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Waves of Change? Radio announcements and fertility decline

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# Waves of Change? Radio announcements and fertility decline

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**Abstract**

Can radio campaigns affect fertility? This paper examines the impact of a national radio campaign promoting family planning clinics in late 1960s Colombia on the country's rapid fertility decline. The campaign, initiated by Profamilia in 1969, provided information about the location of clinics without giving detailed contraceptive information. Using data from the full count 1973 census and information on clinic locations and radio programs, the study leverages exogenous variation in radio signal strength to estimate the campaign's effect on fertility. I follow a difference-in-differences strategy to compare fertility before and after the start of the radio campaign at the individual level. The findings indicate that the radio campaign reduced between 4% to 16% the probability of having a child one year after the campaign. The effects are stronger for women living close to a Profamilia clinic. However, by 1973 motherhood was still almost universal. This research contributes to the understanding of the effects of family planning programs and media exposure on fertility decline, highlighting the role of media in overcoming geographical barriers and driving social change.

**Keywords:** fertility transition, mass media, family planning, Colombia
**JEL Classification:** J13, O33, O15, I18, N36

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# ¿Ondas de cambio? Anuncios radiales y la reducción de la fecundidad

Juliana Jaramillo-Echeverri[*†]



**Resumen**

¿Pueden las campañas de radio afectar la fecundidad? Este artículo examina el impacto de una campaña de radio que promovía clínicas de planificación familiar, en el descenso de la fecundidad en Colombia. La campaña, iniciada por Profamilia en 1969, proporcionó información sobre la ubicación de las clínicas sin ofrecer información detallada sobre anticonceptivos. Utilizando datos del censo completo de 1973 y la información sobre la ubicación de las clínicas y los programas de radio, este artículo usa la variación exógena en la intensidad de la señal de radio para estimar el efecto de la campaña en la fecundidad. Utilizando una estrategia de diferencia en diferencias se compara la fecundidad antes y después del inicio de la campaña de radio. Los resultado indican que la campaña de radio redujo entre un 4% y un 14% la probabilidad de tener un hijo un año después de la campaña. Los efectos son más fuertes para las mujeres que viven cerca de una clínica de Profamilia. Sin embargo, en 1973 la maternidad seguía siendo casi universal. Esta investigación contribuye a nuestro conocimiento sobre los efectos de los programas de planificación familiar y la exposición a los medios en la disminución de la fecundidad, destacando el papel de los medios en superar las barreras geográficas e impulsar el cambio social.

**Palabras clave**: transición de la fecundidad, medios de comunicación, planificación familiar, Colombia
**Clasificación JEL**: O15, D63, I24, J15, J12, N36

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# 1 Introduction

Currently, there is no consensus regarding the role of contraception and family planning programs in the fertility decline of developing economies.[1] Several scholars argue that family planning can have substantial effects on fertility and suggest that knowledge and availability of contraceptive methods are some of the most fundamental barriers to fertility decline (Bongaarts, Mauldin, & Phillips, 1990). On the contrary, others suggest that once changes in the demand for children are accounted for, the effect of contraceptives on fertility is small (Miller & Babiarz, 2016). Although the timing of the decline coincides with the introduction and popularisation of modern contraceptive methods and in particular with the release of birth control pills in the US, in the literature, the impact of family planning programs on fertility reductions varies from no effect in the case of Indonesia (Pitt, Rosenzweig, & Gibbons, 1993) to around 22% to 30% in the case of China (Babiarz, Ma, Miller, & Song, 2020).

This paper investigates if a national radio campaign promoting family planning clinics in the late 1960s in Colombia had an effect on the rapid fertility change that occurred across the country. This initiative by Profamilia, one of the largest family planning organisations in the world, started in 1969 and introduced publicly the concept of family planning. The radio campaign increased the availability of family planning information, especially in rural areas, where radio was the primary source of information. However, the campaign did not describe any contraceptive method and did little to promote new social roles for women or increase the educational level of the population. It targeted mainly married couples and was mostly used to make them both aware of and interested in the programs and clinics, without providing any specific information on methods (Bailey, 1973; Stycos & Avery, 1975).

Measuring the impact of this campaign is relevant as recent literature has shown that the use of new media and information technologies can affect the behaviour of people by spreading new information and at the same time it can shape attitudes. Additionally, the campaign allows us to disentangle two potential effects of contraception and family planning programs: knowledge of and access to family planning.

[1] It is likely that contraception played an important role during the historical fertility transition in Western countries, although mainly by the implementation of withdrawal and abstinence given the high costs of condoms or the diaphragm (Guinnane, 2011). For the US case, scholars have argued that new contraceptive methods like the pill did not play a major role in the sharp drop in fertility after the 1960s (Bailey, 1973; Angrist & Evans, 1998).

Studying the impact of radio campaigns promoting family planning in Colombia offers several advantages. Firstly, during the mid-20$^{th}$ century, the radio emerged as the most widely adopted electronic communication device, thus enabling us to examine the effects of a significant technological innovation that reached a substantial portion of the population. Secondly, the rise in popularity of the radio coincided with the onset of Colombia's fertility transition in the mid-1960s. This transition was concurrent with the global introduction and rapid adoption of oral contraceptives, particularly in urban centres. However, what caused the remarkable and swift decline in fertility rates observed in both rural and urban areas of Colombia after 1965 remains a subject of ongoing debate (Flórez-Nieto, 2000; Miller, 2010).

The radio campaign started in 1969 with 30-second ads that announced the availability of family planning services and locations of Profamilia clinics. The goal was to spread the idea of family planning and increase the number of visitors to the clinics. The ads did not describe any contraceptive method nor intended to persuade the listeners of the advantages of limiting fertility. Early evaluations of the radio campaign show that it reached the urban target population and accelerated information diffusion about fertility control and increased awareness of contraceptive methods (Bailey, 1973; Stycos & Avery, 1975; Bailey & Cabrera, 1981). The evaluations show an immediate increase in the number of visitors to the clinics during the radio campaign, especially in large cities. Still, some suggest that this increase was at the expense of visitors who would have attended the clinics in the future (Stycos & Avery, 1975). Until now, the effect of this campaign on the rapid fertility decline of Colombia has not been measured.

To evaluate the effects of exposure to the radio campaign, I use individual-level data from the full count census of 1973 and collected data on the location and dates of the establishment of Profamilia's clinics. Given that I do not have exact data on the number of radio listeners or variation in access to radio at the individual level, I gathered information on the content, coverage, and timing of Profamilia radio programmes. Using the Irregular Terrain Model (Hufford, 2002), I predict the radio signal strength of several radio stations in the country that were located in the cities were Profamilia launched its radio campaign, and use the predicted signal strength to estimate a lower bound of the intention to treat effect.

The main challenge to estimating the effects of the radio campaign on fertility is that it is possible that the location of the stations was not randomly allocated in the country, and therefore it could be correlated with other characteristics that could influence fertility. Al-

though the configuration of the broadcasting stations was completed before the introduction of the campaign and previous research has shown that the spread of Profamilia was independent of fertility, I employ a difference-in-differences strategy to compare fertility before and after the start of the radio campaign at the individual level. To avoid the potential correlation between the location of the clinics and radio transmitters and other characteristics that could influence fertility at the municipal level, I exclude cities with transmitters in my analysis. Additionally, I show that five years before the campaign, there were no differences in the probability of childbearing between areas with high and low signal strength. The findings reveal that the radio campaign reduced the probability of childbirth and the size of the effects vary from 4% to 9% depending on the intensity of the radio signal. Also, women residing in municipalities that were close to a clinic experienced an ever lower probability of childbearing (16%) after the campaign was launched.

