------------------------|
| | (0.004) | (0.004) | | (0.008) | (0.008) |
| ρ | 0.064** | 0.071** | ρ | 0.044 ⁺ | 0.062** |
| | (0.032) | (0.030) | | (0.028) | (0.027) |
| Observations | 33,588 | 33,588 | Observations | 33,584 | 33,584 |

Note: Covariates are as listed in Table 2. Across specifications, there are 166 districts. The standard errors are clustered at the district level. ***/**/*/⁺ indicates statistical significance at the 1/5/10/11% level. The IV for electricity is the average district-wealth access to electricity by year; the IV for television is the average district-wealth access to television by year; the IV for family planning is the average district-wealth level of family-planning info provided by TELEVISION by year.

the endogenous variables. In Panel B we present the television and family planning channel together. The results indicate that indeed family planning commercials have the biggest impact in reducing fertility. In both specifications, the coefficients are precisely identified. The television channel is only significant at the 11% level in the specification with the total number of children born (Column 3). It is statistically significant at conventional levels in the specification with the number of children born alive (Column 4). Again, the first stage results support the chosen specification. Since the electricity channel is insignificant when included alone (Panel A of Table 2) and when included together with the television channel (Panel A of Table 3), we abstain from a model that includes all three channels jointly. Overall, the pair-wise inclusion of the channels and the robust result it yields makes us confident about the credibility of the findings.

But how important is the identified television and family planning channel? Despite the robustness of the results, it might be argued that we are too narrowly focusing on television. In fact, the radio and family planning commercials broadcasted there might equally function as channels that impact fertility. To address this possibility, we next turn to some robustness checks including radio ownership and having heard about family planning on the radio in our empirical specification. Results are presented in Table 4. Panel A shows the findings for radio ownership. Across specifications, we identify small effects that are imprecisely estimated suggesting that radio ownership does not impact fertility decisions. Moreover, the coefficient associated with the control term ρ in the first stage suggests that radio ownership is exogenous. The limited role for the radio can already be inferred from the descriptive statistics. While in 1990–91, 45.0% of the households owned a radio, this share declined to 11.4% in 2017–18. Over the same period, television gained large importance with almost two-thirds of the households having access in 2017–18 and already 58.1% having access in 2006. This suggests that the radio has had only a temporarily limited role for the Pakistani society and therefore it is not surprising that we do not observe any impacts on fertility.¹⁰

Next, we assess the role of family planning commercials aired on the radio (Table 4, Panel B). As expected, due to the limited role of the radio over time, we do not find any indication that family planning commercials on the radio had an impact on fertility choices.

Lastly, we want to assess whether the earlier identified television and television family planning channels persists when we jointly account for the radio channel. Results are presented in Table 5. Panel A presents the results for the joint inclusion of television and radio ownership showing that across specifications we identify a stable and statistically significant fertility reducing effect stemming from television and ranging between 6.2 [(1-exp(-0.064)) × 100] and 6.5% [(1-exp(-0.067)) × 100]. Note that we estimated one specification treating radio ownership as exogenous and one treating radio ownership as endogenous due to the previously established result

¹⁰The role played by radio in terms of fertility reduction is limited if compared to the television; this is due to the fact “[...] that television, more than radio, exposes viewers to aspects of modern life that compete with traditional attitudes toward marriage” [Westoff and Koffman (2011)]. Furthermore, according to Media Landscapes (1992–2021), mainly teenagers listen to the radio on their mobile phones as do car drivers. From the advertisement revenues across media platforms, the share of the radio was only 4% in 2015/16 suggesting that indeed the role of the radio is limited. Compare <https://medialandscapes.org/country/pakistan/media/radio> [Last accessed: September 14, 2021].

Table 4. Results for the alternative channel: Radio

| | Poisson | | Poisson IV | |
|---|----------------------------|----------------------------------|----------------------------|----------------------------------|
| | Total # of children (1) | Total # of children alive (2) | Total # of children (3) | Total # of children alive (4) |
| Panel A: Radio | -0.005 | -0.002 | 0.025 | 0.030 |
| | (0.007) | (0.007) | (0.030) | (0.029) |
| First stage | | | | |
| IV for radio | | | 0.987*** | 0.987*** |
| | | | (0.005) | (0.005) |
| ρ | | | -0.030 | -0.032 |
| | | | (0.030) | (0.029) |
| Observations | 33,583 | 33,583 | 33,583 | 33,583 |
| Panel B: Heard of family planning on the radio | -0.009 | -0.009 | -0.007 | -0.038 |
| | (0.010) | (0.009) | (0.059) | (0.057) |
| First stage | | | | |
| IV for family planning (radio) ^o | | | 1.000*** | 1.000*** |
| | | | (0.006) | (0.006) |
| ρ | | | 0.001 | 0.031 |
| | | | (0.061) | (0.059) |
| Observations | 33,852 | 33,852 | 33,852 | 33,852 |

