

Toward Better Informed Decision-Making: The Impacts of a Mass Media Campaign on Women's Outcomes in Occupied Japan

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Abstract

Lack of access to information undermines our optimal decision-making. It is, however, an empirical question whether targeted information campaigns toward less-informed populations change their decision-making. This question is particularly salient to gender issues as past research shows that women are often disadvantaged in information acquisition. In this paper, I shed light on women's radio programs that were aired in Japan under the US-led occupation (1945-1952) and brought new information to Japanese women. Exploiting local variation in radio signal driven by soil conditions as an instrumental variable, I identify and estimate the causal impacts of exposure to women's radio programs on female political participation, labor market participation, marriage, and fertility decisions. I find that, in areas where women were more exposed to women's radio programs, women turn out more and a female candidate gains more votes in the first election after World War II. Moreover, information provision through women's radio programs significantly contributes to the fertility decline and therefore has an important implication for the nation's demographic landscape. Female labor force participation and marriage remain the same, suggesting that the declining fertility is neither due to women's greater aspiration for their career nor to decline in marriage. My results are not driven by a pre-existing correlation between radio signal and women's behavior before the US occupation. My findings provide evidence that a targeted information campaign can affect recipients' behavior. They also lend support to the contemporary initiatives by the UN, NGOs, and NPOs to use mass media to reach out to women who have limited access to information.

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1 Introduction

Can a targeted mass media campaign be used to lead women toward better-informed decisions? Evidence suggests that women are often disadvantaged in information acquisition compared to men ¹. Policy makers have been viewing targeted mass media campaigns towards women as a potent policy lever to enable them to make informed decisions and address gender inequality. However, little is known about the causal impacts of targeted mass media intervention on women's outcomes. This is what the present study sheds light on.

In this study, I leverage nationwide women's radio programs aired in Occupied Japan (1945-1952) and examine the causal impacts of these programs on women's decision-making, specifically, on their political participation, labor market participation, and family formation. Occupied Japan, that is, Japan during the US-led occupation, provides a unique context to examine the causal impacts of a mass media campaign targeting women for at least two reasons. First, women's radio programs in Occupied Japan are quasi-experimental in nature; Japanese women were exposed to new information that occupying authorities brought externally. By contrast, women's radio programs in other countries often emerged hand-in-hand with the women's rights movement. Therefore, it would be more challenging to separate the causal impact of the radio campaign from that of the overarching women's rights movement ². Second, I gain access to archival resources on the contents of women's radio programs, the geographical reach of radio, as well as women's outcomes. Such records exist because

¹For example, Beaman and Dillon (2018) conducted an experiment to provide information on a new agricultural technology to a central node of a social network; they showed that women are socially less connected and therefore, receive less information, which results in gender inequality in agricultural outputs.

²We can trace the idea of women's radio programs to the heyday of radio: for example, BBC Radio 4's Woman's Hour in the UK (from October 7, 1946), Radio Donna by Radio Città Futura in Rome (from March 1976 onwards), Womankind by Pacifica Radio in New York (1969), and Hemmafru byter yrke (The Housewife Switches Jobs) by Swedish Radio P1 in Sweden (from October 7, 1965 to December 9, 1965).

women's legal and social status were considered a barometer for the success of the US occupation and therefore, were documented in detail.

From the beginning of the occupation, the authorities aired daily women's radio programs in order to better inform Japanese women. As revealed through my study of the archives and historians' accounts, these women's programs were multifaceted. The programs covered a wide range of topics, including politics, gender equality, marriage, labor law, birth spacing, and health, thereby providing a vast amount of new information to Japanese women. Moreover, a series of Listener Surveys revealed that women's radio programs received high listenership with most female listeners finding them to be informative. Therefore, in this study, I investigate how the differential exposure to women's radio programs affected women's decision-making on electoral turnout, labor market participation, marriage, and fertility.

To carry out the empirical analysis, I digitized various historical records and constructed a unique district-level panel dataset. A primary challenge is to hand-collect data on some women's outcomes, such as electoral turnout, marriage, and birth rate, by going through local newspapers and local governments' yearbooks. Although the resulting sample does not cover the entire nation, the districts in my sample are comparable, in terms of observable characteristics, with districts that were excluded.

My main analysis utilizes district-level variations in the radio listenership to investigate whether differential exposure to women's radio programs causally affects a district's women's turnout and labor market participation as well as marriage and fertility. I use the

radio subscription rate at the district level as a proxy for listenership. The primary challenge for identifying the causal effect is that the radio subscription rate is likely to be endogenous to women's outcomes. To address this endogeneity concern, I exploit quasi-random variations in radio reception quality during the daytime hours, measured by the ground wave field strength. While field strength increases the likelihood of subscribing to radio, it varies based on geographical conditions even after controlling for distance to the nearest transmitter and transmitter fixed effects.

Using the conditional field strength as an instrumental variable, I find that greater exposure to women's programs significantly increases women's political participation, both as voters and representatives, in the first election in which women could vote. Indeed, a standard deviation increase in exposure to women's radio programs increases women's electoral turnout by 2.5 percentage points, closing the gender gap in turnout by 35 percent. The same increase in exposure also raises a female candidate's vote share by 1.3 percentage points, which far exceeds the median win-loss margin of 0.23. Moreover, radio exposure contributes to a decline in the birthrate between 1949 and 1960; a one standard deviation increase in radio exposure contributes to the annual birthrate declining by 1.84 per 1,000 population, compared to the prewar baseline birthrate of 30.8 per 1,000 population. On the other hand, I do not find any significant impacts on either women's labor market participation or marriage. My findings on labor market participation, marriage, and fertility together suggest that the declining fertility is due to neither women's greater career aspirations nor a decline in marriages.

I argue that my findings are not driven by a direct association between the conditional

field strength and outcome variables. In theory, a concern may arise, for example, that the soil type may be correlated with other local factors that influence human fertility. Such a direct association between the field strength and my study outcomes would undermine the exclusivity of the instrumental variable. I argue, however, that such a concern is unfounded because I find no correlation between the instrumental variable and pre-intervention outcomes.

What are the potential mechanisms through which women's radio programs substantially affect women's political participation in 1946 and the fertility rate from 1949 to 1955? I suggest that the impact on political participation arises primarily through an informational channel. Women's radio programs provided women with information on how elections work; they would, otherwise, not have been exposed to such information. Better-informed women lead to a better women's turnout. On the other hand, the multifaceted nature of women's radio programs could have affected fertility through multiple channels. First and foremost, women's radio programs provide information on the health benefit of birth spacing and thus, affected fertility through an informational channel. Second, they provide information on childbearing and therefore, may have influenced women's preferences regarding quality of children. Third, earlier impacts of women's radio programs on women's political participation may have altered the socioeconomic environment, and further affected fertility decisions.

My findings contribute to four strands of literature, namely, on the political impacts of mass media, impacts of commercial entertainment TV content on fertility, various socioeconomic impacts of radio broadcasting, and interventions targeting women other than information campaigns. First, a rich body of literature has examined the causal impact of mass media on electoral turnout and election outcomes. As Della Vigna and Gentzkow (2010)

as well as Strömberg (2015) review, mass media can increase electoral turnout; conversely, it can decrease turnout if it substitutes for other information sources that are more relevant to electoral turnout. My study strengthens their case by showing a substantial positive impact of radio on women's electoral turnout in a setting with few other media outlets (TV or newspapers).

Second, existing literature has shown that entertainment content on TV can decrease fertility in a context in which fertility decline is desired to alleviate poverty and improve children's well-being, such as Jensen and Oster (2009) on cable TV introduced in rural India, La Ferrara, Chong and Duryea (2012) on TV novela in Brazil, and Kearney and Levine (2015) on the MTV show *16 and Pregnant*. My study complements this literature by examining a different type of mass media from commercial entertainment TV content, specifically, public, educational radio programs. Despite differences in media outlet types, I find that women's radio programs also contribute to fertility decline, highlighting the role of information dissemination in fertility change.

Third, my study contributes to a growing body of literature examining the impacts of radio broadcasting on various socioeconomic outcomes, such as political knowledge (Strömberg (2004)), price convergence (Svensson and Yanagizawa (2009)), mass-killing (Yanagizawa-Drott (2014)), emergence of a dictatorial regime (Adena, Enikolopov, Petrova, Santarosa and Zhuravskaya (2015)), registance (Gagliarducci, Onorato, Sobbrío and Tabellini (2017)), and immigrants' assimilation (Russo (2019)). In terms of an identification strategy, my study is closest to that of Strömberg (2004) which also exploits features of AM radio wave propagation.

Fourth, a growing body of economic literature has examined the impacts of public policies targeting women and shown that targeted policies can deliver better outcomes for both women and children, and can even lead to economic growth (for reviews, see Doepke, Tertilt and Voena (2012) and Duflo (2012)). Such policies take various forms, including legal rights such as land ownership (Field (2003)) and voting rights (Lott and Kenny (1999), Miller (2008)); targeted provision of financial means, including conditional cash transfer (Benhas-sine, Devoto, Duflo, Dupas and Pouliquen (2015), Lundberg, Pollak and Wales (1997)), and agricultural investment (Udry (1996)); reserving leadership positions, including gender quota in politics (Beaman, Chattopadhyay, Duflo, Pande and Topalova (2009), Duflo and Chattopadhyay (2004)) and corporate boards (Bertrand, Black, Jensen and Lleras-Muney (2019)); and access to contraception (Ashraf, Field and Lee (2014)). My study is the first to provide causal evidence that targeted mass media intervention toward women can also have substantial effects on women's outcomes.

While the results should be extrapolated with caution, my historical analysis carries important implications for contemporary efforts to provide women with more information. I call for caution in drawing direct policy implications from my findings because Japan under the Allied Occupation was unique in at least two dimensions. First, the Allies started women's radio programs in their broader effort to raise the legal and social status of Japanese women. While other policies, many of which were nationwide legal reforms, do not interfere with the internal validity of my findings, such legal changes need to be considered when generalizing my results outside of Occupied Japan. Second, in the aftermath of World War II, Japanese citizens may have questioned their prewar values and beliefs, and thus may have been more ready to embrace new information. With these caveats in mind, my results provide

evidence that information can change women's behavior and lend support to the contemporary initiatives by the United Nations (UN), non-governmental organizations (NGOs), and non-profit organizations (NPOs) to use mass media to reach out to women who have limited access to information.

The remainder of the paper is organized as follows. Section 2 provides a brief background of women's radio programs in Occupied Japan and highlights key features that are critical for my empirical analysis. Section 3 explains the model, identification, and estimation strategy. Since data collection and digitization are also the key steps of this project, Section 4 discusses them in detail. Section 5 discusses the results and addresses potential threats to the identification strategy. Finally, Section 6 concludes.

2 Contextual background: women's radio program in Occupied Japan

This section provides three pieces of historical background that are essential for my study. Subsection 2.1 highlights the fact that women's radio programs were one of the first efforts of the Allies to raise women's social status. Subsection 2.2 explains the preexisting radio broadcasting infrastructure, which informs my identification strategy. Subsection 2.3 summarizes the content of women's radio program, and presents an examination of women's political participation, labor market participation, and family formation as relevant behavior.

2.1 The Allies' efforts to raise women's status in Occupied Japan

After World War II, Japan was occupied by the Allied Powers from September 2, 1945 to April 28, 1952. Although officially called the "Allied Occupation," it was mostly an undertaking of the United States, with contributions from Australia, India, New Zealand, and the United Kingdom, and therefore it was often called the "American Occupation". General Douglas MacArthur oversaw the occupation as the Supreme Commander for the Allied Powers (SCAP). The acronym SCAP was soon used to refer not only to the commander himself, but also to the offices of occupation set up under him to guide Japan to demilitarize and democratize the nation.

When General MacArthur set up five major reforms on October 11, 1945, later known as the Five Major Reform Directives, one of them turned out to be raising the legal and social status of Japanese women³. The idea behind it was that SCAP arguably attributed the prewar militant political system to the patriarchal Japanese social system (Kobayashi (2004)). The idea of raising women's status was placed at the core of the occupation policies as a major pathway for peacebuilding. In this way, Japanese women gained several legal rights during the Allied Occupation, including rights to vote, run for office, and attend college⁴.

Raising women's status under the Allied Occupation was considered not only radical in relation to the status quo in Japanese society in 1945, but also more liberal than the situation in Western society at the time. This was mainly because the postwar Japanese Con-

³The other four reforms were to abolish the secret police, to encourage the formation of labor unions, liberalize education system, and democratize the economy. Source: Diplomatic Records A' 1.0.0.2-3-4 "Conference Abstracts and Memoranda between the Supreme Commander for the Allied Powers and his Staff and the Prime Minister and other ministers of Japan" <GAI-1, Reel No. A'-0055>

⁴Uemura (2007) provides a detailed historical analysis of raising women's status during the Allied Occupation

stitution, enacted in 1947, guarantees the equal rights of men and women not only in the public domain but also in marriage and family life. In fact, in the new Japanese Constitution, Article 14 reads “All people are equal under the law and there shall be no discrimination in political, economic or social relations because of race, creed, sex, social status or family origin” while Article 24 states that “marriage shall be based on the mutual consent of both sexes and it shall be maintained through mutual co-operation with the equal rights of husband and wife as a basis; With regard to choice of spouse, property rights, inheritance, choice of domicile and other matters pertaining to marriage and the family, laws shall be enacted from the standpoint of individual dignity and the essential equality of the sexes.” As Pharr (1987) argues, there were no other countries except for Communist countries such as the USSR and Poland that guaranteed equal rights between sexes in domestic life. Pharr (1987) calls it “the US experiment with women’s rights in Japan.”