This research contributes to several debates in the literature. The first one is related to the effects of family planning programs on fertility decline. Although global funding for family planning tripled during the 1970s and early 1980s, the effect of these programs on fertility is still contentious (Miller & Babiarz, 2016). Some scholars argued that the large-scale initiative to implement family planning programs across the world was successful in reducing fertility and population growth on a global scale.[2] However, the estimations at the country level range from no effect in the case of Indonesia in the 1970s and 1980s (Pitt et al., 1993) to 27% in the case of China with its "Longer, Later, Fewer" campaign (Babiarz et al., 2020). For the case of Colombia, Miller (2010) estimates that the foundation of a Profamilia clinic in a city accounted for around 6% to 7% of the decline by looking at the geographical spread of the organisation from 1965 to the beginning of the 1970s. My research shows that both knowledge of family planning clinics as well as access to the clinics reduced the probability of childbearing.

This research is also related to the literature on the effects of media and information technologies on fertility. Mass media has the potential to alter the behaviour of people by providing new information but also by shaping the self-identity of people, also known as ideational change (J. Williams & Singh, 1976; Barber & Axinn, 2004; Spolaore & Wacziarg, 2022).[3] For example, the literature finds that there is a significant association between mass media

[2]For example, Bongaarts et al. (1990) estimate that without family planning programmes the population in Asia, Latin America, and Africa would have been 412 million bigger by the early 1990s.
[3]See also DellaVigna and La Ferrara (2015) for a recent survey on the impact of exposure to the media.

and fertility (J. Williams & Singh, 1976; Westoff & Rodriguez, 1995; Parr, 2002; Beach & Hanlon, 2019). At the cross country-level access to television, radio and newspapers is negatively related to fertility rates. Several reasons for these relationships have been suggested in the literature. Potentially, media can directly disseminate information about family planning, as in the case of my study or it can shape social roles, by presenting alternative lifestyles, examples of different aspirations or by raising the general level of education of the population. The paper by La Ferrara, Chong, and Duryea (2012) on the case of Brazil is a clear example of this literature.[4] The study shows how the spread of soap operas affected the Brazilian fertility transition and how *telenovelas* spread a new idea of family and in particular raised women's economic aspirations.

This finding is also related to the seminal paper on Nazi radio and its effects on anti-Semitism by Adena, Enikolopov, Petrova, Santarosa, and Zhuravskaya (2015) or the more recent papers on the effects of radio on political outcomes during the 1930s and 1960s in the US by Wang (2021) which underline the importance of persuasion in communication.[5] Unlike these studies, this paper focuses on a campaign of information that had limited power of persuasion. The campaign was focused on giving information on the location of the clinics and legitimising the idea of family planning and the announcements did not intend to persuade couples of the advantages of smaller families.

Finally, using a difference in difference strategy, my research provides robust evidence of the influence of family planning promotion through radio on fertility behaviour. Since the 1850s family planning advocates have used mass media outlets to inform and motivate people on the methods and advantages of regulating fertility (Parry, 2013; Beach & Hanlon, 2019).[6] But with the rise of new media and information technologies in the 1950s, the use of radio and TV became popular to promote modern contraceptives given their wide coverage and potential effectiveness. However, the evidence of such effectiveness is mixed (Udry, Clark, Chase, & Levy, 1972). Additionally, the interpretation of the evidence as causal could be limited as identification of exposure is not always clear.[7] The results of this research suggest that the diffusion of information had a smaller effect in comparison to the effect of knowledge

[4]See also Barber and Axinn (2004) on Nepal or Kearney and Levine (2015) for the US case.
[5]See Dellavigna and Gentzkow (2010) for a survey on the effects and drivers of persuasive communication.
[6]For example, the dissemination of the Bradlaugh-Besant trial after 1877 in the United Kingdom or the pioneer pamphlet of 1914 called *Family limitations* that circulated in the US published by Margaret Sanger and was followed by the Comstock Laws.
[7]See for example the discussion on Jaeger, Joyce, and Kaestner (2020) and the study for Ghana by Parr (2002).

of and access to family planning.

## 2 A brief history of the radio

As one of the biggest revolutions, the radio arrived in the country in 1929 and expanded through the territory during the 1930s. The first official (from the government) radio station, the HJN, was founded in Bogotá on the 5$^{th}$ of September 1929, while the first commercial radio station, *"La Voz de Barranquilla"*, was founded in Barranquilla on the 8$^{th}$ of December of the same year. The central goal of the radio was to consolidate a national project and to overcome the geographical barriers to unify the country. Public radio stations were mainly used for educational purposes and to connect the country, while commercial radio was mainly used for advertisements (Blanco Sánchez, 2018).

By 1945, the radio had already established itself as the main means of mass communication in Colombia and with the introduction of the transistor radio in the mid-1950s, the radio became the most popular electronic communication device of the 1950s and incorporated the rural area to the national audience. In 1947 the foundation of *Radio Sutatenza*, the first Catholic radio station in Latin America, started an educational campaign through radio to alleviate the high levels of illiteracy in the rural and isolated areas (Roldán, 2014).

After 1957 almost all the radio stations had modernised their equipment and increased their power from 1 or 5 kilowatts to 10 or 20 kilowatts, which improved the coverage range of the radio. By the mid-1970s the radio was regarded as the method par excellence for reaching the lower-income population with around 20 million listeners across the country and 340 radio stations located in 109 municipalities (Ferreira & Straubhaar, 1988). By 1977, almost 90% of the households in the main cities in Colombia had a radio (Table 1), and the 1977 Household Survey indicated that radio usage was consistent across different educational levels, with over 80% adherence. Socio-economic factors that may limit access to other media, such as television or newspapers, did not seem to affect access to radio (DANE, 1978a).

Table 1: Households with radio and TV.

| City | Households with a radio (%) | Households with a TV (%) |
|---|---|---|
| Bogotá | 91 | 39 |
| Medellín | 93 | 67 |
| Cali | 90 | 59 |
| Barranquilla | 89 | 61 |
| Bucaramanga | 86 | 58 |
| Manizales | 89 | 66 |
| Pasto | 90 | 60 |
| **Total 7 cities** | **91** | **61** |

Sources: DANE (1979)

# 3 The *debut* of family planning

Catching up with Europe, like other Latin American countries, in the 1960s Colombia experienced a rapid fertility transition, and in only 25 years the number of children per woman fell from 6.8 to 3 (López Toro, 1968). Despite important regional disparities in development, the fertility decline in the country was not only rapid but also widespread (Jaramillo-Echeverri, 2024). Both rural and urban women decreased their number of children and the reduction was evident in women across all ages. What explains such a rapid and widespread decline in fertility? There is still an open debate in the literature regarding the mechanisms that can account for the fertility decline but the increase in the knowledge, availability and use of contraceptive methods after the mid-1960s has drawn special attention as the fertility transition coincided with the approval of the pill by the FDA in the US in 1960 and its quick dissemination around the world.

In Colombia, the dissemination of modern contraceptive methods kicked off when the Colombian Association for Family Welfare (Profamilia) was founded in Bogota in 1965. As a result, by the early 1970s, the majority of women knew of at least one contraceptive method and approved family planning, and around 40% of urban women were practising contraception (Prada & Ojeda, 1987; Bailey, 1973). Although the use of modern contraceptive methods increased, the role that Profamilia played in the overall fertility decline was limited (Miller, 2010). It is possible that family planning had a small effect on the fertility of urban women because by the early 1960s fertility in urban areas was already being controlled, possibly through more traditional methods and abortion. However, the effects of Profamilia clinics on the fertility of women living in areas outside the city, which were on average more rural and less educated and where access to contraception was more limited, are still unknown.