Note: Covariates are as listed in Table 2. Across specifications, there are 166 districts. The standard errors are clustered at the district level. ***/**/* indicates statistical significance at the 1/5/10/11% level. ^oThe IV for radio is the average district-wealth access to radios by year; the IV for family planning (radio) is the average district-wealth level of family-planning info provided by the RADIO by year.

about the possible exogeneity of radio ownership (compare Table 4). Importantly, no matter what specification we employ, the main effect –i.e. the fertility reducing effect from television– persists. The picture looks similar when comparing the impact of family planning commercials on television and the radio (Panel B of Table 5). The earlier identified fertility reducing effect of family planning messages on television is supported.

In short, we showed that television ownership and being exposed to advertisements on family planning are two channels feeding into reduced fertility in Pakistan.

We conclude the presentation of our results with a discussion of the limitations of the study. First, we only have data on television ownership but not on the channels and soap-operas watched or the time spent watching television. From the qualitative review of the most prominent television series and the data about the audience profile of the different TV channels and programs they broadcast we deduct those very likely women watch soap-operas and get influenced by the way of life –

Table 5. Combined results for the television and the alternative channel radio

| | Two endogenous variables – Two IVs | | One endogenous variable – One IV | | | Two endogenous variables – Two IVs | | One endogenous variable – One IV | |
|---------------------------------------|---|------------------------------|-------------------------------------|------------------------------|--|---------------------------------------|------------------------------|-------------------------------------|------------------------------|
| | Total # of children | Total # of children alive | Total # of children | Total # of children alive | | Total # of children | Total # of children alive | Total # of children | Total # of children alive |
| | (1) | (2) | (3) | (4) | | (5) | (6) | (7) | (8) |
| Panel A: Television | −0.065** | −0.067** | −0.064** | −0.067** | Panel B: Heard of family planning on TV | −0.076*** | −0.091*** | −0.071** | −0.091*** |
| | (0.031) | (0.029) | (0.031) | (0.029) | | (0.029) | (0.028) | (0.029) | (0.027) |
| Radio | 0.027 | 0.032 | 0.003 | 0.006 | Heard of family planning on the radio | 0.050 | 0.030 | 0.025 | 0.031* |
| | (0.030) | (0.028) | (0.007) | (0.007) | | (0.063) | (0.063) | (0.016) | (0.016) |
| <i>First stages</i> | <i>First stages</i> | | | | | | | | |
| <i>First stage for television</i> | <i>First stage for family planning (TV)</i> | | | | | | | | |
| IV for television° | 0.996*** | 0.996*** | 0.995*** | 0.995*** | IV for family planning (TV)° | 0.988*** | 0.988*** | 0.912*** | 0.913*** |
| | (0.004) | (0.004) | (0.005) | (0.005) | | (0.007) | (0.007) | (0.010) | (0.010) |
| IV for radio° | 0.003 | 0.003 | . | . | IV for family planning (radio)° | 0.016 | 0.016 | . | . |

(Continued)

Table 5. (Continued.)

| | Two endogenous variables – Two IVs | | One endogenous variable – One IV | | | Two endogenous variables – Two IVs | | One endogenous variable – One IV | |
|--------------------------------|---------------------------------------|------------------------------|-------------------------------------|------------------------------|--|---------------------------------------|------------------------------|-------------------------------------|------------------------------|
| | Total # of children | Total # of children alive | Total # of children | Total # of children alive | | Total # of children | Total # of children alive | Total # of children | Total # of children alive |
| | (1) | (2) | (3) | (4) | | (5) | (6) | (7) | (8) |
| | (0.004) | (0.004) | | | (0.013) | (0.013) | | | |
| ρ | 0.077** | 0.083*** | 0.076** | 0.082*** | ρ | 0.073** | 0.087*** | 0.068** | 0.087*** |
| | (0.033) | (0.030) | (0.033) | (0.030) | | (0.029) | (0.029) | (0.030) | (0.029) |
| <i>First stage for radio</i> | | | | | <i>First stage for family planning (radio)</i> | | | | |
| IV for television ^o | 0.011** | 0.011** | | | IV for family planning (TV) ^o | −0.007** | −0.007** | | |
| | (0.005) | (0.005) | | | | (0.003) | (0.003) | | |
| IV for radio* | 0.987*** | 0.987*** | | | IV for family planning (radio) ^o | 1.006*** | 1.006*** | | |
| | (0.005) | (0.005) | | | | (0.006) | (0.006) | | |
| ρ | −0.032 | −0.034 | | | ρ | −0.055 | −0.036 | | |
| | (0.030) | (0.029) | | | | (0.064) | (0.064) | | |
| Observations | 33,581 | 33,581 | 33,581 | 33,581 | Observations | 33,849 | 33,849 | 33,849 | 33,849 |