In a significant effort to raise women’s status, one of the first initiatives of the Allied Forces was to start women’s radio programs ⁵. In fact, as early as October 1, 1945, just one month after the Allies started to occupy Japan, the government-sponsored radio station, the Japan Broadcasting Corporation, began to air educational programs targeting women. The women’s programs aimed “to raise political, social, and cultural standards of ordinary women and the breaking away from feudalism,” and “in order to select qualified female leaders, [the women’s radio programs introduced] not only anti-militarists who remained silent during the war but also many unknown progressive, young women.” (Japan Broadcasting Corporation Yearbook (1947); translated by the author).

⁵Table A.1 provides more detailed time line of SCAP’s policy toward emancipation Japanese women.

The important takeaway from this subsection is that women's radio programs started in the unique context of the Allies' broader efforts to raise women's legal and social status. Thus, it is necessary to apply caution in drawing policy implications from my findings that I present in Section 5. As explained in Section 3, however, the analysis relies on cross-sectional variation in exposure to women's radio programs but not the timing. Leveraging cross-sectional variation allows me to ensure the internal validity of the results. Otherwise, different timing may also reflect a different legal environment that women were facing.

2.2 Radio reception and use in Occupied Japan

In this subsection, I explain the preexisting radio broadcasting infrastructure that existed before the Allies' arrival, which allowed the General Headquarters (GHQ)/SCAP to introduce women's radio programs in the very early stage of the occupation period. Not only were the programs on air, but they were also well received by female listeners, as I uncover from listeners' surveys.

At the onset of the Allied occupation, there were 53 radio transmitters and 39 amplifiers across the nation, all of which were connected and operated by a single state-sponsored radio station, the Japan Broadcasting Corporation (JBC). The JBC has a primary channel, channel 1 (*daiichi hoso* in Japanese) which aired various programs throughout the day, and a secondary channel, channel 2 (*daini hoso*) which was utilized for only part of the day. Until 1952, there was no private radio broadcasting. In effect, a radio holder had only two choices: either to listen to the JBC's programs, or not to listen to any programs at all. Such a binary choice set turns out to be critical for my empirical analysis. I do not need to consider the

listener's selection into different radio stations at the same time window.

Importantly for my analysis, the JBC kept records on the number of households subscribing to radio as well as the total number of households in all municipalities. This is because the JBC mandated all radio holders to register and pay subscription fees. The fee was not expensive and thus, I do not worry that it may have excluded low-income families from acquiring radio. In fact, the mandated annual fee in 1950 was 35 yen, which was 2.5 times the price of one serving of Soba noodles, Japanese staples ⁶. I digitize the JBC record to calculate the radio subscription rate, which I later use as an independent variable in my empirical analysis.

During the Allied occupation, the JBC operated under the close supervision of the GHQ/SCAP Civil Information and Education Section Radio Unit (later also called the Radio Branch and hereafter referred to as the Radio Unit). Radio broadcast content was censored in advance by the Radio Unit ⁷. The Radio Unit also conducted modern listener surveys (Mayo (1988), Luther and Boyd (1997), Smulyan (2002)). In effect, the Radio Unit had a large say over what kind of content was on air and therefore played a key role in disseminating information to meet the GHQ's purposes.

The JBC started airing the flagship women's program "Women's Hour (*Fujin no jikan*)" on October 1, 1945, just about a month after the Allies started occupying Japan. The program was designed to draw as many women as possible. A time slot allotted to the

⁶See Table A.3 on annual radio subscription fee from 1925 to 1955. Data are drawn from Okabe (2018).

⁷The head of the production team for women's programs, Fuji Egami recalls "All women's programs, including introductory announcements, were to be submitted to the Civil Information and Education Section 10 days before the broadcast. Translators kept typing all the time. All dramas, stories, lectures, interviews, debates and even round tables were stenographed, rewritten into Japanese, then translated into English. It took more than two weeks to broadcast programs after they were recorded. It was impossible to deliver timely information" (Egami (1955), translated in English by the author.)

women's program was the lunch break when women used to listen to a war-time women's program during World War II; women were appointed as the director of the production team, as well as moderators, in order to be friendly to female listeners; music was played occasionally for a pause so that listeners could maintain concentration (Japan Broadcasting Corporation (NHK), 1947, 1950)

As the JBC's Listener survey reveals, women's programs were indeed well received. In 1947 survey, more than 70 percent of women with a radio subscription said that they currently listened to or used to listen to the women's program. Not only did they listen to the women's program, but more than 60 percent of them answered that they had gained new knowledge through the program. This survey reassures me that women's programs conveyed new information to women as GHQ/SCAP intended.

As time went by and the JBC's production capacity increased, the JBC added more time slots for women's programs. By the end of 1950, the weekly airtime that the JBC allocated to women's programs had quadrupled from its onset in October 1945⁸. This underscores the fact that GHQ/SCAP maintained and strengthened efforts to raise women's status throughout the occupation. As the airtime expanded, the content covered by the women's programs grew too, as I show in detail in the next subsection.

Before diving into the radio content analysis, I note that the analysis primarily focuses on the occupation period (1945-1952) although the JBC continued to air women's programs until 1963. I restrict my attention mainly to the occupation period because, at the end

⁸See Figure A.1. NHK Yearbook (Japan Broadcasting Corporation (NHK) 1947, 1949) and GHQ/SCAP CIE Weekly Report (Radio Education Branch, 1946 - 1950).

of the occupation period, private radio broadcasting as well as TV broadcasting started, giving more choices to potential listeners. Competition among different mass media outlets may have fundamentally changed the nature of media content as well as complicated the listeners' decision process about which information they acquire and why. Although this transition in the broadcasting market opens up a new avenue of research, it is beyond the scope of my current analysis.

2.3 Contents of women's programs

What kind of information did the women's programs try to disseminate? Answering this question is key to determine which women's outcome this study should consider. Therefore I turn to the Weekly Radio Reports (from January 1946 to December 1950), which document daily radio content. I classify them into several topics, and see how the composition of topics changed over the course of the Allied occupation.

The Weekly Radio Report was reported every week, with one section dedicated to the featured programs of the week. The following are examples of content descriptions.

Women's Hour (July 26, 1947, from 13:00 to 14:00)

“ Marriage and Pregnancy, a straightforward talk on the importance of honest information on sex for adolescent boys and girls and young married people, was presented with simple good taste by Dr. Fusao Hori.”

Women's Hour (November 11, 1948, from 13:00 to 14:00)

“Mrs. Ohara, interviewer for the Tokyo Domestic Court, Prof. Kawashima of Tokyo University, and Mrs. Fujioka, editor of Consumer's Co-Op Magazine, discussed the problem of inheritance of all property by the eldest son as it was formerly observed before the Civil Code was revised. Even though the law now provides that the wife and younger children will share an inheritance equally with the first son, many people cling to the old way of doing things.”

Two points should be noted from these examples. First, academics, policymakers, and corporate leaders spoke on the show to provide specialized knowledge. Second, as we notice from the honorifics, both men and women were invited as speakers. In fact, by counting the number of honorifics *Mrs*, *Miss*, and *Mr* that appeared in the Weekly Report from January 1946 to December 1950, I find that the share of female speakers was 49.9 percent: women's radio programs provided an equal playing field for men and women on air.

To understand the topic composition of the women's radio programs in a more systematic manner, I classify the daily contents of women's programs using Latent Dirichlet allocation, and show the year-by-year topic composition (Figure 1)⁹. I find that, women's programs were primarily about politics and elections in 1946, which is consistent with what Okahara (2007) uncovers in her case study. Interestingly, the content covered by the women's programs became more diverse over the years to cover women's organizations, the interests of young women and girls' interests, child development, new labor and welfare laws, and information on food and health.

⁹For a detailed explanation, see Appendix B.

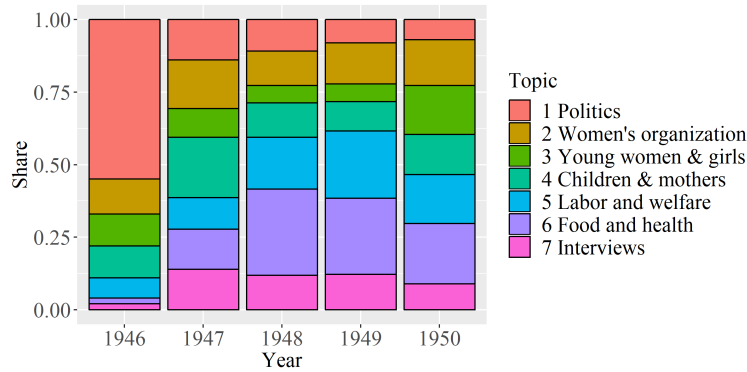


Figure 1: Topic compositions of women's radio over the course of the Allied Occupation. Contents descriptions are drawn from GHQ/SCAP CIE Weekly Report (Radio Education Branch, 1946 - 1950) and classified using Latent Dirichlet allocation.

The fact that program content became diverse over time motivates me to explore whether exposure to women's radio programs can affect not only political behavior but also other women's outcomes, particularly labor market participation, marriage rate, and fertility rate. Based on the words and phrases that appear in the radio content, I hypothesize the following¹⁰. First, women's electoral turnout increases in response to larger exposure to women's radio programs, which "urged" women to vote in the 1946 general election. Second, women's labor market participation increases in response to greater exposure to women's radio, whose content included women's careers and to labor laws that protect women's rights in the workplace. Third, the annual marriage rate decreases, at least in the short run, in response to larger exposure to the women's radio programs, which emphasized women's freedom to choose their own marriage partners. Fourth, the annual birth rate decreases in response to greater exposure to women's radio programs, which discussed the benefit of birth spacing for women's health. Table A.4 summarizes the association between topics within the women's radio programs and the women's outcomes that I examine in this study.

¹⁰Table A.4 summarizes the association between topics within the women's radio programs and women's outcomes that I examine in this paper.

3 Model, identification, and estimation

Based on the content analysis, I hypothesize and test that exposure to women’s radio programs can affect women’s decision-making on political participation, labor market participation, marriage, and fertility. To identify the causal effects of radio exposure, I instrument for the exposure to the radio using quasi-random variation in AM radio reception induced by geographical conditions and perform an instrumental variable (IV) analysis.

3.1 Model

I assume a linear causal model between exposure to women’s radio programs and the outcomes of interests. Here I aim to identify a causal parameter β_1 below, which captures the impact of the exposure on each outcome.

$$\text{Outcome}_{j,t} = \beta_0 + \beta_1 \text{radio exposure}_{j,1946} + \gamma x'_{j,t} + u_{j,t} \quad (1)$$

where j indicates a district. $x_{j,t}$ is a vector of district characteristics, explained in detail in the next subsection.

I describe in detail in Section 4 how each variable is measured, but note here that radio exposure is proxied by the district-level radio subscription rate, defined as the share of households subscribing to radio; this proxy has both advantages and shortcomings. On the one hand, the subscription rate captures the actual listener rate better than signal strength or cable introduction, which potentially overstate the radio listenership but are nonetheless used

as a main explanatory variable by most of existing studies on mass media. To this end, I take advantage of the radio receiver license system in Japan, which provides data on district-level radio subscription rates. Having the actual radio subscription turns out to be especially critical for scaling in this study, because the average radio subscription rate is only 36.7 percent, while the radio signal covers almost the entire nation, however weak it is. Meanwhile, one may worry that the radio subscription captures the impact of radio listenership in general but not necessarily the exposure to women's programs. To address this concern, I draw on evidence that men's and women's ratings were statistically indistinguishable for all programs except women's programs (Figure A.2). Moreover whenever possible, I perform regressions for both men and women separately and compare their impacts. Under the assumptions that (i) there is no gender difference in the impact of radio exposure and (ii) men's and women's ratings are the same across districts, the gender-differential impact of the radio subscription rate captures the impact of women's radio programs on women's outcomes. However, we could instead assume that women react more to new information than men do, owing preexisting gender informational inequality. Under this alternative assumption, the impact of the radio subscription rate can indeed confound women's radio programs and other radio programs. I still argue that the primary impact most likely comes from the women's radio programs, because women's programs but not other programs provide relevant information on female election candidates, labor laws relevant to women, freedom of choosing marriage partner, the health benefit of birth spacing, and so forth. It is beyond the scope of my research to ask how impacts would change if such information were conveyed within general programs that do not specifically target women. An interesting open question remains about how the effects of information vary when conveyed in and out of gendered spaces.

3.2 Identification strategy

The key empirical challenge to identify the causal effect β_1 is that radio exposure, proxied by the radio subscription rate, may be endogenous to women's outcomes through women's unobserved characteristics. Such a concern arises when radio subscriptions are correlated with subscribers' unobserved characteristics, such as attitude toward the American occupation, openness to new ideas, willingness to acquire new information, potential for local economic growth, local culture, or religion. For example, women with greater interest in politics may subscribe to radio to obtain information on politics. Such a positive correlation between the subscription and unobserved characteristics overstates the causal effect β_1 .

To address the endogeneity issue, I leverage quasi-random variation in radio reception quality during daytime hours, which is as good as random to potential subscribers but increases their likelihood of radio subscription. The metric of the radio reception I use is the ground wave field strength (hereafter, field strength), which depends on the horizontal distance from a nearby transmitter, output power of the transmitter, wavelength, and ground conductivity between the transmitter and receiver. The ground conductivity measures how fast the AM radio wave can propagate through a given soil type and depends on the moisture and salt contents of the soil. The key idea is as follows. On the one hand, the distance to nearby transmitter, output power, or wavelength may be based on strategic considerations¹¹, and the ground conductivity is as good as random to potential subscribers. Therefore, after controlling for distance and transmitter fixed effects, the local variation in the field strength

¹¹For example, radio transmitters may have been strategically placed in the area with higher political aspirations, higher aspiration for freedom of marriage, higher demand for birth control, higher potential supply of female labor force, and so forth. Although such a concern may be unwarranted given the historical background of radio, as described in Section 2, these unobserved characteristics of women may indirectly relate to transmitter locations through urbanness, and therefore it is still important to control for the distance.

can serve as an instrumental variable for the radio subscription rate¹².