As reported in Simmons and Cardona (1974), in 1969 63% of women living in Bogota had ever used a contraceptive method, while only 19% of rural women had. Similarly, abortion was commonly practised in big cities during the 1960s (Mendoza-Hoyos, 1968). According to Mendoza, more than 60% of abortions happened in women with seven or more births, suggesting that abortion was a common practice to limit the number of children. Interestingly, abortion was present mainly in big cities where the induced abortion rate per pregnant woman was around 20%, while only 8% of women living in rural areas practised induced abortion (Requena, 1968).

As shown in Table 2, despite the difference in the practice of contraception and abortion, Simmons and Cardona (1974) show that in 1969 women living both in rural and urban areas had similarly favourable attitudes to family planning. This could indicate that the limited adoption of contraception in rural areas was due to the availability of contraceptive methods rather than a lack of awareness or knowledge. Therefore, once access to contraception was ensured, the use of contraceptive methods should have increased among rural women. However, an increase in the utilisation of modern contraceptive methods after the establishment and promotion of family clinics does not necessarily imply an effect on fertility if couples were already effectively controlling their fertility.

Table 2: Favourability to family planning, 1969

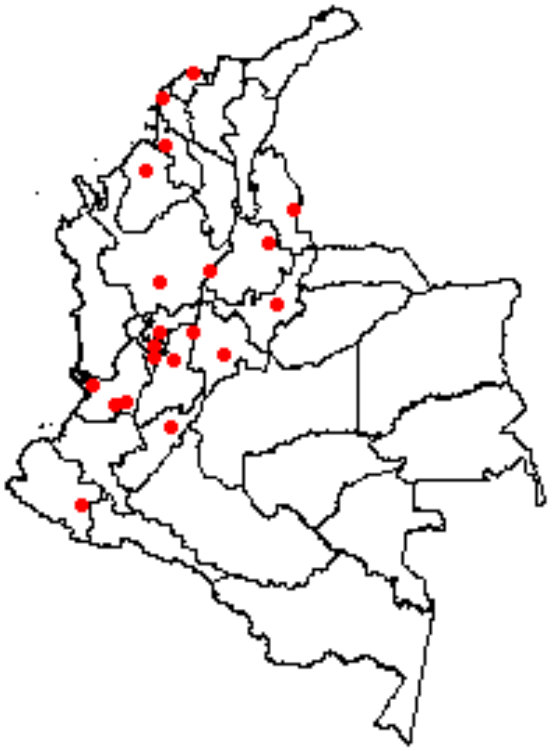
| | Rural | Cartagena | Medellin | Bogota |
|---|---|---|---|---|
| Favourable to family planning | 62 | 69 | 58 | 76 |
| Have ever used a contraceptive method | 19 | 48 | 52 | 63 |

Notes: Percent of respondents by place of residence in 1969. The table shows the difference in favourability and use between regions in Colombia and small rural areas. Source: Simmons and Cardona (1974).

By 1969 Profamilia had already established 17 clinics in urban centres covering most regions of the country, except for the Amazon and the Orinoquia regions (Fig. 1). In the same year, the organisation launched a radio campaign in 13 of the 17 cities in which they had a clinic. The main objective of the radio campaign was to spread the idea of family planning in Colombia and "to change the attitudes of Colombians toward the rational control of the size of their families" (Stycos and Avery, 151:1975). The campaign announced the availability of family planning services and the locations of Profamilia clinics, but it did not describe any contraceptive method. The announcements were broadcast several times a day between 8 am and 6 pm along with other commercial spots and lasting between 15 to 30 seconds

long. Since the start of the campaign, the ads were usually broadcast during the second six months of each year but, due to financing constraints, there were occasional suspensions of broadcasting for weeks. The 1971 campaign was broadcast over 51 radio stations and every station aired one spot each half-hour, which means that about 900 announcements each day were aired (Stycos & Avery, 1975).

Figure 1: Profamilia clinics in 1969



Notes: The map shows the geographical location of Profamilia clinics by 1969. Sources: Based on Miller (2010)

There were different types of announcements, but the following examples from Bailey (1973) show that, the main message of the radio spots, was to make the population aware of the ideas of family planning while giving the exact location of the family planning clinics. These announcements introduced the concept of family planning and fertility control but, did not shape different social norms nor persuade the listeners to visit a clinic or modify their habits.

***Announcer 1**: Every child needs special attention. Therefore have only the number of children you can take care of.*
***Woman 1**: Talk with your husband and go to Profamilia.*
***Woman 2**: [Gives the address of a clinic]*

***Announcer 1**: Do you know what family planning is?*
***A woman**: Family planning means to have the number of children one wants and to have them when they are wanted*
***Announcer 1:** [Gives the address of a clinic]*

The idea behind this campaign was to promote the clinics so that couples who did not want any more children, could have information about where to get access to family planning services. Given that in the 1970s radio was the best method for reaching lower-income and rural populations, the campaign could have been successful in making the population both aware and interested in family planning programs, but as the campaign did little in promoting new social roles, increasing the educational level of women, persuading women or couples of the advantages of smaller families or raising the economic aspirations of the radio listeners, the impact of the campaign in the fertility decline of the country could have been limited. Additionally, it seems plausible that the information about family planning and fertility control was not new to radio listeners. As previously discussed, urban women were already limiting their fertility using other methods such as abortion and rural women were not only aware but also in favour of family planning.

In the eyes of Profamilia, the campaign was successful as the number of users increased soon after the radio campaign started and most importantly, it did not face any opposition from the public or the church, which demonstrated the broad acceptance of family planning in the country. Early evaluations of the radio campaign confirmed that it reached the urban target population and that it accelerated information diffusion about fertility control. Given that broadcasting was not cheap and Profamilia was a private initiative, financed particularly by USAID and Planned Parenthood Federation, most of these evaluations were concerned with the cost-effectiveness of the campaign. The evaluations estimated that the cost per new client was between $8 and $17 US dollars (Bailey, 1973; Stycos & Avery, 1975).[8]

[8]The cost per client of the radio campaign was considerably low in comparison to the estimations of the 1971 campaign in the US by Udry et al. (1972) that estimated an average cost per additional new client between $75 and $5,000 US dollars.

In general, the evaluations find that the radio campaign added a substantial number of visitors to the clinics. Bailey (1973) showed that the number of visitors increased in the urban clinics immediately after the beginning of the campaign and that radio was the second most important source, after friends, neighbours and relatives, of information about the existence of the service. Bailey and Cabrera (1981) calculate that between 1971 and 1972 more than 8,000 new visitors went to a clinic because of the radio campaign, although it is possible that this increase was at the expense of visitors that would have attended the clinics in the future, even in the absence of the initiative. Also, the major impact of the campaign was in two big cities, Bogota and Medellin, which accounted for almost 60% of the campaign's impact on the number of new visitors. Stycos and Avery (1975) argue that although the radio campaigns likely accelerated the process of information diffusion about fertility control, the campaign was less effective in smaller cities, which suggests that informal channels of communication were sufficient to diffuse the information about the location of the clinics.

# 4 Data

To measure the effects of the national radio campaign on fertility, I have assembled a unique data set using several sources. I collected data on the location and dates of the establishment of Profamilia's clinics and radio programmes. I gather data on transmitters' location, frequency, and power for the complete broadcasting network in Colombia and calculate radio signal strength in the country during the 1970s to measure exposure to the radio campaign. Using the full count census of 1973, I calculate a measure of the probability to give birth in a given year for all women in the census.

## 4.1 Exposure to the radio campaign

Using data from Miller (2010), I compile the location and dates of establishment of Profamilia clinics from 1965 to 1970. From Bailey (1973) and Stycos and Avery (1975), I collected the cities where the radio campaign started in 1969.

