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While a simple time substitution effect (between television viewing and reproductive activities) is unlikely to be the primary driver, evidence suggests that digital terrestrial television facilitated more individualized viewing experiences through increased household television ownership. The findings point to a significant shift in gender roles following digital terrestrial television adoption: I observe an increase in female labor force participation and a more equitable division of domestic work, with men undertaking a larger share of lighter household tasks.

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Abstract

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JEL-Codes: J130, J160, L820, C230, D830.

Keywords: reproductive decisions, digital terrestrial television, media influence, difference-in-differences analysis.

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1 Introduction

The impact of mass media on social and economic outcomes has been widely studied, with evidence highlighting its influence on behaviors ranging from consumer choices to political preferences. In Italy, where television remains a dominant medium, individuals spend an average of three hours per day watching TV—a habit linked to shaping behaviors in areas such as consumption, education, and political participation (DellaVigna and La Ferrara, 2015). Given this substantial exposure, it is particularly relevant to explore the potential role of television in shaping critical demographic choices, including fertility. This issue is especially compelling in the context of Italy's severe demographic challenges. With a fertility rate of just 1.25 births per woman (2021)—far below the replacement level of 2.1—and a high life expectancy of 82.7 years (2021), the country faces significant population decline, raising pressing questions about the economic and social consequences of these trends.

In Italy, the law of November 29, 2007, No. 222, stipulated that the "transition to digital" (terrestrial) had to be completed by December 31, 2012, following a mandatory directive from the European Union (2007/65/EC). The introduction of Digital Terrestrial Television (DTT) marked a milestone in the Italian television landscape, representing the most significant innovation in the sector in recent decades. By abandoning the now obsolete analog signal, DTT brought with it a series of notable advantages. DTT allows for more efficient use of radio frequencies, enabling the transmission of a greater number of channels compared to analog. Digital terrestrial television provides a markedly better image and audio quality than analog, ensuring a more immersive and engaging viewing experience.

Before Italy's digital transition, its television landscape was notably centralized, dominated by a handful of major channels controlled by influential figures like Silvio Berlusconi. Channels such as Canale 5, Italia 1, and Rete 4, owned by Berlusconi's Mediaset, played a significant role in shaping public perception through entertainment-focused programming. The content on these channels often portrayed women in traditional, stereotypical roles, such as homemakers or decorative figures, contributing to the reinforcement of societal norms regarding gender roles and behaviors. Berlusconi's dual roles as a media tycoon and political figure allowed him to wield considerable influence over public discourse and cultural representation. This influence extended to shaping political narratives and societal attitudes, including those related to gender equality and the roles of women in Italian society.

The transition from analog to digital terrestrial television marked a significant shift in Italy's media landscape. It introduced a wider range of diverse channels and programming options, enabling users to select content that aligns more closely with their individual preferences. This greater variety facilitates exposure to alternatives to traditional gender stereotypes, potentially challenging established norms. By presenting diverse perspectives and representations, the expanded content spectrum may contribute to shifting societal attitudes and fostering a more nuanced understanding of gender roles.

The focus of this paper revolves around the causal analysis of the impact of the new digital television on newborns in Italian municipalities. Furthermore, this study contributes to the existing literature by examining the potential mechanisms through which television can influence the attitudes of its viewers. Exploring this relationship introduces several challenges in terms of identification. For instance, the decision to have children can significantly influence the amount of time parents spend watching television. Alternatively, television viewing habits might be correlated with unobservable characteristics, such as preferences, which also shape reproductive attitudes and behaviors. To address potential endogeneity concerns, this study employs a natural experiment that occurred during the transition from analog to digital terrestrial television in Italy.

The implementation of the analog-to-digital TV transition took place gradually across different provinces of Italy between October 2008 and July 2012. The division of the Italian territory into 16 areas, mostly corresponding to one or more regions, was based on the infrastructure conditions that originated from the post-war era. [1] Consequently, several new channels entered the television market, supplementing the existing seven traditional national free-to-air channels. To attract viewers, these new television channels had to differentiate themselves by focusing on lifestyle-related content.[2] The most commonly broadcasted programs on digital channels encompassed TV shows, movies, children's programs, and, to a lesser extent, sports, educational/historical programs, and lifestyle shows. As a result, the prime-time viewership shares of the six main traditional channels declined from approximately 82% in June 2008 to 60% in June 2012.[3] The impact of the Digital Reform extended beyond the market share loss for traditional channels, as it also led to the emergence of new channels.

The paper investigates the impact of television access on fertility rates in Italian municipalities, utilizing the transition from analog to Digital Terrestrial Television as an exogenous shock. The empirical strategy is based on a difference-in-differences approach. This approach not only compares

[1] The implementation of the transition program was contingent upon the conditions of post-war infrastructure, thereby eliminating the possibility for local authorities or television network owners to influence an earlier and potentially more advantageous transition for their respective areas of interest.