Furthermore, I control for other district characteristics: industry composition, measured by the labor share in 10 industries (agriculture, forestry, fishery, mining, construction, manufacturing, wholesale and retail, finance and real estate, information and transportation, and services; an omitted category is public service). Doing so addresses the concern that the soil may reflect how fertile the land is and correlate with the economic potentials of a given area. I also include the number of households, number of households per square km, and a city indicator to control for urbanness. Moreover, I control for the fact that a district was subject to bombing during World War II to take into account that bombings might have affected citizens' attitudes toward the American Occupation and their radio programs. Finally, prefecture fixed effects control for any inter-prefectural public policy differences¹³. Figure 2 shows the residualized field strength after controlling for the distance, transmitter fixed effects, and all the other control variables. Notice that areas with high residualized field strength, in dark blue, and areas with low residualized field strength, in dark red, are adjacent to each other. It is reassuring that there is no systematic pattern.

With the instrumental variable in hand, I estimate the causal impact of radio exposure on each outcome of interest via two-stage least squares (TSLS) and compute robust standard errors¹⁴.

¹²Formally, our conditional exogeneity condition and the relevance conditions take the form

$$E[\text{Field strength} \times u | \text{transmitter fe, distance, } \mathbf{x}] = 0$$

$$E[\text{Field strength} \times \text{Radio exposure} | \text{transmitter fe, distance, } \mathbf{x}] \neq 0$$

¹³A prefecture is the first level of jurisdiction and administrative division in Japan and is overseen by an elected governor, legislature and administrative bureaucracy.

¹⁴In Appendix D, I also discuss another specification where instrumental variables are discretized into decile bins to address a potentially non-linear relationship between field strength and radio subscription. The main results are robust.

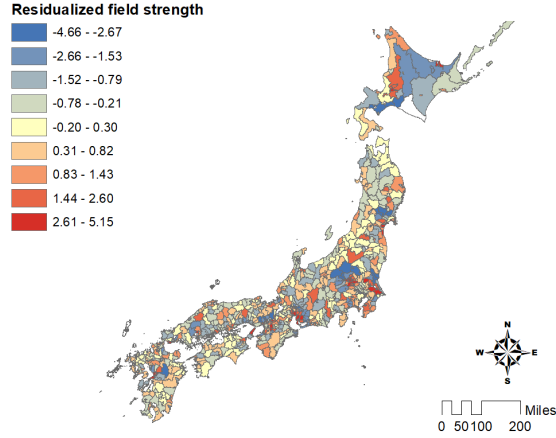


Figure 2: Residualized field strength

4 Data

I hand-collect data on election turnout, labor market participation, marriage, and fertility, as well as the geographical reach of the radio from various historical resources. All variables are observed at the district (*shi* and *gun*) level¹⁵ unless stated otherwise. Using these variables, I construct a unique, district-level panel dataset. Table A.2 summarizes all the data sources.

4.1 Radio exposure, field strength, and distance to a nearby transmitter

As mentioned in Subsection 3.1, the degree of exposure to women's radio programs is proxied by the radio subscription rate, which is defined as the share of households subscribing to radio in 1946. I draw the radio subscription rate from the 1946 yearbook published

¹⁵There are around 700 districts in the late 1940's. The average population size is 54,000 in 1950.

by the JBC, which recorded the number of households subscribing to radio as well as the total number of households at the village level. In 1946, the village level subscription rate ranges from less than 10 percent to over 80 percent, with an average of 37.7 percent. Figure 3a shows how radio subscription varies across Japan. The map is colored based on the decile bins: from areas with low subscription rate in yellow to areas with high subscription rate in dark blue.

I draw data on the AM wave field strength, which serves as the instrumental variable for radio exposure, from the map that the JBC published in 1949. To the best of my knowledge, this is the first map of the field strength published after World War II. I digitize the map (Figure 3b) and compute the district level average field strength to construct the instrumental variable.

Finally, I compute the distance from each district to the nearest radio transmitter by utilizing the information on latitude and longitude of radio transmitters taken from the Japan Broadcasting Service 1947 yearbook as well as data on administrative boundaries¹⁶.

4.2 Election turnout

I draw data on electoral turnout by sex in the 22nd House of Representative Election held on April 10, 1946, the first election after women's suffrage. The data are from local editions of three national newspapers as well as prefectural newspapers, which reported district level turnout by sex between April 12 and April 14, 1945¹⁷. My final dataset contains 26

¹⁶I use shape files on administrative boundaries provided by Maruyama Lab, Tsukuba University, Japan.

¹⁷The three national news papers are Yomiuri, Asahi, and Mainichi.

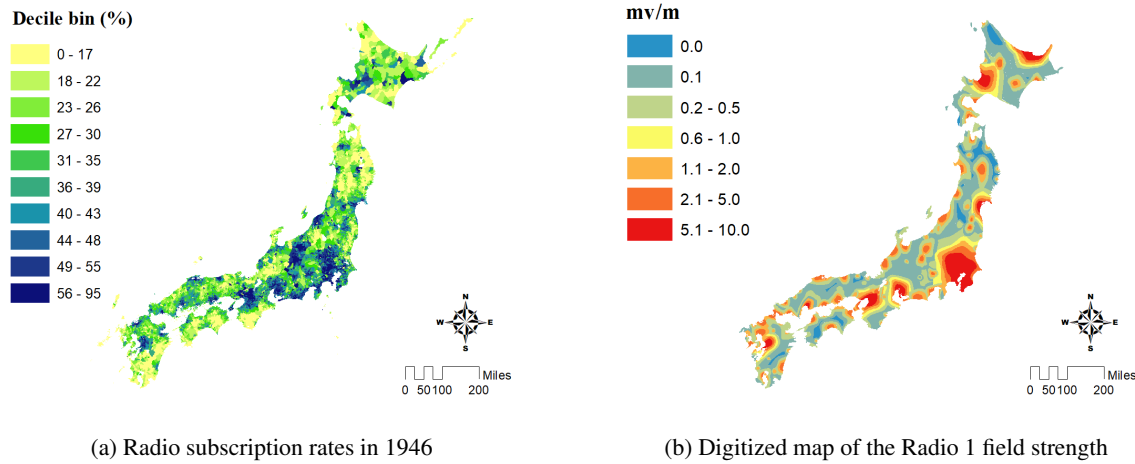


Figure 3

prefectures, covering 56.7 percent of eligible voters in Japan in the 1946 election.

Although turnout is available for only a subset of the nation, the average turnout in my sample is statistically indistinguishable from the nationally aggregated turnout by sex¹⁸: In my sample, women's average turnout rate is 0.64 with a standard deviation of 0.08 while the national average is 0.67. Meanwhile, men's average turnout rate is 0.76 with a standard deviation of 0.09 in my sample, while the national average is 0.78. The gender difference of 0.13 is statistically significant. Moreover, Table A.5 shows that districts in my sample and out of my sample are observably similar.

In addition, I digitize votes that a female candidate obtained by district as well as total votes cast in each district to compute the vote share of a female candidate. In the 1946 general election, 79 females ran for office, accounting for 3 percent of all candidates. The average vote share is 0.08 with a minimum of 0 and a maximum of 0.58.

¹⁸Tabulated statistics on electoral turnouts by sex are drawn from Japan Ministry of Internal Affairs and Communications and compiled by the National Women's Education Center

4.3 Labor market participation

I compute women's labor force participation at the district level by using the 1950 Population Census: I divide the number of women aged 14 years or above who participate in the labor force by the total number of women who are in the respective age group¹⁹. Using the same data source, I compute women's labor force participation at district level by excluding women in family business, most of whom were farmers' wives at the time. Moreover, the 1950 Population Census also provides the labor share of industries, which I use as a control variable.

For sensitivity tests, I compute women's labor force participation at the district level by using the 1940 Population Census: because the age breakdown of the population is not available at the district level, I cannot use the number of women in the age most relevant to the labor force, and therefore, I divide the number of women in the labor force by the total number of women ²⁰.

4.4 Annual marriage rate and birth rate

I draw the annual marriage rate, defined as the number of marriages per 1,000 population, and the annual birth rate, defined similarly as the number of births per 1,000 population, from prefecture yearbooks between 1949 and 1960 in five prefectures (Iwate, Chiba, Mie,

¹⁹The total number of women in the work force is drawn from Table 8 and the total number of women is drawn from Table 4 of the 1950 Japan Population Census digitized by Kishimoto Lab (Takita, Ogasawara and Kishimoto (2012))

²⁰The total number of women in the work force is drawn from Table 2-1 and the total number of women is drawn from Table 1-1 of the 1930 Japan Population Census digitized by Kishimoto Lab, Tsukuba University, Japan.

Nara, and Tokushima). These are the only five prefectures that provide the necessary information to the best of my knowledge. I digitize these prefecture yearbooks and spatially merge them across years using municipality boundaries ²¹. I also digitize the 1935 vital statistics to obtain prewar annual marriage and birth rates. As Figure A.5 in shows, the average annual marriage and birth rates in my sample resemble the national averages. Moreover, Table A.6 shows that districts in my sample are similar in terms of prewar birth and marriage rates, as well as residualized field strength and share of agricultural labor. Districts in the sample are less densely populated and have a slightly different industrial composition than those out of the sample. Therefore, caution is required in extrapolating these findings to the entire nation.

4.5 World War II damage

To proxy the degree of war damage, I draw data on district-level total casualties during World War II from the *Overall Report of Damage Sustained by the Nation During the Pacific War* published by the Economic Stabilization Agency, Planning Department, Office of the Secretary General (1949) and digitized by Japan Air Raid Org. The casualties, estimated in May 1948, include those due to air raid bombings (in many places, e.g., Tokyo and Yokohama), atomic bombings (in Hiroshima and Nagasaki) and naval artillery (in some coastal cities, e.g., Kamaishi, Muroran and Hamamatsu). Since the report presents district-level casualties only for cities with a significant number of casualties, I further create a dummy variable

²¹When analyzing marriage and birth rates, I use a municipality as a unit of observation instead of using a district, which is a collection of municipalities. I do so to deal with major municipality mergers and consolidations, which make it difficult to maintain the same district boundaries over the period of my study. In fact, the number of municipality significantly declined from 9,868 (in October 1953) to 3,975 (in September 1956) due to municipality mergers and consolidations (<http://www.soumu.go.jp/gapei/gapei2.html>). Therefore, I apply municipality boundaries in 1960 to data in 1935 as well as in years between 1949 and 1960, and merge all of them to create a municipality-level panel dataset. This procedure requires me excluding municipalities that were split although such cases are very rare.

that takes one if the war casualties are above median.

5 Findings

This section presents the main results concerning the effects of exposure to women’s radio programs on political participation (Subsection 5.1), labor market participation (Subsection 5.2), and family formation (Subsection 5.3).

5.1 Political participation

First, I find that exposure to women’s radio programs yields positive impacts on women’s political participation. Table 1 shows results from the regressions of equation 1 with three different outcomes: women’s turnout (Columns 1, 2, and 3), men’s turnout (Columns 4 and 5), and women’s share of those who cast ballots (Column 6). For each outcome, I present ordinary least squares (OLS) and TSLS estimates. The key independent variable (radio subscription rate at district level) is in standard deviation units. Analyzing the OLS estimates first, radio subscription has a strong positive association with women’s turnout (Column 1) but not men’s turnout (Column 4). These associations turn out to be causal: Column 2 demonstrates that a one standard deviation increase in radio subscriptions increases women’s electoral turnout by 2.45 percentage points. The magnitude of the TSLS estimate is slightly smaller than the OLS estimate (Column 1), suggesting a small positive bias in the OLS estimate. In other words, there may be a positive association between women’s unobserved characteristics and their radio subscription. Compared to Column 2, Column

3 includes additional control variables: city indicator and industrial compositions in 1950. Notice that these control variables do not affect the estimate of the causal effect of women's radio programs. Since these variables are measured in 1950 which is later than the electoral turnouts were observed and moreover including these variable does not change the coefficient on the radio subscription rate, I prefer the specification in Column 2 than that in Column 3. Column 5 presents the TSLS estimate regressing men's turnout on the radio subscription. Similar to the OLS estimate, the TSLS estimate is not statistically distinguishable from zero. The difference between women's turnout (Column 2) and men's turnout (Column 5) suggests that the radio subscription has impacts only on women through the provision of women's radio programs. In addition, Column 6 shows the impact on the women's share among voters, defined by the share of women out of men and women who cast ballots, and confirms that the radio exposure increases the women's share by 1.6 percentage points. Later in this section, I further ask if the increase in the women's share among voters induced by radio increases a female candidate's vote share.

The magnitude of 0.245 in Column 2 is not only statistically significant but also politically significant: it accounts for 30 percent of the standard deviation of women's turnout. A back-of-the-envelope calculation, assuming that the impact is homogenous at any level of radio subscription rate, suggests that the radio exposure overall reduced the gender disparity in turnouts by 4.8 percentage point²². This accounts for almost one-third of the gender gap. Moreover, the persuasion rate based on Della Vigna and Gentzkow (2010) is 46.4 percent, larger than other papers on voter persuasions²³.

²²To calculate the overall impact, I assume that the impact of radio subscription is homogenous at any level of radio subscription rate. By setting the radio subscription to be zero, I compute the level of women's turnout that would have occurred in the absence of radio in each district and then aggregate them to the national level. I compare such counter-factual turnout with the observed turnout of 0.64 to get at the overall impact.