Although by the 1960s radio was very popular across the country, the information on how many people had a radio at home, listened to the radio or the radio announcements is not available.[9] To overcome this, I exploit continuous variation in signal strength that results

[9]Table 7 presents statistics compile by Stycos and Avery (1975) on exposure of new visitors to radio. The table shows that on average 89% of women who went to a Profamilia clinic during July and August of 1971

from topographic factors and proxy radio exposure in each municipality by a measure of its signal strength. Using the first National Directory of Broadcasting Stations of 1976 published by the National Office of Statistics (DANE, 1978a), I collected information on the radio stations that had transmitters in all cities that broadcast the radio campaigns. Although this information comes from 1976, according to a report from DANE (1978b), by 1957 most of the radio stations had increased their power from 1, 2 or 5 kilowatts to 10 or 20 kilowatts, and bigger radio broadcasters mostly absorbed those local radio stations that were unable to improve their coverage. Therefore, by 1964 the configuration of the broadcasting stations was almost invariant, except for some new independent radio stations that emerged after 1964, but these stations were not included in the data.[10]

Given that I don't have information on the exact radio stations used by Profamilia to broadcast the radio announcements, I collected data by city on transmitters' location, frequency, and power from long-established radio stations in the country (Caracol, RCN and Todelar). It seems reasonable to focus on these stations to measure the effect of the radio announcements on fertility, given that as Stycos and Avery (1975) mention, Profamilia did achieve coverage of the most popular radio stations in the cities.

To estimate the strength of the signal, I use the Irregular Terrain Model (ITM) developed by Hufford (2002).[11] Using professional radio software, the model combines data on the location and characteristics of radio transmitters and the orographic characteristics of the country using a 1 km grid elevation data and information on surface refractivity, radio climate and conductivity of the ground, to predict radio signal strength. For each municipality-radio station pair, the ITM calculates the predicted signal power a receiver would get including the effects of topography and distance to the transmitter.[12] I use the maximum predicted signal strength in each municipality across all transmitters as the predicted signal strength in that municipality.[13] The Fig. 2 shows the maximum predicted signal strength of Profamilia transmitters to all municipalities in the country.

listened to the radio, 40% of these women listened to the radio more than 36 hours per week, and 83% heard one of Porfamilia's spots.

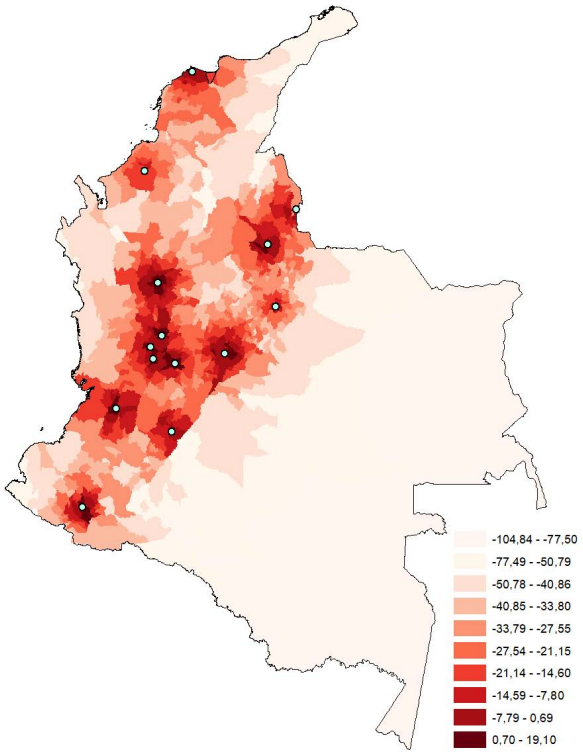
[10]These radio stations are Radio Cadena Independiente, Coral, Super, Cadena Lider de Colombia and Radio Sistema Colibri.

[11]I would like to thank the generosity of Benjamin Olken who kindly shared with me the ITM software.

[12]Following Olken (2009), Wang (2021) and others I use the centroid of each municipality as the receiver location.

[13]Municipalities represent the lowest administrative unit in Colombia.

Figure 2: Location and signal strength of Profamilia transmitters in 1976




Notes: The map shows the maximum predicted signal strength computed using the Irregular Terrain Model (ITM) and measured in decibel-milliwatts (dBm). The grey dots are the transmitter location. Sources: Authors' calculations based on Miller (2010), Bailey (1973), Stycos and Avery (1975) and the National directory of broadcasting (1976).

## 4.2 Fertility measures

I use data from the full count census of 1973 to measure the short-term effects of the radio campaign on fertility.[14] I built a comprehensive women-level panel dataset spanning the years 1966 to 1970 to estimate the likelihood of childbearing in a given year. This dataset incorporates an extensive array of socioeconomic indicators for each woman, including place of birth, education level, marital status, and age.

Fig. 3 show the conditional and unconditional effects of radio on the probability of having a child from 1966 to 1971. Before 1970, women residing in municipalities with stronger signal strength had a 2% higher likelihood of having a child compared to women in municipalities

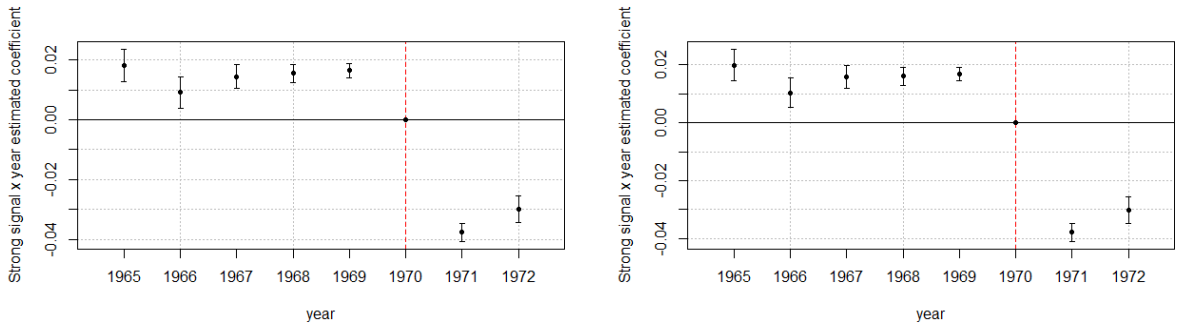
[14] Potter and Ordoñez (1976) in a review of the completeness of enumeration of the census show that the coverage of the enumeration for women was 94.1% and for men 91.8%.

with weaker signal strength. Importantly, this difference remained relatively stable over the pre-treatment period, indicating that the treatment and control groups followed similar trajectories in the absence of the campaign. This stability in pre-treatment differences suggests that any deviation observed post-treatment can be attributed to the campaign rather than pre-existing trends.

Following the implementation of the campaign, we observe a notable shift: one year after the campaign, women in municipalities with signal strength above the median exhibited a 4% reduction in the probability of giving birth compared to their counterparts in lower signal strength areas. This post-treatment divergence suggests a significant impact of the campaign on childbearing behaviour.

Figure 3: Yearly impact of signal strength on the probability of having a child

(a) Unconditional (b) Conditional




Notes: Estimates are based on an OLS model evaluating the expected probability of childbearing for women in Colombian municipalities excluding women living in cities where the transmitters were located. Strong signal$_m$ equals 1 if the signal strength of the municipality is above the median signal strength.

# 5 Empirical strategy

To measure the effects of Profamilia's radio campaign on fertility, it would be ideal to estimate the impact at the individual level, however, I do not have exact data on the number of radio listeners. Using the Irregular Terrain Model (Hufford, 2002), I predict the radio signal strength of the radio stations that were located in the cities where Profamilia launched its radio campaign. With the predicted signal strength as a proxy, I estimate a lower bound of the intention to treat effect.