[2] Table A1 in the appendix provides an overview of the programs introduced with DTT and traces their evolution over time.

[3] http://www.auditel.it/

fertility decisions influenced by the digital transition across different years but also within municipalities before and after the digital transition. To address potential bias stemming from varying treatment effects across provinces, I employ a doubly robust estimator in this analysis. This estimator, as proposed by (Callaway and Sant'Anna, 2021), is applied to staggered event studies with heterogeneous treatment effects.

My analysis reveals a statistically significant negative effect of DTT adoption on fertility, particularly in areas with low pre-treatment fertility, fewer young couples with children, high population density, more taxpayers, and left-leaning political preferences. These findings suggest stronger impacts in urban, progressive areas, where communities were more receptive to the diverse content introduced by DTT. I explored two mechanisms behind this effect: a substitution between television viewing and reproductive activities, and a shift in gender norms due to diverse media exposure. While time spent watching TV increased only modestly among women, suggesting limited support for a substitution effect, increased television ownership—especially among childless couples—points to more individualized viewing experiences, likely amplifying exposure to diverse content and influencing societal attitudes.

These results enhance the broader understanding of how media access and content can shape demographic trends and individual behaviors, emphasizing the role of television in influencing societal outcomes. Given the influential role of media, regulators might consider monitoring and regulating content that significantly affects public health and societal trends. This could involve guidelines for broadcasting content related to family life, gender roles, and reproductive health.

This paper primarily contributes to two strands of literature. First, my paper belongs to the literature that studies the determinants of fertility and in particular its relationship with media. The effects of media on fertility decisions are influenced by various factors, including child-rearing expenses, labor market policies, and education (Mörk et al., 2013; Brewer et al., 2012; Milligan, 2005; Kalwij, 2010; Goldin and Katz, 2000; Brand and Davis, 2011). Labor market opportunities and job displacement also play a role (Jensen, 2012; Del Bono et al., 2012). Economic models explaining fertility decisions now consider neighborhood effects, income inequality, personal experiences, and cultural factors (Becker and Lewis, 1973; Kearney and Levine, 2014; Li and Zhang, 2009; Fernández and Fogli, 2006).

While previous studies have overlooked television, research in other fields suggests that television exposure can shape attitudes and behaviors relevant to fertility decisions (Morgan and Rothschild, 1983; Holbert et al., 2003; Becker, 2004; Chong and Ferrara, 2009). Recent attention has been given to the influence of television on fertility, particularly concerning family structure, women's status, and fertility decisions (Ferrara et al., 2012; Jensen and Oster, 2009; Bönisch and Hyll, 2023). However, there is limited evidence on the impact of television consumption on fertility in developed countries, where established development-related policies already affect fertility choices.

Secondly, I contribute to the literature investigating the impact of terrestrial digital television on viewers. The terrestrial digital television rollout had an impact on viewers' beliefs, political preferences, mental health, obesity, labor supply, and academic performance in Italy and the United Kingdom (Mastrorocco and Minale, 2018; Barone et al., 2015; Belloc, 2018; Castro and Nieto, 2019; Nieto and Suhrcke, 2021; Nieto, 2023)

The article is organized as follows. Section 2 describes the transition from analogical to digital TV. The construction of the dataset is reported in Section 3, while the empirical strategy is detailed in Section 4. Section 5 reports the main results and illustrates the heterogeneity, while, Section 6 studies the underlying mechanisms at play. Section 7 discusses the results obtained and Section 8 offers some concluding remarks.

2 From analogical to digital TV

Until 2007, Italy featured a notably concentrated television market.[4] Through the analog signal, viewers had access to seven national channels, with the six major channels collectively holding about 85% of the total TV viewing shares. The primary components of the Italian public broadcasting system (Rai) were Rai 1, Rai 2, and Rai 3, while the privately-owned trio of Rete 4, Canale 5, and Italia 1 was under the control of Mr. Berlusconi through his media conglomerate, Mediaset. A seventh channel, LA7, was also part of the landscape. Berlusconi's influence extended beyond ownership, with key executive appointments at both Mediaset and the public broadcaster. Evidence from Durante and Knight (2012) shows slanted coverage favoring his right-wing coalition on Mediaset channels, and a similar, though weaker, bias on public channels. Barone et al. (2015) confirm systematic media bias favoring Berlusconi's candidates. Furthermore, Durante et al. (2019) link early exposure to Mediaset's content with increased support for his party, suggesting long-term political effects. Padovani (2012) show that Berlusconi's media influence continued into the DTT transition, with Mediaset maintaining a strong ideological bias.