²³There are at least two possible reasons for the persuasion rate being larger than that shown in the past literature. First, recall that

Table 1: Ordinary least squares and two-stage least squares results
The impact of the radio subscription in 1946 on turnout in the first postwar election

	Women's turnout Mean 0.66 Std.dev. 0.08			Men's turnout Mean 0.79 Std.dev. 0.06		Turnout female share Mean 0.37 Std.dev. 0.06
	(1) OLS	(2) TSLS	(3) TSLS	(4) OLS	(5) TSLS	(6) TSLS
Radio subscription in std.dev. unit	0.0289*** (0.00519)	0.0245** (0.00999)	0.0248* (0.0142)	0.00231 (0.00482)	0.0106 (0.00769)	0.0157** (0.00612)
R^2	0.707	0.707	0.740	0.620	0.615	0.726
Distance control	decile bins	decile bins	decile bins	decile bins	decile bins	decile bins
N.of HH, HH density	✓	✓	✓	✓	✓	✓
Transmitter FE	✓	✓	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓	✓	✓
City indicator			✓			
Industrial composition			✓			
Male to female ratio						✓
Observations	346	346	346	336	336	288

¹ Standard errors are in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

² In Columns (4) and (5), the sample size is reduced in men's regression because only women's (but not men's) turnout was reported in one prefecture (Miyazaki prefecture).

³ In Column (6), the sample size further decreases because data on the number of qualified eligible voters are available for districts with at least one female candidate. Saitama, Aichi 2nd, and Yamaguchi prefectures did not have any female candidates. The male-to-female ratio is defined as the number of eligible male voters per female voters.

A question that follows is whether women's greater turnout in the election translates into greater women's representation at the Diet ²⁴. To observe this, Table 2 presents the impacts of radio exposure (Column 2) as well as women's turnout share (Column 4) on a female candidate's vote share, each of which is instrumented by field strength. Column 2 shows that greater radio exposure increases a female candidate's vote share by 1.3 percentage points. The direct impact of female turnout is also positive although the estimate is noisier

the 1946 general election was the first election after women gained their right to vote. They had never voted before. Thus the estimated effect may capture both the persuasion effect and an educational effect. Radio would have been primary mean to inform women about voting. Second, to compute the persuasion rate, we need to assume homogeneous impacts of radio. But the impact of radio exposure may be heterogeneous and it may be larger for marginal voters. If this is the case, the persuasion rate that I compute may overstate the true persuasive effect.

²⁴In the 1946 general election, 2770 candidates run for office and 79 (2.8 %) were women. Of 46 prefectures, 40 prefectures had at least one female candidate and the share of female candidates ranged from 0.01 to 0.09 with the median of 0.03. As Figure A.4 shows, there is no systematic relationship between the radio subscription rate and the female candidacy.

(Column 4): a one percentage point increase in women's turnout share increases a female candidate's vote share by 1.29 percentage points.

Was the impact large enough to push a female candidate to win? To put the 1.29 % figure into perspective, I calculate a win-loss margin, defined as the difference in vote shares of the lowest-ranked winner and the runner up in each electoral district. It turns out that the 1946 election was quite competitive: the minimum win-loss margin was 0.005 percentage point, the median win-loss margin was 0.23 percentage points, and the maximum win-loss margin was 2.19 percentage points ²⁵. Therefore, I conclude that the impact of a one standard deviation increase in radio exposure on the female vote share, 1.3 percentage point, is above the median win-loss margin and thus sizable.

Overall, the women's radio programs successfully amplified women's voices in the political sphere in Japan: the women's programs effectively induced more women to vote, which in turn resulted in a greater vote share for a female candidate. The findings echo what the GHQ/SCAP Radio Unit wrote in a weekly radio report: the women's programs "undoubtedly contributed in a large measure to the fact that 65 percent of the eligible women voters went to the polls" ²⁶.

²⁵In order to calculate the win-loss margin, I draw the total number of men and women who cast ballots from the government's official report. Moreover, I draw data on vote counts of winners and runner-ups from *the Mainichi*, one of the major newspapers, published on April 13, 1946. Because the vote counts were not finalized in five electoral districts (Hokkaido 2nd district, Tokyo 2nd district, Chiba, Nagasaki, and Kagoshima), I calculated win-loss margins with and without these five districts. The distribution of win-loss margin is robust.

²⁶Weekly radio report, SCAP Civil Information and Education Section

Table 2: Ordinary least squares and two-stage least squares results
The impact of greater exposure to women's radio on the vote share of a female candidate

	Vote share of female candidate Mean 0.08 Std.dev. 0.08			
	(1) OLS	(2) TSLS	(3) OLS	(4) TSLS
Radio subscription (std.dev)	0.00308 (0.00193)	0.0133** (0.00655)		
Female share turnout (p.p.)			0.00143** (0.000670)	0.0129 (0.00887)
R^2	0.538	0.531	0.622	0.415
Control variables	✓	✓	✓	✓
Observations	958	958	465	465

¹ * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are clustered at the level of electoral districts and shown in parentheses. In the 1946 general election, there were 52 multi-member districts, whose boundaries align with prefecture boundaries except for Hokkaido, Tokyo, Niigata, Aichi, Osaka, Hyogo, and Fukuoka prefectures, each of which was split into two. Appendix C explains in detail how the electoral system worked in the 1946 election.

² The sample size is larger than the dataset on women's turnout analysis because (i) I have data on all female candidates (whereas the data on turnout has missing values) and (ii) some electoral districts had multiple female candidates.

³ I compute the dependent variable, the vote share of a female candidate, by dividing the number of votes a female candidate received by the number of voters who cast votes in the district.

⁴ All columns include dummies for the deciles of the distance to the nearest transmitter, transmitter fixed effects, number of households, number of households per square km, an indicator for whether a district was bombed during World War II, and the male to female ratio defined as the number of eligible male voters per one eligible female voter. In all columns, I also control for the candidate's characteristics (party dummies, the age of a candidate, an indicator for whether a candidate was a women's suffrage activist, and an indicator for whether a candidate worked before running for office) and electoral district characteristics (total number of candidates, dummies for the number of female candidates, number of seats, and number of votes per voter).

5.2 Labor market participation

If radio exposure effectively encourages women to participate in politics, what about labor market participation? I examine the causal impact of radio subscription on women's labor force participation, by adding two control variables to the main equation (1);

$$\begin{aligned}
\text{Women's LFP}_{j,1950} = & \beta_0 + \beta_1 \text{radio exposure}_{j,1946} + \iota_t \\
& + \gamma_1 \text{Women's LFP}_{j,1930} + \gamma_2 \text{Male-to-female ratio}_{j,1950} \\
& + f(\text{distance to a nearby transmitter}_{j,1946}) + \nu_{\text{transmitter}(j)} \\
& + \kappa_t \text{industries}'_{j,1950} + \pi_{h1} \text{N of HH}_j + \pi_{h2} \frac{\text{N of HH}_j}{\text{SqKM}_j} + \delta_{\text{prefecture}(j)} \\
& + I_{j=\text{city}} + \psi_{\text{bombed}(j)} + u_{j,t}
\end{aligned} \tag{2}$$

The additional variables are “Women’s LFP_{*j*,1930}” and “Male-to-female ratio_{*j*,1950}”. Women’s LFP_{*j*,1930} indicates women’s labor force participation in 1930, controlling for pre-existing across-district variation in women’s labor force participation. Male-to-female ratio_{*j*,1950} measures the sex ratio, defined by the number of men per one woman aged 15 years and above. The inclusion of the sex ratio as a determinant of women’s labor force participation is motivated by the existing literature on the impact of wartime male casualties on women’s labor market participation after the war (Rose (2018)) on the United States after World War II and Boenke and Gay (2019) on France after World War I.

Regardless of how I define the female labor force participation rate, I find no significant impact of radio subscription. Table 3 presents results from regressions of the form of equation 2 with three different outcomes: female labor force participation rate (Columns 1 for OLS and Column 2 for TSLS), female labor force participation rate excluding family

Table 3: The impact of the radio subscription in 1946 on labor force participation

	(1) Women's LFP Mean 0.521 Std.dev. 0.134	(2) Women's LFP excl'd. family emp Mean 0.283, Std.dev. 0.06	(3) Female share in LF mean: 0.398 sd. 0.065
Radio subscription in std.dev. unit	-0.00923 (0.00736)	-0.00994 (0.00708)	-0.00263 (0.00357)
Women's LFP in 1930	0.373*** (0.0293)	0.206*** (0.0282)	0.170*** (0.0142)
Male to female ratio	-0.297*** (0.0385)	-0.572*** (0.0371)	-0.433*** (0.0187)
Distance control	decile bins	decile bins	decile bins
N.of HH, HH density	✓	✓	✓
Transmitter FE	✓	✓	✓
Prefecture FE	✓	✓	✓
Prewar LF participation	✓	✓	✓
Industrial composition	✓	✓	✓
Observations	674	674	674

¹ Standard errors are clustered at an electoral district (which in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

² LFP stands for labor force participation. LF stands for labor force.

³ The male to female ratio is defined as the number of women aged 15 and above per man in the same age group.

⁴ The 1930 Population Census provides the latest data on women's labor force participation in the prewar period.

employees (Column 3), and women's share in the labor force (Column 4). I exclude family employees from the definition of women's labor participation in Column 3 in order to isolate the impact of radio on salaried employees. Women's share in the labor force in Column 4 highlights the composition of the labor force rather than the level of the labor force. The radio subscription rate is in standard deviation units. In no case is the impact of the radio subscription distinguishable from zero or economically insignificant.

5.3 Family formation

Last, I turn to the impact of exposure to women's radio programs on decision-making on family formation, namely, marriage and fertility. Because marriage and childbirth are infrequent decisions, I use a panel dataset of 10 years to capture any lagged impact. Accordingly, I modify the main model (1) as follows

$$\begin{aligned}
\text{Crude rate}_{j,t} = & \beta_0 + \beta_{1t} \text{radio exposure}_{j,1946} + \iota_t \\
& + \gamma_1 \text{Crude rate}_{j,1935} + \gamma_2 \text{Male-to-female ratio}_{j,1950} \\
& + f(\text{distance to a nearby transmitter}_{j,1946}) + \nu_{\text{transmitter}(j)} \\
& + \kappa_t \text{industries}'_{j,1950} + \pi_{h1} \text{N of HH}_j + \pi_{h2} \frac{\text{N of HH}_j}{\text{SqKM}_j} + \delta_{\text{prefecture}(j)} \\
& + I_{j=\text{city}} + \psi_{\text{bombed}(j)} + u_{j,t}
\end{aligned} \tag{3}$$

where crude rate refers to either the number of marriages or births per 1,000 population in a specified year. I allow the impact of radio exposure (β_{1t}) to vary across time. I add four control variables to the main model (1). First, $\text{Crude rate}_{j,1935}$ controls for the baseline marriage or birth rate prior to the US occupation to make sure that any preexisting marriage and fertility patterns do not drive my results. Keeping the baseline rate constant is important also because, as the baseline rate is higher, there is more room for a decline (or vice versa). Second, I also include the postwar male to female ratio ($\text{Male-to-female ratio}_{j,1950}$) as a de-

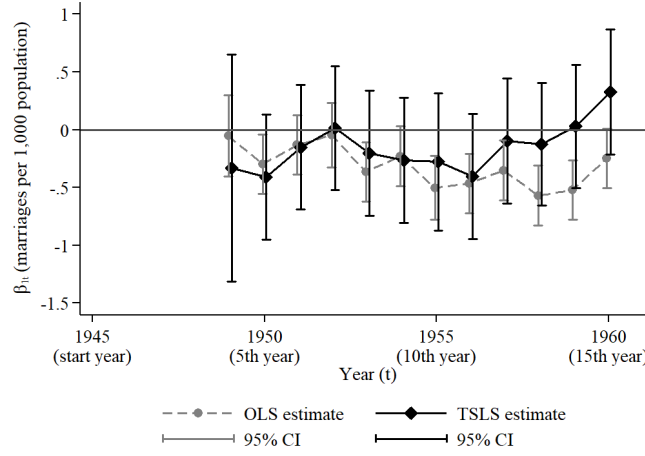


Figure 4: The impact on the annual marriage rate

terminant of marriage and fertility rate. The idea of the sex ratio determining marriage-market outcomes dates back to Becker (1973). A growing body of empirical literature exploits the war-induced variation in the male to female ratio and shows its causal impacts on marriage and fertility²⁷. Third, year fixed effect ι_t takes into account the nationwide trend in marriage and fertility rate. Last but not least, I allow coefficients on the industrial composition ($\text{industries}'_{j,1950}$, a vector of labor shares of 10 out of 11 industries in 1950) to vary across time to capture industry-specific time trends. Industry-specific time trends accommodate the fact that postwar birth-control first emerged among wives of coal miners and factory workers (Tama (2006), Ogino (2008), Takagi (2012)). Other control variables remain the same as the main model (1).

On the one hand, Figure 4 plots the TSLS coefficients ($\hat{\beta}_{1t}$) for the marriage rate from regressions of the form of equation 3. I find no significant effect of radio intervention

²⁷For examples, refer to Abramitzky, Delavande and Vasconcelos (2011) in post World War I France, Kvasnicka and Bethmann (2012) in the German state of Bavaria during and after World War II, Brainerd (2017) in post World War II Soviet Union and Ogasawara and Komura (2018) in post World War II Japan.

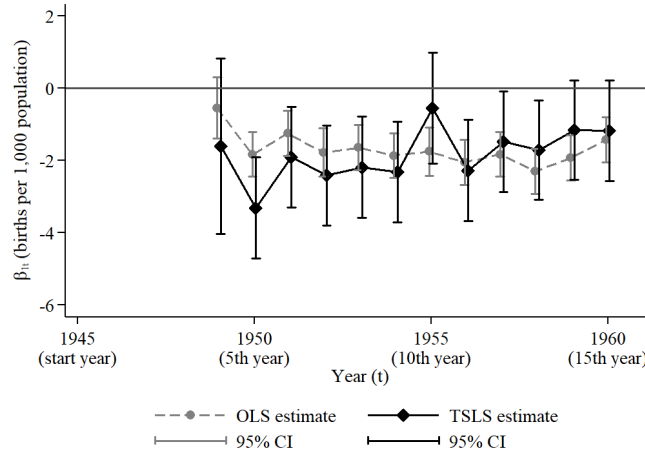


Figure 5: The impact on the annual crude birth rate

on marriage rates²⁸. On the other hand, Figure 5 plots the TSLS coefficients ($\hat{\beta}_{1t}$) for birth rate. I find negative impacts up until the 10th year (1955) from the onset of the women's radio programs, after which the impact starts to fade over time. In other words, in areas in which women are more exposed to women's radio programs, their fertility decrease their fertility around 1.84 per 1,000 on average. Note that changes are not driven by changes in marital behavior. Putting the result into context, the time period that I study saw a substantial decline in birth rate as Figure A.8 shows. The back-of-the-envelope calculation shows that the radio intervention contributes of 4.5 per 1,000 population out of an overall decline of 13.5 per 1,000 from prewar to 1960²⁹.