The main challenge of identification is that the location of the radio stations and the Profamilia clinics may not be randomly distributed in the country and that these locations could be correlated with other characteristics that influence fertility at the municipal level. As for the location of Profamilia clinics, Miller (2010) shows that the process of expansion of Profamilia was mostly arbitrary as it did not follow any clear geographical pattern (See Fig. 1). Furthermore, Miller (2010) demonstrates that programme placement was not correlated with pre-existing trends in the socio-economic conditions of the municipalities.

Regarding the placement of the radio stations, the configuration of the broadcasting stations was completed in 1964, 5 years before the radio campaign started. Therefore it is unlikely that the radio campaign influenced the location of the antennas. However, to minimise further concerns of identification, I employ a Difference-in-Differences design to compare fertility rates before and after the start of the radio campaign. To address potential concerns of endogeneity in the treatment, I exclude cities with transmitters in my analysis. In this model, the effect is identified by comparing changes in fertility rates in municipalities that received a strong radio signal (treated) with the changes in fertility rates of the municipalities that received a weak radio signal. The difference-in-differences (DD) setup is indicated in Eq. (1).

$$Y_{imt} = \alpha_m + \theta_t + \sum_t (\text{strong signal}_m \times post)\lambda_k + \mathbf{X}_i\beta_i + \epsilon_{imt} \tag{1}$$

Where $Y_{imt}$ is a dummy variable that equals 1 if individual $i$ living in municipality $m$ had a child in year $t$. The main coefficient of interest is the interaction term between the post-treatment indicator ($post_t$) and treatment status strong signal$_m$, where treated status means that the signal strength of the municipality $m$ is above the median signal strength in the case of a binary treatment. Although the campaign started in 1969, it is only after around 9 months that we expect to see an effect, given that fertility takes time to respond to this type of policy, therefore the post-treatment indicator will take the value of 1 after 1970. The estimation includes municipality fixed effects to control for both observed and unobserved municipality characteristics with time-invariant effects on fertility and year-fixed effects, which control for time-varying factors affecting fertility rates in the country in the same manner (for example, it accounts for the downward trend of fertility across municipalities). In some specifications, I also include individual fixed effects such as marital status, age, urban location and education, and department-specific time trends allowing for differential

time trends as suggested by Jaeger et al. (2020). Other unobserved factors are captured with the random error term $\epsilon_{i,m,t}$. The standard errors are robust and clustered at the municipality level to account for the possibility of serial correlation in the error term.

A potential concern from the previous specification is the definition of treatment status as using the median of the distribution is a somewhat arbitrary threshold. This is even more crucial when the treatment is not clear on and off treatment, as in the case of the radio. A recent paper by Callaway, Goodman-Bacon, and Sant'Anna (2021) suggests that using a binary treatment when the treatment is continuous can bias the results due to treatment effect heterogeneity and that the bias could be ambiguous. To deal with this issue and following Lindo, Myers, Schlosser, and Cunningham (2020), I allow the treatment to vary in dosages to see if there were nonlinearities in treatment effects. More importantly, this model allows me to compare the effect of radio signal strength on fertility at different points in the radio signal distribution providing a more robust estimation. In this case, the estimation of the effect of signal strength on fertility rate corresponds to the Eq. (2):

$$Y_{i,m,t} = \alpha_m + \theta_t + \beta \text{signal}_m \times post + \mathbf{X}_i\beta_i + \epsilon_{i,m,t} \tag{2}$$

Where $Y_{i,m,t}$ is the probability of childbearing of a woman $i$ living in municipality $m$ in year $t$ and $signal_m$ is a set of signal strength ranges (doses). The estimation includes time and municipality-fixed effects and the standard errors are robust and clustered at the municipality level.

## 5.1 Testing knowledge and access to family planning

It is possible that the radio campaign had an effect only on those municipalities that had a strong radio signal (knowledge) and at the same time had **access** to a Profamilia clinic. To evaluate this, I follow two different strategies. First, I limited the sample of municipalities to those that were not further away than 30 kilometres from the city with a Profamilia clinic.[15] I repeat the estimations of Eq. (1) and Eq. (2) for this sample of municipalities.

Second, I employ a triple difference in differences comparing municipalities that are neighbours to a city with a Profamilia clinic with non-neighbouring municipalities, where neigh-

[15] I considered 30 km because this distance allows people to move from the centre of a municipality to another in approximately 1 hour and a half in public transportation.

bours are those municipalities that share a common edge or a common vertex.[16] The difference-difference-in-differences (DDD) setup is indicated in equation Eq. (3).

$$Y_{m,t} = \alpha_m + \theta_t + \beta \text{strong signal}_m \times post \times \text{Access to clinic}_m + \epsilon_{m,t} \tag{3}$$

Where $Y_{m,t}$ is some measure of fertility in municipality $m$ in year $t$. The main coefficient of interest is the interaction term between the post-treatment indicator ($post_t$), the treatment status strong signal$_m$ and Access to clinic, where treated-status means that the signal strength of the municipality is above the median signal strength and access to a clinic takes the value of 1 if the municipality shares a common edge with a city with a Profamilia clinic by 1969. Although the campaign started in 1969, it is only after around 9 months that we expect to see an effect, given that fertility takes time to respond to this type of policy, therefore the post-treatment indicator will take the value of 1 after 1970. As in the previous estimations, I include municipality and year-fixed effects and the standard errors are robust and clustered at the municipality level to account for the possibility of serial correlation in the error term. I exclude the cities that had the clinic because it is likely that urban centres differ considerably from their rural neighbours.[17]

# 6 Results

In this section, I present and discuss the findings related to the differential exposure to knowledge of family planning, measured by variations in radio signal strength, and the differential access to family planning services, indicated by proximity to a city with a clinic. By examining these two dimensions, we can better understand the distinct channels through which the campaign could have affected fertility.

## 6.1 Knowledge of family planning

Table 3 reports the results of the estimated effects of radio signal strength on the probability of having a birth from Eq. (1). The coefficients are reported as odd ratios to ease interpretation. In line with Fig. 3, all the specifications suggest that the average post-treatment

[16] This is also known as the Queen Matrix.

[17] Table 10 presents the summary statistics for these municipalities and Fig. 5 shows the predicted signal strength for neighbours and non-neighbours.

difference was a significant reduction in the probability of having a child. Column 1 reports the unconditional effect and indicates that getting a strong signal reduced the probability of having a child one year after the campaign by 4%. In Columns 2 and 3, I added different individual, geographical and historical controls, and the coefficients remain the same. As a further check, in Column 4, I removed values that are close to the cutoff (0.5 standard deviations from the mean). In this case, the probability of having a child one year after the campaign is reduced by 9%. In Column 5, I include department-specific time trends. Overall, across all the specifications the results suggest a fall in the probability of childbearing of around 4%.

Table 3: Estimated effects of radio signal strength on the probability of having a birth

| | Having a child | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Strong signalxPost | 0.958*** | 0.957*** | 0.957*** | 0.905*** | 0.958*** |
| | (0.0126) | (0.0129) | (0.0129) | (0.0230) | (0.0130) |
| Avg. childbirth rate 1966 | 0.271 | 0.271 | 0.271 | 0.269 | 0.271 |
| Municipality fe | Y | Y | Y | Y | Y |
| Year fe | Y | Y | Y | Y | Y |
| Individual controls | | Y | Y | Y | Y |
| Geographical and historical controls | | | Y | Y | Y |
| Department-specific time trends | | | | | Y |
| Observations | 10,238,617 | 9,909,853 | 9,896,586 | 5,763,327 | 9,895,834 |
| Squared Correlation | 0.004 | 0.023 | 0.023 | 0.023 | 0.023 |
| N Clusters | 917 | 917 | 917 | 527 | 916 |
| Sample | Complete | Complete | Complete | Trimmed | Complete |

Notes: Estimates are based on a Logit model evaluating the probability of having children for women in Colombian municipalities excluding women living in cities where the transmitters were located. The coefficients are reported as odd ratios to ease interpretation. Strong signal$_m$ equals 1 if the signal strength of the municipality is above the median signal strength. In column 4 I remove values that are close to the cutoff of the median signal strength. Column 5 includes department-specific time trends. Standard errors in parentheses are clustered at the municipality level, and $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$ indicate statistical significance.