The Berlusconi government's policies on gender equality have also been the subject of analysis. The dominance of men in politics and the prevailing societal view of women primarily belonging to the domestic sphere (Lombardo and Del Giorgio, 2013) presented significant obstacles to progress.

[4]See among others Cornia (2016)

In contrast, center-left governments exhibited a greater commitment to gender equality issues. Furthermore, Berlusconi's media empire's portrayal of women was frequently criticized for being sexist and objectifying. The "velina" phenomenon (Hipkins, 2011) exemplifies this trend, with women reduced to decorative objects. His personal scandals, involving parties with showgirls and attempts to appoint them to political positions, further fueled criticism that he was turning Italian politics into a "beauty contest" (Hipkins, 2011). This media landscape prompted a public backlash from Italian women during the Berlusconi era, as documented by Benini (2012). Lorella Zanardo's 2009 documentary "The Body of Women" played a significant role in raising awareness and criticism of the media's portrayal of women as solely sexual objects.[5] [6] While there has been some progress in female representation within traditional media over the past two decades, rising from 7% in 1995 to 21% in 2015 (Azzalini and Padovani, 2015), the pace of change is insufficient to achieve gender parity. Furthermore, progress has been uneven across different media types. The proportion of women in radio news has increased significantly, but female representation in print and traditional TV news remains at 20%, below the global average of 24%.[7]

The Digital Reform's impact extended beyond the decline in market share for traditional channels. It also led to the emergence of new channels primarily airing TV shows, movies, children's programs, and, to a lesser extent, sports, educational/historical programs, and lifestyle shows. The transition to DTT significantly impacted both the public broadcaster RAI and private operators. RAI was forced to revamp its offerings, investing in new content and technologies to remain competitive in the evolving media landscape. Private operators also had to adapt, focusing on niche content creation and innovative services to attract and retain audiences. Discovery and Cairo Communication stand out among the major private operators. Despite having an initial market share of less than 2%, they have established a strong presence with successful channels like Focus, Dmax, Real-Time, Giallo, and La7.

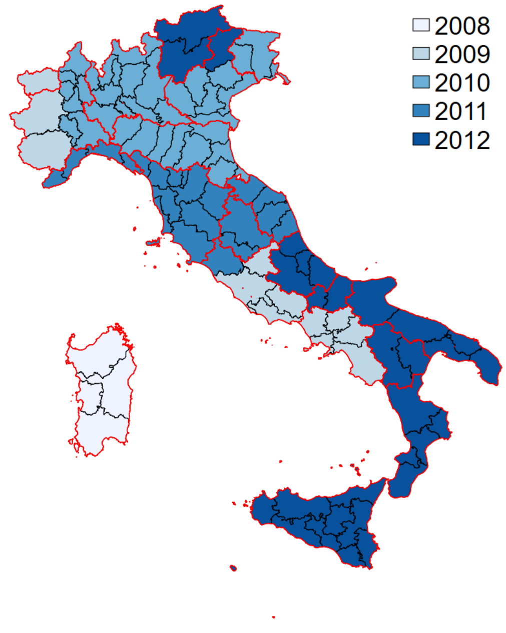
The introduction of DTT marked a major milestone in Italy's television landscape, representing the most significant innovation in recent decades. By replacing the obsolete analog signal, DTT offered several key advantages. It uses radio frequencies more efficiently, enabling the transmission of more channels, and provides superior image and audio quality, enhancing the viewing experience. DTT also introduced interactive services like Teletext, the Electronic Program Guide, and

[5] See the documentary here: https://www.youtube.com/watch?v=Y42hqlTmM00

[6] For some media coverage see https://www.theguardian.com/world/2009/sep/20/berlusconi-italian-women-backlash

[7] Female representation in print was 10% in 2005, 19% in 2010, and 22% in 2015. In radio, it was 13% in 2005, 14% in 2010, and 21% in 2015, while in traditional TV channels, the participation did not increase as much, being 16% in 2005, 22% in 2010, and only 20% in 2015.

Figure 1. *Timing switch-off across Italian regions Source: Italian Ministry of Communication.*



Timing switch-off across Italian regions Source: Italian Ministry of Communication.

On-demand content. Over time, it reduced operational and transmission costs for broadcasters, increasing market competitiveness. Additionally, DTT helped reduce the digital divide, making a wide range of channels and services accessible to even rural and remote areas.

The transition from analog to digital terrestrial television in Italy occurred gradually through a switch-off plan divided into 16 technical areas. The progressive discontinuation of the analog signal began in Sardinia in 2008 and concluded in December 2012 with the shutdown in Palermo. The transition was implemented gradually across different provinces following a mandatory directive from the European Union (2007/65/EC). The law of November 29, 2007, No. 222, stipulated that the "transition to digital" (terrestrial) had to be completed by December 31, 2012.