How can the impact be so substantial? I examine two possibilities. First, the high

²⁸The mean coefficient is -1.89 with a standard error of 2.06 and therefore the coefficient is statistically indistinguishable from 0. The mean coefficient in the first half of the period of my study, from 1949 to 1954, is -1.35 with a standard error of 1.15 and therefore the impact is not significant

²⁹I draw data from the National Institute of Population and Social Security Research. The prewar average birth rate is 30.8 per 1,000 population annually, which is the average between 1932 and 1937 (plus and minus two years of the base year 1935). The average birthrate at the end of the sample period is 17.3 per 1,000 population per year, which is the average between 1957 and 1962 (plus and minus two years of 1960).

baseline birthrate prior to the US occupation may have left large room for change. Prior to the US occupation, the annual birthrate was at a level of around 30 per 1,000 population, or 4.8 children per married woman (Figure A.7). To test this hypothesis, I split my sample into two groups, districts with the baseline birthrate higher or lower than the median of 32.77 per 1,000 population in 1935, and rerun regression (3) to observe whether the impact of the exposure to women's radio programs is higher in the high birth-rate districts. The difference is, however, statistically indistinguishable (Figure A.9) and not in favor of my first hypothesis.

I also consider an alternative interpretation: that the multifaceted nature of women's radio programs caused the large impact through multiple channels. By "multifaceted nature", I mean that the women's radio programs covered various topics, including politics, marriage, children, health, and labor market. As summarized in Figure 6, there are at least three ways in which the women's programs could cause the fertility decline. First, women could update their beliefs about the health benefits of birth spacing and consequently, change their fertility decisions. Second, women could change their preference for quality of children versus quantity of children in response to new information on childrearing. Third, recall my earlier finding that radio exposure increases women's political participation in Subsection 5.1. Past literature has also shown that greater women's political participation can lead to more public spending on women's and/or children's issues ³⁰ and therefore can cause changes in the socioeconomic environment surrounding childrearing. Overall, the multifaceted nature of women's radio programs can cause a larger impact on fertility than a situation in which an information campaign focuses only on the health benefits of birth spacing. Although it is beyond the scope of my study to disentangle these different channels, my findings open a

³⁰See Aidt and Dallal (2008). Duflo and Chattopadhyay (2004), Lott and Kenny (1999), Miller (2008), Okuyama (2018), and Powley (2006)

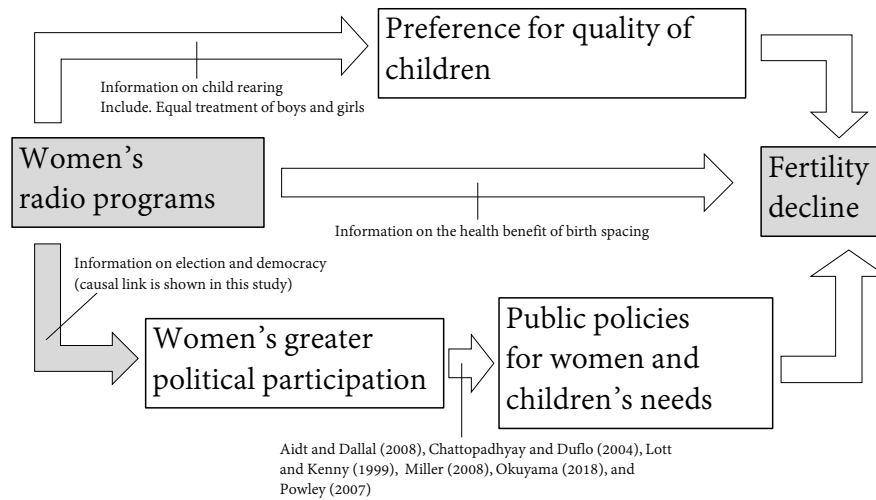


Figure 6: Potential channels through which women's radio programs can contribute to birth rate decline.

new avenue for future research ³¹.

5.4 Addressing potential threats for the instrumental variable

In this Subsection, I discuss potential mechanisms through which my instrumental variable may violate the conditional exogeneity assumption. Then, I provide a series of tests to show that they are not first-order concerns in this context.

There may be concern that soil type, which provides local variation in the field strength, directly determines the outcomes that I am interested in. Such concern arises if the soil type happens to indicate agricultural productivity, which then directly determines the optimal labor input. Alternatively, the soil type may capture an environmental factor for

³¹To examine the second channel, we would need data on parental investments and children's outcomes. To examine the third channel, I would additionally need the municipality spending on issues related to mothers and children.

human fertility, which then directly determines the birth rate. In either case, the direct association between the outcomes and field strength would undermine the exclusion restriction of the instrumental variable.

To address these concerns, I regress the pre-intervention outcomes on the field strength and full set of control variables. Pre-intervention variables are available for the annual marriage rate (1935), the birth rate (1935), and the labor force participation rate (both men and women in 1940). Since women did not have the right to vote before 1945, data for neither women's election turnout nor the vote share of a female candidate were available. As Table 4 shows, the outcome variables are not associated with field strength, in the absence of the radio intervention³².

6 Conclusion

This study examines the impact of women's radio programs on women's outcomes, namely electoral turnout, labor force participation, marriage, and fertility in Occupied Japan (from 1945 to 1952). I find that greater exposure to women's programs significantly increases women's political participation, both as voters and representatives. A one standard deviation increase in exposure to women's radio programs increases women's electoral turnout by 2.5 percentage points, closing the gender gap in turnout by 35 percent. The same increase in exposure also raises the vote share of a female candidate by 1.3 percentage points, which is much greater than the median win-loss margin of 0.23. Moreover, radio exposure contributes to the birthrate decline: a one standard deviation increase in radio exposure contributes to

³²Figure A.10 graphically shows that there is no association between field strength and marriage or fertility rate in 1935.

Table 4

	(1)	(2)	(3)	(4)
	Birth rate 1935	Marriage rate 1935	LFP 1940 (men and women)	LFP 1940 (women)
	Mean 32.70 Std.dev. 4.28	Mean 8.50 Std.dev. 1.30	Mean 0.45 Std.dev. 0.05	Mean 0.37 Std.dev. 0.10
Field strength in std.dev.	-0.293 (0.180)	-0.0321 (0.0846)	0.000218 (0.00220)	-0.00509 (0.00384)
R^2	0.848	0.634	0.854	0.902
Distance control	decile bins	decile bins	decile bins	decile bins
N.of HH, HH density	✓	✓	✓	✓
Transmitter FE	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓
City indicator	✓	✓	✓	✓
Industrial composition	✓	✓	✓	✓
Male to female ratio	✓	✓	✓	✓
Observations	771	771	651	651

Standard errors are in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

¹ In column 1, the birth rate is defined as the annual number of births in 1935 per 1,000 population. Similarly, in column 2, the marriage rate is the annual number of marriages in 1935 per 1,000 population. I draw the number of births and marriages from the 1935 vital statistics (*Shi-cho-son betsu zinko dotai tokei: showa 10 nen*), which I digitize for this project.

² In columns 3 and 4, LFP stands for the labor force participation rate, which is a share of the respective population working out of all the population (but not the working-age population). I draw the number of men and women working from Table 2-1 of the Japan Population Census 1940 while I draw the number of total population from Table 1-1 of the same census.

³ I spatially merge data in different years using year-by-year municipality boundaries, to take into account municipality mergers. The match rate was lower for 1935, which results in a smaller sample size in columns 1 and 2.

the annual birthrate decline by 1.84 per 1,000 population from a prewar baseline birthrate of 30.8 per 1,000 population. On the other hand, I find no significant impacts on women's labor market participation or marriage.

I suggest that the impact on political participation arises primarily through the informational channel. Women's radio programs provide information on how elections work to women, who otherwise would not have been exposed to such information. As a result, better-informed women turned out to vote more, which is consistent with existing literature (see Pande (2011) for a review of the empirical evidence that better-informed voters change their electoral behavior). However, the multifaceted nature of women's radio programs can affect fertility through multiple channels. First, women's radio programs provide information on the health benefits of birth spacing and thus, affect fertility through informational channel. Second, women's programs provide information on child bearing and therefore they may change women's preferences about quality of children. Third, earlier impacts of women's radio programs on women's political participation may change the socioeconomic environment, and further affect fertility decisions. Although it is beyond the scope of my study to disentangle different channels, it would be an interesting avenue of future research.

My findings open new avenues of economic research. First, it is still an open question as to whether the intervention during the Allied Occupation has had a long-term effect and triggered a virtuous cycle toward gender equality in Japanese society. Second, the case of Occupied Japan limits my ability to investigate what would have happened if both men and women, or only men, had been exposed to women's radio contents. This limitation, however, provide motivation for field experiments to understand the nature of targeted information

interventions further. Third, my findings call for a theoretical framework, that incorporates gender disparity in information access and gender disparity in behavioral outcomes.

While there is much work to be done, my results provide evidence that information can change women's behavior and lend support to the contemporary initiatives by the UN, NGOs, and NPOs to use mass media to reach out to women who have limited access to information.

References

- Abramitzky, Ran, Adeline Delavande, and Luis Vasconcelos**, “Marrying Up: The Role of Sex Ratio in Assortative Matching,” *American Economic Journal: Applied Economics*, 2011, 3 (3), 124–157.
- Adena, Maja, Ruben Enikolopov, Maria Petrova, Veronica Santarosa, and Ekaterina Zhuravskaya**, “Radio and the Rise of the Nazis in Prewar Germany,” *The Quarterly Journal of Economics*, 2015, pp. 1885–1939.
- Aidt, Toke S and Bianca Dallal**, “Female voting power: the contribution of women’s suffrage to the growth of social spending in Western Europe (1869-1960),” *Public Choice*, 2008, pp. 391–408.
- Ashraf, Nava, Erica Field, and Jean Lee**, “Household Bargaining and Excess Fertility: An Experimental Study in Zambia,” *American Economic Review*, 2014, 104 (7), 2210–2237.
- Beaman, Lori and Andrew Dillon**, “Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali,” *Journal of Development Economics*, jul 2018, 133, 147–161.
- , **Raghavendra Chattopadhyay, Esther Duflo, Rohini Pande, and Petia Topalova**, “Powerful Women: Does Exposure Reduce Bias?,” *Quarterly Journal of Economics*, nov 2009, 124 (4), 1497–1540.
- Becker, Gary S**, “A Theory of Marriage : Part I,” *Journal of Political Economy*, 1973, 81 (4), 813–846.
- Benhassine, Najj, Florencia Devoto, Esther Duflo, Pascaline Dupas, and Victor Pouliquen**, “Turning a Shove into a Nudge? A “Labeled Cash Transfer” for Education,” *American Economic Journal: Economic Policy*, 2015, 7 (3), 86–125.
- Bertrand, Marianne, Sandra E Black, Sissel Jensen, and Adriana Lleras-Muney**, “Breaking the Glass Ceiling? The Effect of Board Quotas on Female Labour Market Outcomes in Norway,” *Review of Economic Studies*, 2019.
- Boenke, Jorn and Victor Gay**, “The missing men,” *Retrieved from SSRN (April 2019)*, 2019, pp. 79–102.
- Brainerd, Elizabeth**, “The Lasting Effect of Sex Ratio Imbalance on Marriage and Family: Evidence from World War II in Russia,” *The review of Economics and Statistics*, 2017.
- Doepke, Matthias, Michèle Tertilt, and Alessandra Voena**, “The Economics and Politics of Women’s Rights,” *Annual Review of Economics*, 2012.
- Duflo, Esther**, “Women Empowerment and Economic Development,” *Journal of Economic Literature*, 2012, 50 (4), 1051–1079.
- and **Raghavendra Chattopadhyay**, “Women as Policy Makers : Evidence from a Randomized Policy Experiment in India,” *Econometrica*, 2004, 72 (5), 1409–1443.
- Economic Stabilization Agency, Planning Department, Office of the Secretary General**, “Overall Report of Damage Sustained by the Nation During the Pacific War,” Technical Report 1949.
- Egami, Fuji**, “Fujin no Jikan no Ju Nen (Ten Years of Women’s Hour),” *Fujin Koron*, aug 1955, pp. p.164–165.
- Field, Erica**, “Fertility Responses to Urban Land Titling Programs: The Roles of Ownership Security and the Distribution of Household Assets,” 2003.