However, a potential concern is the definition of the treatment status as a dichotomous variable given that signal strength is a continuous variable. To overcome this, I allow the treatment to vary in dosages grouping the signal strength into 5 groups.[18] In this model, the average post-treatment effect is the differential probability of childbearing after 1970 between the group of municipalities with the weakest signal strength ($-105$ dBm to $-35.8$ dBm) and municipalities with different ranges of signal strength. The results are reported in Table 4.

[18]Table 11 in the appendix presents some statistics of these municipalities in 1973.

Across all specifications, the findings reveal a heterogeneous effect across different dosages. Women living in municipalities with the strongest radio signal ($-10.2$ dBm to 16.3 dBm) had 6% lower chances to give birth one year after the campaign compared to women with virtually no signal strength ($-105$ dBm to $-32.7$ dBm). For the other groups, the effect is non-significant. The effect is robust to the inclusion of several controls.

Taken together, Table 3 and Table 4 show that women who were exposed to the radio campaign had lower chances of bearing a child after the campaign started, and the effects were sizeable, particularly for women exposed to a strong radio signal.

Table 4: Estimated effects of radio signal strength on fertility

| | Having a child | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $[-105, -35.8)dBm$xPost (ref. group) | | | | |
| $[-35.8, -28)dBm$xPost | 1.018 | 1.020 | 1.021 | 1.021 |
| | (0.0157) | (0.0161) | (0.0162) | (0.0157) |
| $[-28, -20.3)dBm$xPost | 1.010 | 1.011 | 1.012 | 1.013 |
| | (0.0151) | (0.0156) | (0.0157) | (0.0160) |
| $[-20.3, -10.2)dBm$xPost | 1.004 | 1.004 | 1.004 | 1.004 |
| | (0.0149) | (0.0153) | (0.0154) | (0.0154) |
| $[-10.2, 16.3)dBm$xPost | 0.944*** | 0.943*** | 0.944*** | 0.944*** |
| | (0.0199) | (0.0204) | (0.0205) | (0.0203) |
| Municipality fe | Y | Y | Y | Y |
| Year fe | Y | Y | Y | Y |
| Individual controls | | Y | Y | Y |
| Geographical and historical controls | | | Y | Y |
| Department-specific time trends | | | | Y |
| Observations | 10,238,617 | 9,909,853 | 9,896,586 | 9,895,834 |
| Squared Correlation | 0.004 | 0.022 | 0.024 | 0.024 |
| N Clusters | 917 | 917 | 917 | 916 |

Notes: Estimates are based on a Logit model evaluating the probability of having a child for women in Colombian municipalities excluding women living in cities where the transmitters were located. Standard errors in parentheses are clustered at the municipality level, and $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$ indicate statistical significance.

## 6.2 Access to family planning

Although the results suggest an effect of the radio campaign on the probability of childbearing, it is possible to explore a potential mechanism through which family planning could have affected fertility: not only through the diffusion of knowledge of availability but also

through access.

Table 5 reports the result for the estimated effects of radio signal strength on fertility for women living in municipalities located less than 30 km away from cities that had a Profamilia clinic by 1970, following Eq. (2). These women lived close to a clinic while experiencing differences in signal strength. The results show that when limiting the sample to women in municipalities near a clinic, there was a reduction in the probability of having a birth after the campaign of 5% for a woman living in a municipality with a radio signal strength between $[3.48, -1.43)dBm$. Women living in a municipality with a radio signal strength between $[16.3, 3.48)dBm$ had a 16% less chance to give birth in the years following the campaign. The size of the effect is consistent across all specifications.

Table 5: Estimated effects of radio signal strength on fertility - continuous treatment

| | Having a child | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $[-26.5, -9.80)dBm$xPost (ref. group) | | | | |
| $[-4.85, -9.80)dBm$xPost | 0.9998 | 0.9943 | 0.9943 | 0.9861 |
| | (0.0077) | (0.0106) | (0.0106) | (0.0246) |
| $[-1.43, -4.85)dBm$xPost | 1.0017 | 0.9935 | 0.9935 | 0.9869 |
| | (0.0100) | (0.0152) | (0.0152) | (0.0284) |
| $[3.48, -1.43)dBm$xPost | 0.9235*** | 0.9187*** | 0.9187*** | 0.9248*** |
| | (0.0065) | (0.0124) | (0.0124) | (0.0255) |
| $[16.3, 3.48)dBm$xPost | 0.8234*** | 0.8163*** | 0.8163*** | 0.8221*** |
| | (0.0097) | (0.0123) | (0.0123) | (0.0382) |
| Municipality fe | Y | Y | Y | Y |
| Year fe | Y | Y | Y | Y |
| Individual controls | | Y | Y | Y |
| Geographical and historical controls | | | Y | Y |
| Department-specific time trends | | | | Y |
| Observations | 1,858,874.5 | 1,783,965.5 | 1,787,134.4 | 1,582,033 |
| Squared Correlation | 0.005 | 0.020 | 0.020 | 0.023 |
| N Clusters | 130 | 130 | 130 | 130 |

Notes: Estimates are based on a Logit model evaluating the probability of having a child for women in Colombian municipalities less than 30 km away from cities that had a Profamilia clinic by 1970 excluding women living in cities where the transmitters were located. The coefficients are reported as odd ratios to ease interpretation. Standard errors in parentheses are clustered at the municipality level, and $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$ indicate statistical significance.

As a different way to measure access that is not based on distance to the clinic, Table 6 reports the results of the triple difference in difference in which I compare women living in

municipalities that are neighbours to a city with a Profamilia clinic with non-neighbouring municipalities. The results confirm once again that both knowledge of and access to Profamilia clinics reduced the likelihood of having a birth by around 6% after the campaign.

Table 6: Triple Difference in Difference (DDD)

| | Having a child | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Strong signalxPostxAccess to clinic | 0.938*** | 0.9375*** | 0.937*** | 0.937*** |
| | (0.0218) | (0.0222) | (0.0222) | (0.0229) |
| Municipality fe | Y | Y | Y | Y |
| Year fe | Y | Y | Y | Y |
| Individual controls | | Y | Y | Y |
| Geographical and historical controls | | | Y | Y |
| department-specific time trends | | | | Y |
| Observations | 10,238,617 | 9,909,853 | 9,896,586 | 9,895,834 |
| Squared Correlation | 0.004 | 0.023 | 0.023 | 0.023 |
| N Clusters | 917 | 917 | 917 | 916 |

Notes: Estimates are based on a Logit model evaluating the probability of having a child for women in Colombian municipalities excluding women living in cities where the transmitters were located. Strong signal equals 1 if the signal strength of the municipality is above the median signal strength.Access equals 1 if the municipality shares a common edge with a city with a Profamilia clinic. The coefficients are reported as odd ratios to ease interpretation. Standard errors in parentheses are clustered at the municipality level, and $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$ indicate statistical significance.