Note: Covariates are as listed in Table 2. Across specifications, there are 166 districts. The standard errors are clustered at the district level. ***/**/*/* indicates statistical significance at the 1/5/10/11% level. The IV for television is the average district-wealth access to television by year; The IV for radio is the average district-wealth access to radios by year; the IV for family planning (TELEVISION) is the average district-wealth level of family-planning info provided by TELEVISION by year; the IV for family planning (RADIO) is the average district-wealth level of family-planning info provided by the RADIO by year.

including family structure— represented there. But since we do not know the frequency of what women watch, we have to limit ourselves in alluding to the role soap-operas can play in spurring the fertility decline. As discussed in the results, we can make a stronger argument for the role of family planning commercials as we know that the women have watched them.

Second, we only have a pooled cross-sectional dataset and not panel data. Obviously, other development interventions such as public health and infrastructure projects are important determinants of the fertility decline as well. We cannot control for the presence of these programs directly as we do not have detailed information on the outreach and timing of these interventions. Yet, we know that even a large program that was considered a success, the Lady Health Worker Programme, was only gradually introduced in 1994 and never reached full country coverage [WHO (2008)]. Thus, by controlling for location-specific and time-specific effects along with the age cohort of the respondents, we address at least partly influences from other events and programs. Moreover, the stability of the findings across specifications makes us confident that the identified effects highlight the contribution that television and family planning commercial make to the fertility transition in Pakistan.

Third, part of the decrease in the observed fertility outcomes over this almost 30-year period may be attributable to changes in the male-female dynamics within the household. Contraceptive use has increased across surveys from 14.5% in 1990–91 to slightly above 35% in 2012 and 2017–18. We did not include contraceptive use in the multivariate analysis as it is potentially endogenous. The same applies for birth taking place in health clinics; this decision is also potentially endogenous. Thus, we acknowledge that we cannot fully rule out effects stemming from access to health services for women.

Fourth, our IVs are population sub-group specific averages and not external events. While they can be criticized for coming from the dataset they have been approved by the existing literature and demonstrate to have excellent predictive power. With the type of data and information at hand, we considered the chosen approach the best possible option.

7. Conclusions

This paper explores the effects that electricity, television ownership and family planning commercials have on women's fertility decisions. Our analysis draws on Pakistan, one of the most populated countries which is currently experiencing a slow decline in the fertility rate, in a period of time spanning between 1990 and 2018.

This paper presents supportive quantitative evidence for the statement made by the Pakistani Prime Minister, Imran Khan, that television can be used to reduce population growth. While our results do not support his notion that population growth can be reduced through the mean of television, we show that exposure to television has the potential to reduce the fertility rate by around 6%. The effect of family planning campaigns broadcast on television is even larger, inducing about 8% of a decline. While those findings are promising for Pakistan, which is under huge population pressure, the evidence presented here clashes with recent trends in television programs/advertisements being broadcast. Starting from 2016, advertisements for all contraceptive, birth control and family planning products broadcast on television and radio were banned as concerns that they expose children to the subject of sex were raised. The ban was lifted 3 days later with the agreement that commercials on contraception could only be aired in the evening after 11 pm.

While our evidence is only suggestive, it points to the fact that the content of television programs plays a major role for the fertility transition. Pakistani aired soap-operas portray a particular household -less numerous than the typical Pakistani family- and a typology of woman -successful, wealthy, emancipated with positions of power in politics- which in the long-run has affected the country's fertility outcome.

The findings highlighted in this paper have important policy implications for Pakistan as well as for other developing countries that face the pressure of over-population. In those societies where the literacy rate is still relatively low and the internet is not as available as in Western economies, television may play an important role in exposing citizens to different ways of living. Furthermore, the results suggest that television programs/advertisements of whatever genre have the potential of reaching a huge number of households at relatively low costs, and could be used by policymakers to deliver animated messages to the population.

Conflict of interest. There are no conflicts of interests.

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