- Gagliarducci, Stefano, Massimiliano Gaetano Onorato, Francesco Sobbrino, and Guido Tabellini**, “War of the Waves: Radio and Resistance During World War II,” *Ssrn*, 2017, 12746.
- Japan Broadcasting Corporation (NHK)**, “Radio Yearbook (Radio Nen Kan),” Technical Report, Tokyo 1947.
- Jensen, Robert and Emily Oster**, “The Power of TV: Cable Television and Women’s Status in India,” Technical Report 3 2009.
- Kearney, Melissa S and Phillip B Levine**, “Media Influences on Social Outcomes: The Impact of MTV’s 16 and Pregnant on Teen Childbearing,” *American Economic Review*, 2015, 105 (12), 3597–3632.
- Kobayashi, Yoshie**, *A Path Toward Gender Equality: State Feminism in Japan*, Routledge, 2004.
- Kvasnicka, Michael and Dirk Bethmann**, “World War II, Missing Men, and Out-of-Wedlock Childbearing,” *The Economic Journal*, 2012, 123 (567), 162–194.
- La Ferrara, Eliana, Alberto Chong, and Suzanne Duryea**, “Soap Operas and Fertility: Evidence from Brazil,” *American Economic Journal: Applied Economics*, 2012, 2012 (4), 1–31.
- Lott, John R and Lawrence W Kenny**, “Did Women’s Suffrage Change the Size and Scope of Government?,” *Journal of Political Economy*, 1999, 107 (6).
- Lundberg, Shelly J, Robert A Pollak, and Terence J Wales**, “Do Husbands and Wives Pool Their Resources? Evidence from the United Kingdom Child Benefit,” *The Journal of Human Resources*, 1997.
- Luther, Catherine A. and Douglas A. Boyd**, “American Occupation Control over Broadcasting in Japan, from 1945 to 1952,” *Journal of Communication*, 1997, 47 (2), 39–59.
- Mayo, J. Marlene**, “The War of Words Continues: American Radio Guidance in Occupied Japan,” in “The Occupation of Japan: Arts and Culture” 1988.
- Miller, Grant**, “Women’s Suffrage, Political Responsiveness, and Child Survival in American History,” *The Quarterly Journal of Economics*, 2008.
- National Women’s Education Center**, “Gender Statistics Database.”
- Ogasawara, Kota and Mizuki Komura**, “Consequences of War: Japan’s Demographic Transition and the Marriage Market,” 2018.
- Ogino, Miho**, *Kazoku Keikaku e no Michi: Kindai Nihon no Seishoku o Meguru Seiji*, Iwanami Shoten, 2008.
- Okabe, Tadanobu**, *The 50 years of Japanese Radio 1925-75*, Matsumoto, Japan: Japan Radio Museum, 2018.
- Okahara, Miyako**, *America senryoki no minshuka seisaku* 2007.
- Okuyama, Yoko**, “The Consequences of Increased Women’s Representation in Politics: Evidence from Japan,” 2018.
- Pande, Rohini**, “Can Informed Voters Enforce Better Governance? Experiments in Low-Income Democracies,” *Annual Review of Economics*, 2011.

- Pharr, Susan**, “The Politics of Women’s Rights,” in “Policy and Planning During the Allied Occupation of Japan,” University Press of Hawaii, 1987, chapter 8.
- Powley, Elizabeth**, “Rwanda: The Impact of Women Legislators on Policy Outcomes Affecting Children and Families,” in “The State of the World’s Children 2007” number December 2006 2006, pp. 1–18.
- Rose, Evan K**, “The Rise and Fall of Female Labor Force Participation During World War II in the United States,” *The Journal of Economic History*, 2018.
- Russo, Gianluca**, “Mass Media and Cultural Homogenization: Broadcasting the American Dream on the Radio,” 2019.
- Smulyan, Susan**, “Now It Can Be Told: the Influence of the United States Occupation on Japanese Radio,” in “Radio Reader: Essays in the Cultural History of Radio,” Routledge, 2002, chapter 14.
- Strömberg, David**, “Radio’s Impact on Public Spending,” *Quarterly Journal of Economics*, 2004, 119 (1), 189–221.
- Strömberg, David**, “Media Coverage and Political Accountability,” in “Handbook of Media Economics” 2015, pp. 595–622.
- Svensson, Jakob and David Yanagizawa**, “Getting prices right: The impact of the market information service in Uganda,” *Journal of the European Economic Association*, 2009, 7 (2-3), 435–445.
- Takagi, Masahi**, “Sengo Shoki Nihon ni okeru Jutai Chosetsu Shido,” *Fukuoka University Review of Literature & Humanities*, 2012, 44.
- Takita, D., Y. Ogasawara, and K. Kishimoto**, “Kokusei Chousa (1950 Nen) Shikuchousonbetsu Deeta Beesu Sakusei ni Tsuite,” Technical Report, Tsukuba University 2012.
- Tama, Yasuko**, *Kindai Kazoku to Body Politics*, Sekai Shiso Sha, 2006.
- Udry, Christopher**, “Gender, Agricultural Production, and the Theory of the,” Technical Report 5 1996.
- Uemura, Chikako**, *Josei kaiho o meguru senryo seisaku*, Tokyo: Sosho jenda bunseki, 2007.
- Vigna, Stefano Della and Matthew Gentzkow**, “Persuasion: Empirical Evidence,” *Annual Review of Economics*, 2010.
- Yanagizawa-Drott, David**, “Propaganda and Conflict: Evidence from the Rwandan Genocide,” 2014.

A Supplemental figures and tables

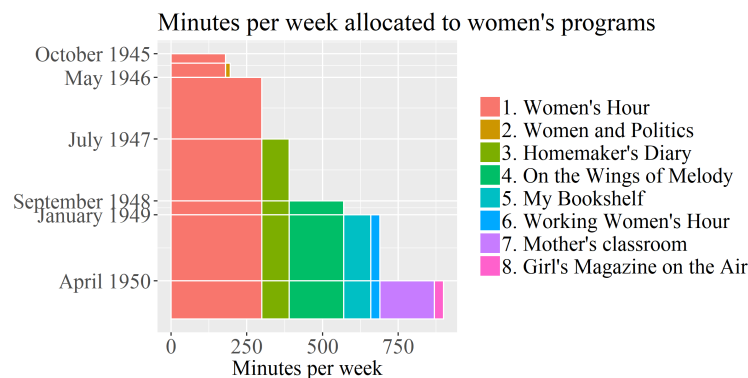


Figure A.1: Airtime allocated to women’s programs. The programs were categorized as “Women’s program” by the JBC. Source: NHK Yearbook (1947, 1949) and GHQ/SCAP CIE Weekly Report (Radio Education Branch, 1946 - 1950).

Table A.1: Time line for policies aimed at raising women’s status under the Allied Occupation

October 1, 1945	The flagship women’s radio program “Women’s Hour” was on air for the first time
December 17, 1945	Women were granted voting rights in national elections.
April 10, 1946	House of Representative General Election. Women voted for the first time.
November 3, 1946	New Japanese Constitution was enacted.
1947	Women’s and Minor’s Bureau was established within the Ministry of Labor.
1948	Women were allowed to attend college.

Table A.2: Data sources

Data source	Variable
Japan Broadcasting Corporation Statistic Report 1946	Post-war radio subscription rate N. of households in 1946
A map on medium wave field strength 1949	Field strength
Latitudes and longitudes of transmitters obtained from Japan Broadcasting Corporation Yearbook 1947 District boundaries year by year provided by Maruyama Lab, Tsukuba University	Distance to a nearby transmitter
Prefecture Annual Statistics Book (annually from 1949 to 1960)	Postwar crude birth rate
The Annual Vital Statistics Report in 1935	Prewar marriage rate and birth rate
Population Census 1940	Prewar labor force participation
Population Census 1950	Postwar labor force participation Industrial composition
News papers	Turnout in the 1946 election by sex
The 22nd House of Representatives election results A list of female candidates provided by Ito (2008)	Female candidate's vote share
Overall Report of Damage Sustained by the Nation During the Pacific War	District-level total casualty during the World War II

Table A.3: Radio subscription fees

	Radio subscription fee (monthly)	TV subscription fee (monthly)	Starting teacher salaries (monthly)	Japanese soba noodle unit price
1925	1.00		45.00	0.10
1930	0.75		45.00	0.10
1933	0.75		55.00	0.10
1937	0.50		55.00	0.13
1941	0.50		55.00	0.16
1946	2.50		400.00	-
1948	35.00		2000.00	-
1950	35.00		5000.00	15.00
1954	67.00	300.00	7800.00	30.00
1955	67.00	300.00	7800.00	30.00

Source: Okabe (2018) "*The 50 Years of Japanese Radio 1925-1975*" The Japan Radio Museum.

In real terms radio subscription fees had been declining before World War II. Table A.3 shows the monthly radio subscription fee (in Japanese Yen) from 1925 to 1955 along with the monthly salary for first-year teachers and a unit price for Japanese soba noodles. While inflation accelerated, the JBC decreased the monthly fee and made radio more accessible for a wide income-range of Japanese: the fee was 1 Japanese yen compared to 45 yen of teachers' starting salaries in 1925. In 1941, however, the fee halved while teacher salaries moderately grew. After World War II, the inflation outpaced the increase in nominal subscription fee, and thus the subscription fee further drops in real terms. Therefore, I am less concerned that subscription fees deterred low income Japanese from listening to the radio.

Table A.4: Topics within women's radio programs, associated phrases, and women's outcomes

Topics	Outcomes to examine	Key words and expected impact
Politics Women's organization	Turnout in the 1946 general election	+ "urge to vote"
Children and mothers	Fertility (1949-1960)	- "birth control" "[birth] spacing"
Young women and girls	Marriage (1949-1960)	- "seeking marriage by their own choice" "marriage vs. career"
Labor and welfare	Labor force participation (1950)	+ "new labor law" "interesting careers"

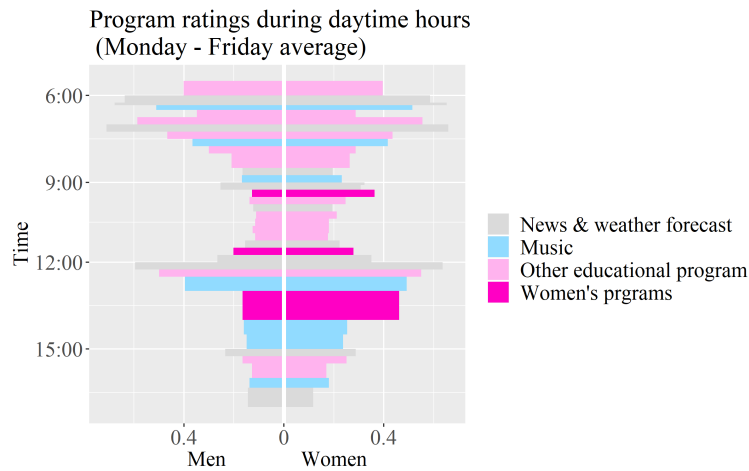
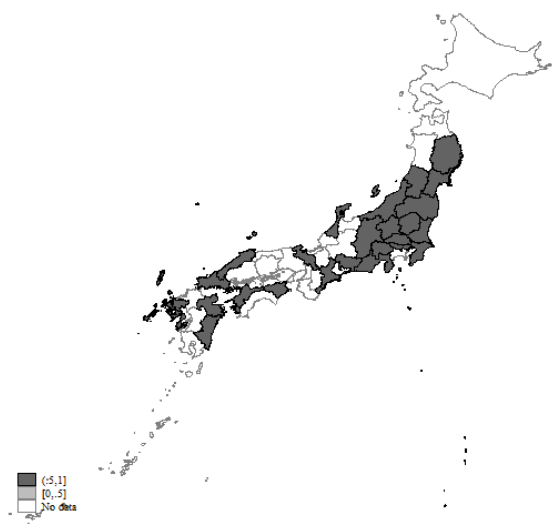
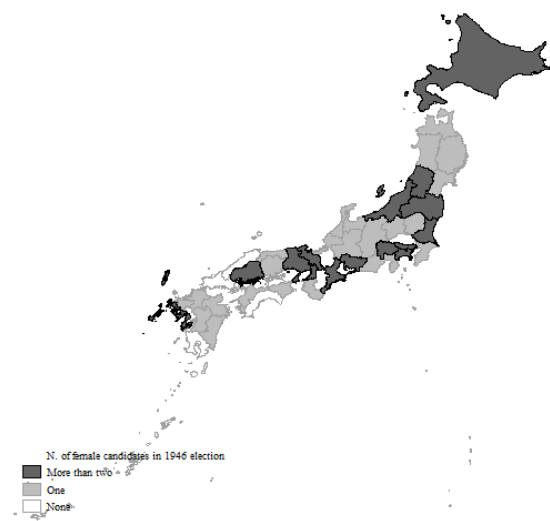


Figure A.2: Channel 1 program ratings during daytime hours. Rating is defined as a percentage of male and female radio holders who actively listened to the radio in a given time slot. The figure shows the average rating from Monday to Friday in the survey week. Dark pink represents times slots allocated to women's programs, which were aired daily. Grey, pale blue, and pale pink indicate news and weather forecasts, music, and educational programs respectively. Men's rating is no larger than women's rating for any time slot. Women's rating is especially higher than men's for women's programs: the gender rating gap is 23.6 percentage points from 9:15 to 9:30, and 29.6 percentage points from 1 pm to 2 pm. Source: Radio Listeners Survey - Report of the 3rd Regular Survey, Part 1-4 (November 1948))



(a) Prefectures for which data on 1946 turnout are available. Data on electoral turnouts by sex in each district are available for 26 prefectures.