## 6.3 Caveats

All in all the specifications show that women living in places with different signal exposure had a reduction of 4% to 16% on the probability of having a child after the campaign. However, some caveats should be taken into consideration to interpret the magnitude of the results. First, Simmons and Cardona (1974), as shown in Table 2, confirm that by 1969, more than 60% of the women in the country, including women living in rural areas, were favourable to family planning. Furthermore, the positive public reaction to the radio campaign, as indicated by the director of Profamilia, suggests that fertility control was already well-known and accepted in the country even before the start of the radio campaign. As Bailey (1973) suggested, it is then likely that information about family planning came also from other sources such as friends, neighbours and relatives.

Second, the findings are also related to the short-term effects. Because the census was carried

out 4 years after the release of the campaign, we can only observe fertility estimations for the period 1966 to 1972 and post-treatment effects for 1971 and 1972.

Finally, estimating the long-term effects of the initial radio campaign is challenging due to subsequent interventions that could also influence fertility rates. For example, in 1973, Profamilia launched another radio campaign in collaboration with Radio Sutatenza, one of the most influential radio stations in the country. Founded in 1947 in Sutatenza, Boyacá, Radio Sutatenza was the first Catholic radio station in Latin America, initially aimed at combating adult illiteracy. By 1973, it had the most powerful transmitters and national coverage, and it launched the radio campaign "Responsible Procreation". This campaign aired several radio spots lasting between twenty to sixty seconds multiple times a day from 5:00 am to midnight (Roldán, 2014). Like the previous Profamilia campaign, it did not explicitly recommend any specific form of birth control, but emphasised mutual respect and shared decision-making between spouses as core values of Christian marriage. The campaign was further supported by newspapers, 15-minute radio dramas, and theatre scripts. It advocated for having children as a deliberate choice involving equal input from both spouses and extended health education (Roldán, 2014). Additionally, in 1976, Profamilia introduced mobile units to provide sterilisation services in rural areas (Seltzer & Gomez, 1998; T. Williams, Ojeda, & Trias, 1990). Given that the next available census data is from 1985, it is difficult to disentangle the effects of the initial Profamilia campaign from those of these subsequent interventions.

# 7 Conclusions

This paper investigates if a national radio campaign by Profamilia promoting family planning clinics in the late 1960s in Colombia impacted fertility decisions across the country. Some argue that contraception was, without question, the main force underlying the fertility decline of developing economies (Weinberger, 1987). But for Colombia, Miller (2010) shows that, in urban areas, the effects of Profamilia on lifetime fertility were modest. I focus on the effects of the Profamilia radio campaign on fertility, as mass media increases the availability of information, especially in rural areas. Additionally, mass media has the potential to shape new social roles, change social norms and raise the level of education of the population.

To measure the effectiveness of the radio campaign on fertility, this paper exploited variations in radio signal strength. Using professional radio software, I predicted the radio signal

strength of several radio stations that were located in the cities where Profamilia launched its radio campaign. With the predicted signal strength, I estimate a lower bound of the intention to treat. I employed a difference-in-differences strategy to compare childbirth rates before and after the start of the radio campaign. I test two mechanisms through which the campaign could have affected fertility: through knowledge of availability or access to clinics and contraceptive methods. To do so, I restricted the sample of municipalities to those not further away than 30 kilometres from a city with a family clinic or I compared municipalities that neighboured a city with a clinic with municipalities that did not.

The results show that the Profamilia radio campaign reduced the probability of childbearing by 4% to 16%, where access to family planning had the biggest impact. Several evaluations of the period suggested that the announcements were successful in increasing the number of visitors to the clinics and the findings in this paper demonstrate that the overall short-term effect of the campaign translated into a decrease in the probability of childbearing. The test for the mechanisms reveals that places that were close to a Profamilia clinic experienced a stronger decline in childbearing rates, which suggests the importance of access to family planning more than the importance of knowledge.

In comparison to other interventions, the radio campaign did little in disseminating new social roles or raising the economic aspirations of the population. The results suggest that the impact of media on fertility is more about promoting new social norms than spreading information on family planning (Dellavigna & Gentzkow, 2010; La Ferrara et al., 2012).

In line with what cost-efficiency evaluations conducted in the late 1970s, the results suggest that the radio campaign was an effective strategy for disseminating and promoting the adoption of modern contraceptive methods, in particular, given that this campaign was relatively inexpensive compared to other initiatives (Bailey, 1973). Finally, in the long term, the campaign laid the foundation for Profamilia to launch subsequent campaigns with Radio Sutatenza, and potentially, it helped consolidate the partnerships with the Government.

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# 8 Appendices

## 8.A Family planning and radio

This appendix provides additional information regarding exposure to the radio.

By the end of the 1960s radio was very popular across the country with close to 20 million

listeners in urban as well as rural areas. However, the information on how many people had a radio at home or listened to the radio is not available. Table 7 presents statistics compile by Stycos and Avery (1975) for 1971 on the exposure to the radio of new visitors of different Profamilia clinics. The table shows that on average 89% of women that went to a Profamilia clinic during July and August of 1971 listen to the radio, 40% of these women listen to the radio more than 36 hours per week, and 83% heard one of Porfamilia's spots.

Table 7: Exposure of new clients to radio and Profamilia announcements, 1971

| **City** | **Listen to Radio (%)** | **Listen 36 Hrs. + per week (%)** | **Heard Profamilia announcement (%)** |
|---|---|---|---|
| Bogotá | 97 | 30 | 96 |
| Medellín | 97 | 55 | 89 |
| Cali | 64 | 22 | 44 |
| Barranquilla | 87 | 71 | 86 |
| Bucaramanga | 84 | 32 | 74 |
| Manizales | 98 | 44 | 95 |
| Pereira | 90 | 47 | 86 |
| Cúcuta | 79 | 27 | 74 |
| Ibagué | 94 | 78 | 94 |
| Palmira | 94 | 45 | 91 |
| Pasto | 90 | 20 | 82 |
| Armenia | 89 | 26 | 80 |
| Neiva | 90 | 44 | 91 |
| **Total** | **89** | **40** | **83** |

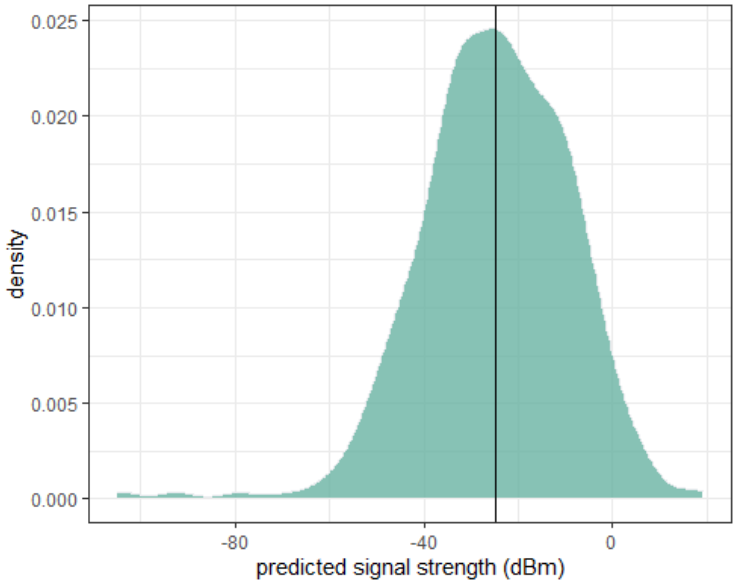
Notes: The data comes from Stycos and Avery (1975) and shows the results of interviews of women who attended the clinics during July and August 1971.