(b) A map of prefectures where at least one female candidate ran for office

Figure A.3

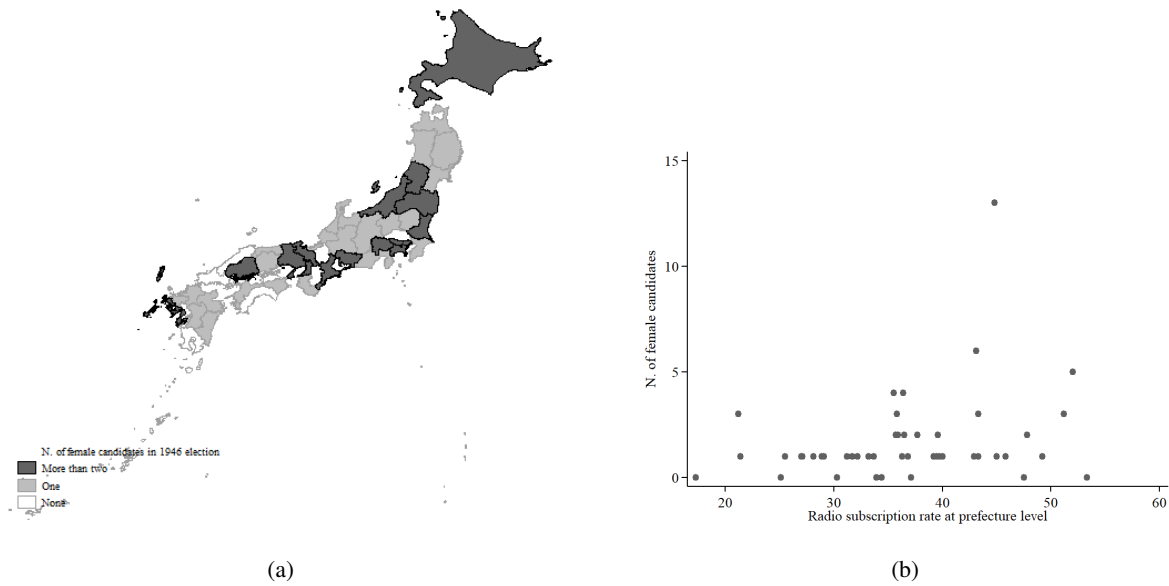


Figure A.4: (a) Geographical variable in the number of female candidates in the 1946 general election . (b) Relationship between the radio subscription rate and the number of female candidates running for office in the 1946 general election. Each dot represents a prefecture. Five prefectures (Saitama, Shiga, Nara, Shimane, Yamaguchi, and Kagoshima) had no female candidates and therefore are omitted in from the figure. Conditional on having at least female candidate, there is no significant relationship between female candidacy and the radio subscription rate.

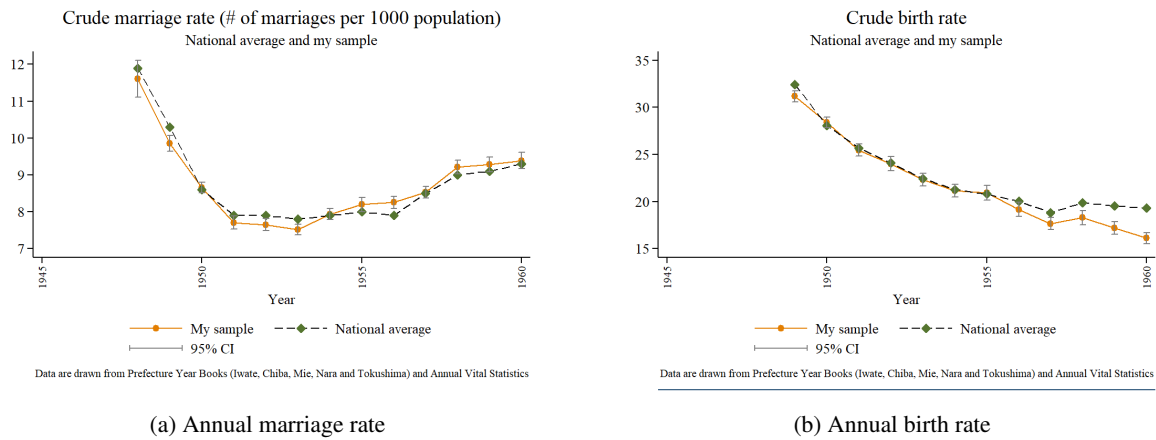


Figure A.5: Annual marriage and birth: comparing the national average and the average in my sample

Figure A.6: Radio and TV subscriptions

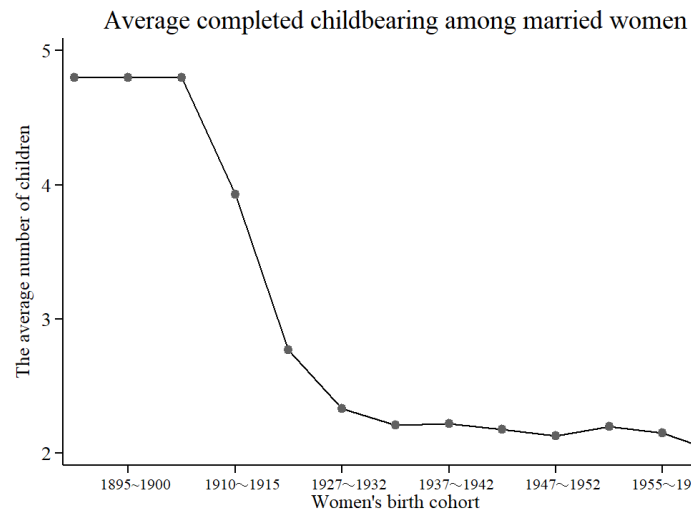
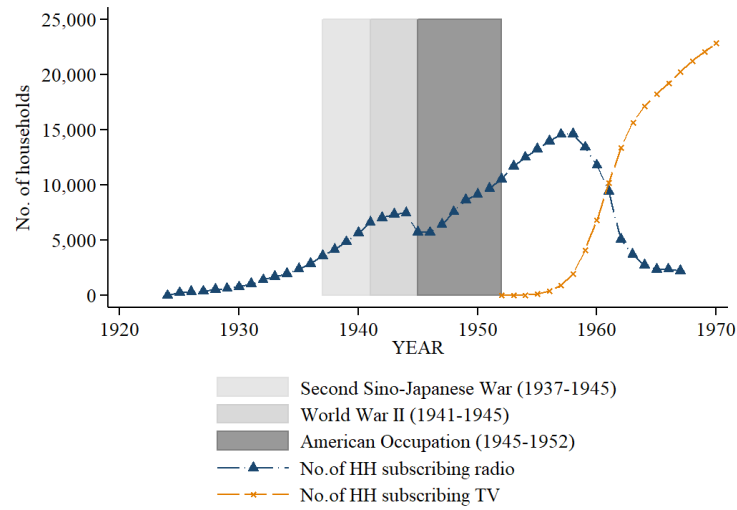


Figure A.7: Average number of children per married woman. Data are from the Census and Vital Statistics and compiled by the National Institute of Population and Social Security Research. Okinawa prefecture is not included during 1947-1970. The female population includes foreign citizens who were living in Japan until 1940 but only Japanese citizens from 1941.

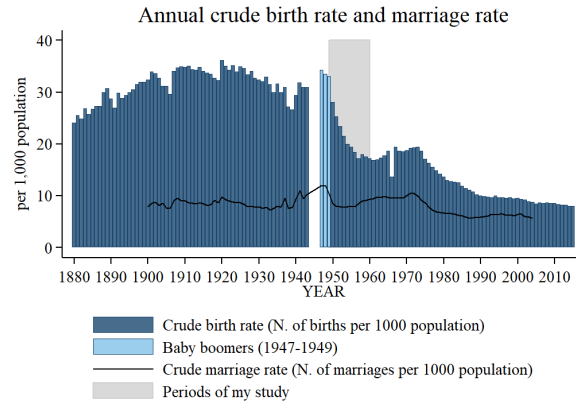


Figure A.8: The number of births per 1,000 population in Japan from 1880 to 2015

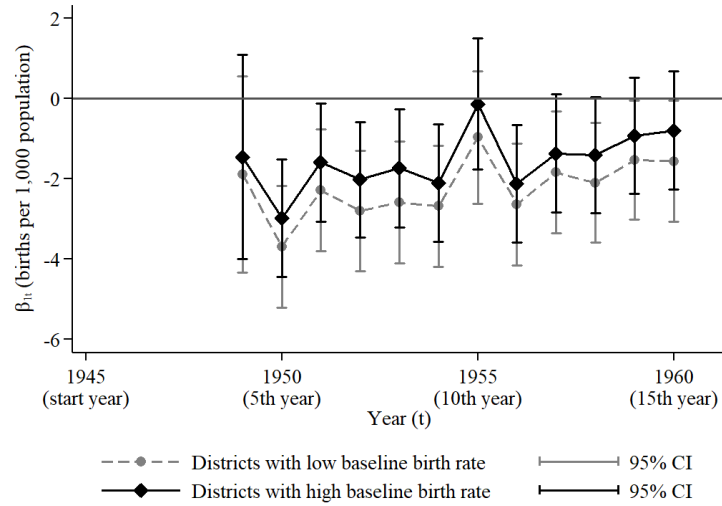
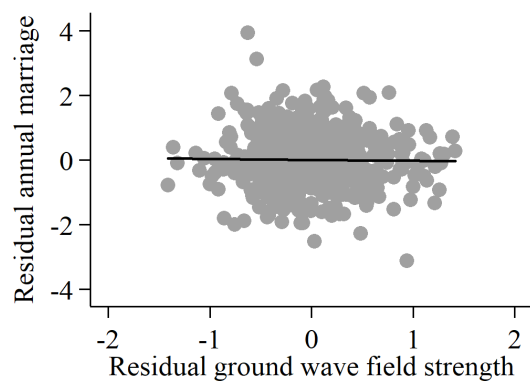
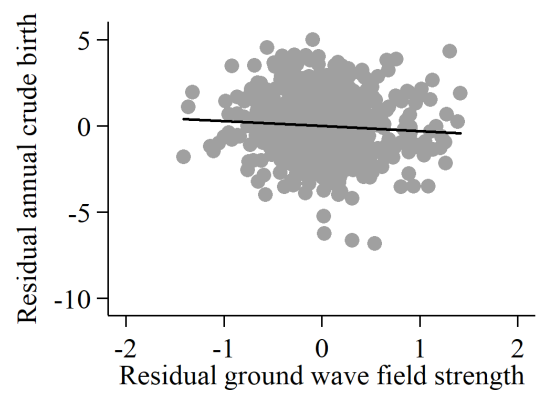


Figure A.9: Heterogeneous impacts of the radio exposure on birth rates. Radio exposure is in standard deviations. Regressions include the full set of control variables presented in equation (3). The sample is split into two groups, based on the baseline birth rate and its median.



(a) Annual marriage rate in 1935



(b) Annual birth rate in 1935

Figure A.10: Association between residualized field strength and residualized annual marriage and birth

Table A.5: Observable characteristics of my sample to examine electoral turnout

	(1) All mean/[std.dev.]	(2) My sample mean/[std.dev.]	(3) Out of my sample mean/[std.dev.]	(4) Diff. diff/(std.err.)
Radio subscription rate	0.378 [0.126]	0.383 [0.121]	0.374 [0.130]	0.010 (0.01)
Residualized field strength	-0.000 [1.227]	-0.018 [1.247]	0.018 [1.210]	-0.036 (0.09)
Distance from a nearby transmitter (km)	32.606 [21.667]	33.326 [22.947]	31.938 [20.418]	1.388 (1.61)
No. of households (in 1,000)	1.928 [1.975]	2.021 [1.926]	1.847 [2.016]	0.174 (0.14)
No. of hh (in 1,000) per km2	88.348 [253.695]	121.094 [326.421]	56.784 [147.794]	64.310*** (19.18)
Labor share: Agriculture	0.369 [0.225]	0.394 [0.222]	0.351 [0.225]	0.043*** (0.02)
Labor share: Forestry	0.017 [0.026]	0.015 [0.024]	0.019 [0.027]	-0.003* (0.00)
Labor share: Fishery	0.024 [0.045]	0.023 [0.041]	0.025 [0.048]	-0.002 (0.00)
Labor share: Mining	0.019 [0.072]	0.015 [0.045]	0.023 [0.087]	-0.008* (0.00)
Labor share: Construction	0.057 [0.020]	0.057 [0.020]	0.056 [0.020]	0.001 (0.00)
Labor share: Manufacturing	0.170 [0.110]	0.159 [0.102]	0.178 [0.115]	-0.020*** (0.01)
Labor share: Whole sale and retail	0.129 [0.071]	0.129 [0.068]	0.129 [0.073]	-0.000 (0.00)
Labor share: Finance	0.011 [0.010]	0.011 [0.010]	0.011 [0.010]	-0.000 (0.00)
Labor share: Transportation	0.066 [0.035]	0.059 [0.027]	0.070 [0.040]	-0.011*** (0.00)
Labor share: Service	0.091 [0.034]	0.092 [0.036]	0.090 [0.032]	0.001 (0.00)
Heavy damage in WWII	1.214 [0.411]	1.286 [0.453]	1.162 [0.369]	0.124*** (0.03)
Observations	873	367	506	873

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard deviations are in square brackets. Standard errors are in parentheses.

Table A.6: Observable characteristics of my sample to examine marriage and fertility

	(1) All mean/[std.dev.]	(2) My sample mean/[std.dev.]	(3) Out of my sample mean/[std.dev.]	(4) Diff. diff/(std.err.)
Radio subscription rate	0.350 [0.158]	0.329 [0.135]	0.353 [0.161]	-0.023*** (0.01)
Residualized field strength	0.000 [1.495]	-0.000 [1.552]	0.000 [1.489]	-0.000 (0.09)
Male to female ratio at reproductive age in 1950	0.924 [0.087]	0.916 [0.069]	0.925 [0.089]	-0.008** (0.00)
No. births per 1000 population in 1935	34.353 [4.916]	34.379 [4.919]	34.350 [4.916]	0.029 (0.29)
N. marriage per 1000 population in 1935	8.881 [1.693]	8.789 [1.634]	8.892 [1.699]	-0.103 (0.10)
Distance from a nearby transmitter (km)	28.991 [16.468]	42.090 [21.764]	27.442 [14.989]	14.648*** (1.23)
No. of households (in 1,000)	0.388 [0.619]	0.353 [0.425]	0.393 [0.638]	-0.039 (0.03)
No. of hh (in 1000) per km2	38.354 [103.302]	29.415 [43.061]	39.411 [108.189]	-9.996*** (3.12)
Labor share: Agriculture	0.526 [0.186]	0.530 [0.188]	0.526 [0.186]	0.004 (0.01)
Labor share: Forestry	0.033 [0.061]	0.036 [0.073]	0.033 [0.059]	0.003 (0.00)
Labor share: Fishery	0.023 [0.063]	0.037 [0.078]	0.021 [0.061]	0.015*** (0.00)
Labor share: Mining	0.021 [0.090]	0.009 [0.049]	0.023 [0.094]	-0.014*** (0.00)
Labor share: Construction	0.047 [0.023]	0.043 [0.019]	0.047 [0.024]	-0.004*** (0.00)
Labor share: Manufacturing	0.106 [0.083]	0.101 [0.075]	0.106 [0.084]	-0.006 (0.00)
Labor share: Whole sale and retail	0.085 [0.045]	0.089 [0.047]	0.084 [0.045]	0.005* (0.00)
Labor share: Finance	0.006 [0.005]	0.005 [0.005]	0.006 [0.005]	-0.001** (0.00)
Labor share: Transportation	0.048 [0.031]	0.047 [0.027]	0.048 [0.032]	-0.001 (0.00)
Labor share: Service	0.070 [0.026]	0.071 [0.023]	0.070 [0.027]	0.000 (0.00)
Observations	3148	333	2815	3148

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard deviations are in square brackets. Standard errors are in parentheses.

B Analyzing radio content

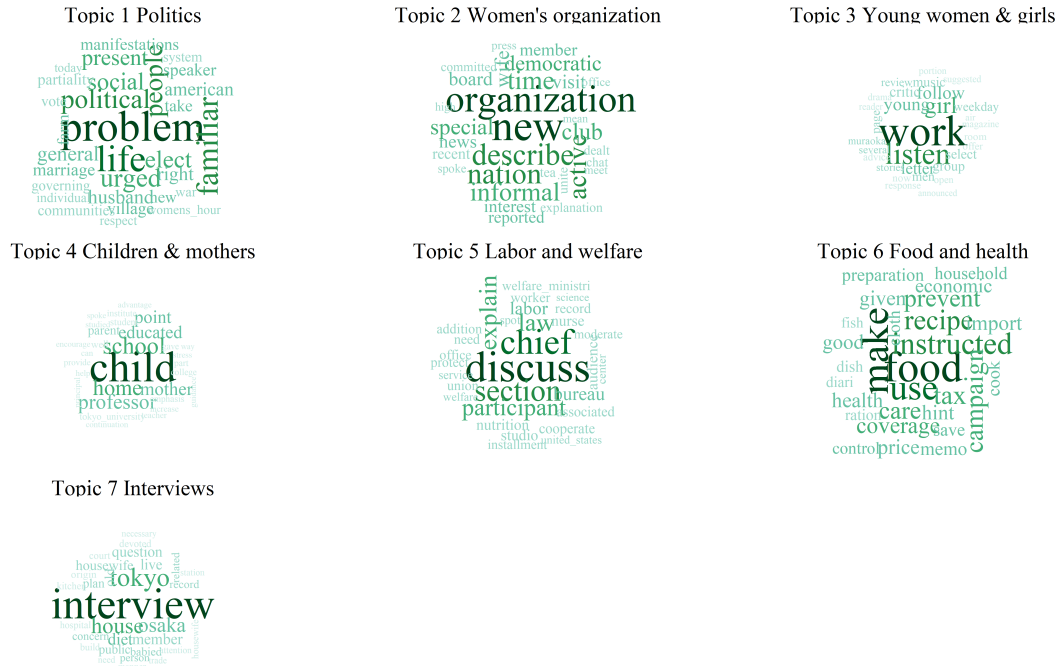


Figure B.11: Word clouds characterizing each of seven topics in women's radio programs.

Latent Dirichlet Allocation (LDA) is an unsupervised machine learning technique for topic modeling. It considers each document as a predetermined number of topics in a certain proportion, and each topic as a collection of keywords in a certain proportion. A goal of LDA is to estimate a word distribution within each topic, then a topic distribution within each document by maximum likelihood. In other words, LDA tries to find a topic model that fits best to the corpus within a collection of documents under analysis. In my study, a document corresponds to a daily content of women's radio programs, two of which are quoted in Subsection 2.3. On the one hand, each topic obtains a probability distribution over words. Figure B.11 shows word clouds for each of seven topics; each word cloud shows the top-30 most frequently used words in each topic. The relative size of a word corresponds to its assigned probability, that is, larger words are weighted higher within the topic. Based on the word clouds, I assign labels to the topics: politics, women's organization, young women and girls, children and mothers, labor and welfare, food and health, and interviews. Each document (i.e., a daily content description) obtains a probability distribution over the seven topics as in Figure 1. Then, for further simplicity, I assign each document one topic with the highest probability, and obtain a mapping from a collection of documents to the seven topics. The choice of seven groups was made as follows. On the one hand, in a model with a larger number of topics than seven, some topics appear to be too specific. On the other hand, in a model with a smaller number of topics than seven, some topics turn out to be too general and need to be split to be interpretable. However, my main takeaways are robust to the number of topics.

C Background on the 1946 general election

This section explains in details how the electoral system worked in the 1946 general election. The limited voting, as it is called, resembles multi-seat plurality voting because it also uses multi-seat districts. A key difference between the limited voting and the multi-seat plurality voting is that, in the limited voting, a voter casts multiple ballots, but the number of ballots per voter is *limited* strictly to less than the number of seats. In Japan's 1946 general election in Japan, in particular, a voter casted two ballots in a district with less than or equal 10 seats whereas they voted three ballots in a district with more than 10 seats.

Although the limited voting system is less common compared to multi-seat plurality voting, and less understood theoretically, it is often advocated as a way to better reflect the voices of both majority and minority groups. In fact, the limited voting was considered a desirable electoral system as the very first election that Japanese women participated in. However the status-quo majority (right-wing male politicians) was less favor of the limited voting and, in 1947, the Diet agreed to reform the electoral system again and employ multi-seat plurality. Therefore, the 1946 general election was the first and last to employ limited voting. In fact, in 1946, as many as 39 women were elected with winning probability of 49.4 percent, which was much higher than that of men (15.8 percent). The initial success of a female candidate, however, was followed by a long stagnation, and 39 remained the record high for more than five decades until 2009.

I construct a dataset of 958 female candidate and district pairs and run the following regression. To identify the parameter of interest, β_1 , I instrument the radio subscription by the ground wave field strength. Table 2 column (2) presents the result.

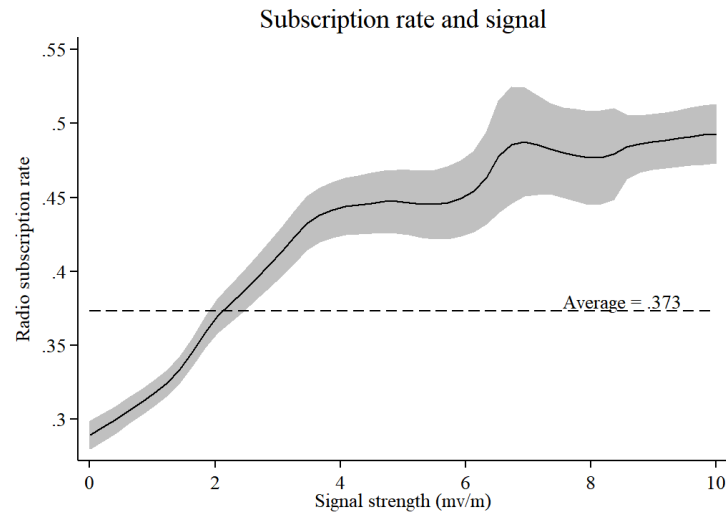
$$\begin{aligned}
 s_{i(p),j(d)} = & \beta_0 + \beta_1 \text{radio subscription}_{d(j)} \\
 & + \underbrace{\phi_d}_{\text{electoral district FE}} + \underbrace{\gamma x'_d}_{\text{electoral district characteristics}} \\
 & + \underbrace{\iota c_{i(p)}}_{\text{candidate characteristics}} \\
 & + f(\text{distance to a nearby transmitter}_{j,1946}) + \nu_{\text{transmitter}(j)} \\
 & + \pi_{h1} \text{N of HH}_j + \pi_{h2} \frac{\text{N of HH}_j}{\text{SqKM}_j} + \psi_{\text{bombed}(j)} + u_{i(p),j(d)}
 \end{aligned}$$

where $s_{i(p),j(d)}$ is candidate i 's vote share in administrative district j which belongs to an electoral district d . The exposure to the women's radio programs is again measured by the radio subscription rate, which is the share of households subscribing to radio in district j . The set of electoral district characteristics is meant to control for competitiveness in each district and include the number of seats, number of candidates, female candidates, number of votes per voter (two or three), and male-to-female ratio of eligible voters. The set of

candidate characteristics include age, partisanship, whether or not she was employed before the election, and whether or not she was engaged in the women's suffrage movement in the prewar period. Unlike the regression of women's turnout, I do not include prefecture fixed effects, because they are highly collinear with electoral district fixed effects. In fact, in the 1946 general election in Japan, there were 52 multi-member districts, whose boundaries align with prefecture boundaries except for Hokkaido, Tokyo, Niigata, Aichi, Osaka, Hyogo and Fukuoka prefectures, each of which was split into two. Finally, standard errors are clustered at an electoral district level.

D Binned Instrumental Variable

Figure D.12: Plotting the radio subscription rate against the field strength



Motivated by a non-linear relationship between radio subscription and field strength (Figure D.12), this section presents results from regressions with binned instrumental variables. By binned instrumental variable, I create indicator variables for each decline bin of the field strength, and use them as instrumental variables.

Table D.7, Table D.8, and Table D.9 show results for electoral turnout, a female candidate's vote share, and labor force participation respectively. Figure D.13a and Figure D.13b present results for marriage rate and fertility rates. The results are similar to those of the main specification (1). There are, however, two exceptions: first, the impact of women's turnout on the female candidate's vote share is now statistically significantly positive (Column 4 of Table D.8). This is likely because flexibly fitting the instrumental variable yields a stronger first stage. Second, the impacts on the birth rate (Figure D.13b) has become more persistent.

Table D.7

	Women's turnout Mean 0.66 Std.dev. 0.08			Men's turnout Mean 0.79 Std.dev. 0.06		Turnout female share Mean 0.37 Std.dev. 0.06
	(1) OLS	(2) TSLS	(3) TSLS	(4) OLS	(5) TSLS	(6) TSLS
Radio subscription in std.dev. unit	0.0289*** (0.00519)	0.0247*** (0.00861)	0.0248** (0.0111)	0.00231 (0.00482)	0.0114 (0.00791)	0.0136** (0.00581)
R^2	0.707	0.707	0.740	0.620	0.613	0.727
Distance control decile bins	✓	✓	✓	✓	✓	✓
N.of HH, HH density	✓	✓	✓	✓	✓	✓
Transmitter FE	✓	✓	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓	✓	✓
City indicator	✓		✓			
Industrial composition	✓		✓			
Male to female ratio						✓
Observations	346	346	346	336	336	288

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard deviations are in square brackets. Standard errors are in parentheses.

Table D.8

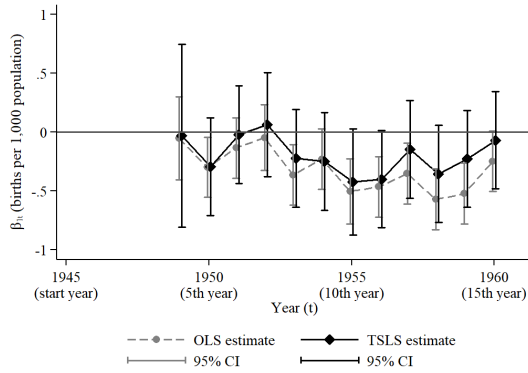
	Female vote share Mean .077 Std.dev. .08			
	(1) OLS	(2) TSLS	(3) OLS	(4) TSLS
Radio subscription (std.dev)	0.00308 (0.00193)	0.0114* (0.00591)		
Female share turnout (p.p.)			0.00143** (0.000670)	0.00890** (0.00380)
R^2	0.538	0.533	0.622	0.534
Distance control decile bins	✓	✓	✓	✓
Electoral district FE	✓	✓	✓	✓
Electoral district controls	✓	✓	✓	✓
Transmitter FE	✓	✓	✓	✓
N.of HH and HH density	✓	✓	✓	✓
War casualty	✓	✓	✓	✓
Candidate controls	✓	✓	✓	✓
Candidate FE				
Std.error clustered	Yes	Yes	Yes	Yes
Observations	958	958	465	465

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard deviations are in square brackets. Standard errors are in parentheses.

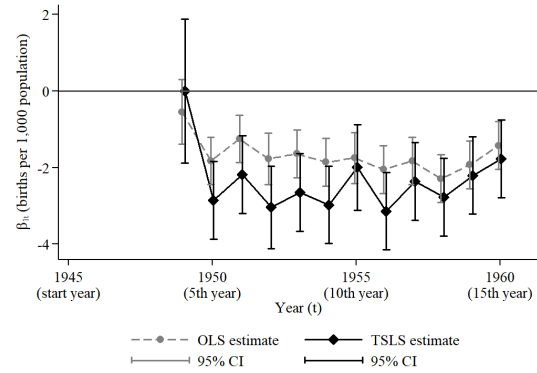
Table D.9

	(1) Women's LFP Mean 0.521 Std.dev. 0.134	(2) Women's LFP excl. family emp Mean 0.283, Std.dev. 0.06	(3) Female share in LF mean: 0.398 sd. 0.065
Radio subscription in std.dev. unit	-0.00987 (0.00617)	-0.00479 (0.00591)	-0.00143 (0.00300)
Women's LFP in 1930	0.374*** (0.0291)	0.205*** (0.0279)	0.169*** (0.0141)
Male to female ratio	-0.293*** (0.0379)	-0.579*** (0.0363)	-0.433*** (0.0184)
Distance control	decile bins	decile bins	decile bins
N.of HH, HH density	✓	✓	✓
Transmitter FE	✓	✓	✓
Prefecture FE	✓	✓	✓
Prewar LF participation	✓	✓	✓
Industrial composition	✓	✓	✓
Observations	678	678	678

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard deviations are in square brackets. Standard errors are in parentheses.



(a) Annual marriage rate



(b) Annual birth rate

Figure D.13: Annual marriage and birth: comparing the national average and the average in my sample