## 8.B Data

This appendix presents additional information on the data collected and estimated. First, it shows the distribution of the predicted signal strength for the whole country. Then I show the predicted signal strength calculated for each neighbouring municipality that is less than 70 km away from the transmitter of the radio stations. I also present the distribution of the Crude Birth Rate for the whole country, and the Total Fertility Rate by quintiles for the whole country and for each neighbouring municipality.

### 8.B.1 Signal strength

Figure 4: Distribution of the predicted signal strength



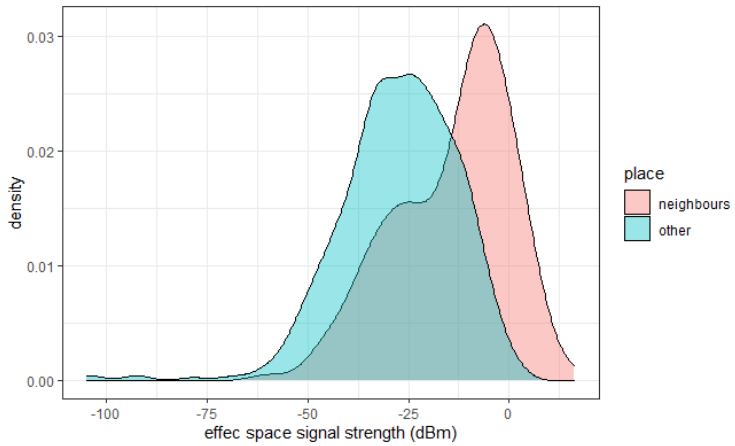

Notes: The graph shows the distribution of the predicted signal strength of the radio stations, computed using the Irregular Terrain Model (ITM) and measured in decibel-milliwatts (dBm). The black line is the median of the distribution. Sources: Authors' calculations based on Miller (2010); Bailey (1973); Stycos and Avery (1975) and the National Directory of Broadcasting (1976).

Table 8: Descriptive statistics predicted radio signal

| | Min | Median | Mean | Max | sd |
|---|---|---|---|---|---|
| Effective signal strength | -104.84 | -24.25 | -24.91 | 19.10 | 15.94 |

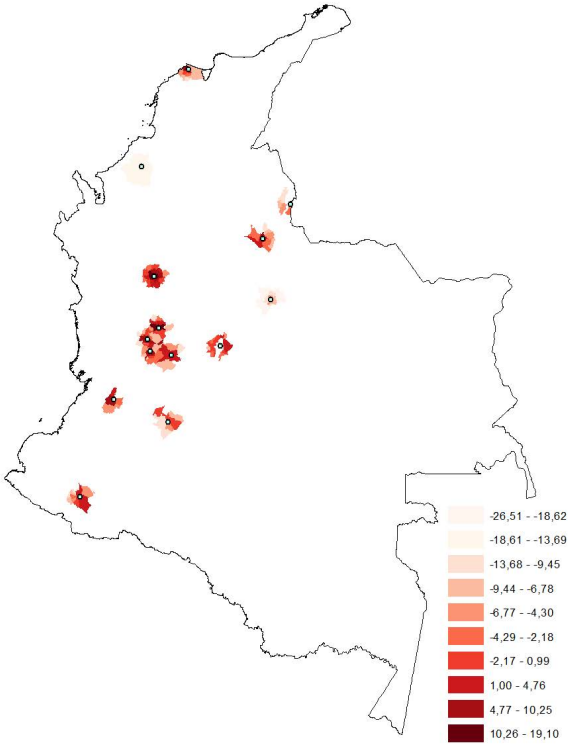
Notes: Descriptive statistics of the predicted signal strength of radio stations, computed using the Irregular Terrain Model (ITM) and measured in decibel-milliwatts (dBm) using the complete sample. Sources: Authors' calculations based on Miller; Bailey; Stycos and Avery and the National directory of broadcasting (1976).

Figure 5: Distribution of the predicted signal strength for neighbours and non-neighbours




Notes: The graph shows the distributions of the predicted signal strength of the radio stations, computed using the Irregular Terrain Model (ITM) and measured in decibel-milliwatts (dBm) for neighbours of cities with a Profamilia clinica and non-neighbours municipalities. Neighbours are defined following a queen matrix where neighbours are spatial units sharing a common edge or a common vertex. Sources: Authors' calculations based on Miller (2010); Bailey (1973); Stycos and Avery (1975) and the National directory of broadcasting (1976).

Figure 6: Location and signal strength of Profamilia transmitters - municipalities close to a Profamilia clinic




Notes: The map shows the maximum predicted signal strength in each neighbouring municipality that is less than 70 km away from the transmitter radio stations and it is computed using the Irregular Terrain Model (ITM) and measured in decibel-milliwatts (dBm). The grey dots are the transmitter location. Sources: Authors' calculations based on Miller; Bailey; Stycos and Avery and the National directory of broadcasting (1976).

Table 9: Summary statistics by signal strength - All country

| | **Strong signal** | **Weak signal** |
|---|---|---|
| Total Fertility Rate in 1968 | 6.80 | 7.50 |
| | (1.20) | (1.46) |
| General Birth Rate in 1970-1973 | 581 | 645 |
| Population in 1973 | 27,890 | 14,285 |
| Urbanization rate | 37% | 31% |
| Distance to Profamilia city (kms.) | 42.17 | 113.70 |
| Sex ratio | 0.89 | 0.97 |
| Number of municipalities | 468 | 470 |

Notes: Summary statistics for municipalities of Colombia. Strong signal strength means that the municipality received a signal strength that is above the median. The Total Fertility Rate is computed using the Own Child Method. The General Birth Rate is the proportion of children age 0 to 3 years old in the census to women ages 15 to 48. Sex ratio is the proportion of men ages 15 to 50 to women ages 15 to 48. Source: Authors' calculations based on 1973 full Census data.

Table 10 presents summary statistics dividing the neighbouring municipalities of cities with a Profamilia clinic by 1970 into those that received signal strength above the median with those that received signal strength below the median. On average municipalities with a strong signal had lower fertility, were more populated and were closer to a Profamilia clinic.

Table 10: Summary statistics by signal strength - municipalities with access to clinic

| | **Strong signal** | **Weak signal** |
|---|---|---|
| Total Fertility Rate in 1968 | 6.72 | 7.11 |
| | (1.14) | (1.20) |
| General Birth Rate in 1970-19 | 572 | 615 |
| Population in 1973 | 14,770 | 12,197 |
| Urbanization rate | 38% | 31% |
| Distance to Profamilia city (kms.) | 31.61 | 54.34 |
| Sex ratio | 0.96 | 0.97 |
| Number of municipalities | 248 | 265 |

Notes: Summary statistics for neighbouring municipalities of cities with a Profamilia clinic by 1970. Strong signal strength means that the municipality received a signal strength that is above the median. The Total Fertility Rate is computed using the Own Child Method. The Crude Birth Rate is the proportion of children age 0 to 3 years old in the census to women ages 15 to 48. Sex ratio is the proportion of men ages 15 to 50 to women ages 15 to 48. Source: Authors' calculations based on 1973 full Census data.

Table 11: Summary statistics by signal strength groups

| | Children born | Urbanization (%) | Distance to clinic (km) | Population in 1973 |
|---|---|---|---|---|
| $[-105, -35.8)dBm$ | 11 | 34 | 145 | 23,988 |
| $[-35.8, -28)dBm$ | 10 | 40 | 90 | 30,147 |
| $[-28, -20.3)dBm$ | 10 | 37 | 68 | 28,477 |
| $[-20.3, -10.2)dBm$ | 9 | 40 | 46 | 25,162 |
| $[-10.2, 16.3)dBm$ | 9 | 52 | 24 | 34,337 |

Notes: Summary statistics for municipalities with different signal strength. Source: Authors' calculations based on 1973 full Census data.