The division of Italy into 16 areas (see Figure 1), mostly corresponding to regions, was based on the similarity of infrastructures from the 1950s. This division ensured that the switch-off deadlines were determined objectively and couldn't be manipulated by local politicians or interest groups. This approach aimed to mitigate geographic disparities by alternating between northern and southern regions. When the transition took place in each region, the analog signal was deactivated, depriving households of access to old analog broadcasts on their televisions. To receive the new digital TV signal, families were required to acquire a decoder, which cost approximately 50 euros and was fully subsidized by the government through vouchers.

3 Data

In Italy, data on newborns are collected in a large administrative database known as the "Bilancio Demografico" (Demographic Balance), which is produced by ISTAT (Italian National Institute of Statistics). This extensive database encompasses data from approximately 8,000 Italian municipalities, covering a significant period from 2002 to 2018. The range and depth of these data allow for comprehensive and detailed analyses of demographic trends and patterns across the country. To obtain precise and reliable information at the municipal level, data from the 2001 Census is employed. The Census provides a large amount of detailed demographic information, which serves as a crucial foundation for municipal-level analyses. This data enables to accurate capture and understand demographic dynamics within individual municipalities, ensuring that the analyses are grounded in robust and comprehensive data.

In addition to demographic data, information concerning income is sourced from the Ministry of Economic and Financial Affairs. This income data is critical for understanding the economic conditions and disparities within and between different municipalities. By integrating income data with demographic information, possible interactions between economic factors and demographic trends can be examined, providing a greater understanding of the factors influencing population changes. Furthermore, to account for characteristics that vary over time at the provincial level, additional data is acquired from ISTAT.[8] This provincial-level data is essential for capturing temporal variations and trends that may not be evident at the municipal level.

In addition, the multi-purpose household survey, conducted by ISTAT, provides additional data that enriches the analysis. These data will be used to better understand the mechanisms underlying the main effect. This is because the survey collects a wide range of information on various aspects of household characteristics and behaviors, providing valuable context and additional dimensions to the demographic data.

Finally, again to better understand the possible mechanisms, I used data retrieved from ISTAT's Labor Force Survey. This provides official estimates of employment and unemployment, as well as detailed information on the main aggregates of labor supply, occupations, economic sectors, hours worked, types and durations of contracts, and educational attainment in Italy.

[8] Data sourced from the Demographic Indicators section of ISTAT's demo website.

4 Identification strategy

In this analysis, I leverage an identification strategy similar to that employed by Mastrorocco and Minale (2018). This approach shares some conceptual similarities with the framework adopted by Barone et al. (2015). Both studies exploit the introduction of DTT as an exogenous shock. They rely on the idiosyncratic nature of the DTT rollout to isolate its causal effects within their specific research contexts in Italy. To analyze the effects of the staggered implementation of DTT and capture the changes before and after its introduction, I employ a Difference-in-Differences (DID) approach. This method allows to compare the fertility rate in municipalities that received digital television access at different points in time, controlling for unobserved time-invariant factors that may influence television viewing and fertility decisions. The estimated equation is as follows:

$$Y_{mt} = \alpha + \gamma(\text{Post} \times \text{Treat}) + \eta C_{m2001} + \theta I_{mt} + \Lambda X_{pt} + \phi_m + \gamma_t + \epsilon_{mt} \tag{1}$$

Here, Y_{mt} represents the number of births in a specific year (t) per 1000 inhabitants (in $t-1$) for each municipality (m). The term Post $\times$ Treat is a binary variable that takes the value one when DTT implementation occurs in that municipality. Municipality and year fixed effects are denoted by ϕ_m and γ_t, respectively. The vector C_{m2001} includes 2001 Census controls. I_{mt} represents municipality-level total income, while X_{pt} includes province-level lagged variables. Standard errors are clustered at the municipality level. This empirical strategy hinges on the assumption that the switch-off deadlines are exogenous and not correlated with unobserved determinants of fertility after controlling for the aforementioned observable covariates, year-fixed effects, and municipality-fixed effects.

The classic DiD approach typically involves two groups (treated and control) over two time periods, estimating the average treatment effect on the treated (ATT) by comparing changes in outcomes from before to after the intervention. It relies on the parallel trends assumption, where, in the absence of treatment, the outcomes for treated and control groups would follow the same path over time. However, this traditional approach is not as well-suited to the staggered nature of DTT switch-off. The staggered DiD model extends this framework by incorporating multiple periods and allowing for the varying initiation of treatments across provinces.

I then proceed by estimating Equation 1 following the robust methodology proposed by Callaway and Sant'Anna (2021) to mitigate potential biases that may arise when using the classic Two-Way Fixed Effects-Difference in Differences method. Potential biases include the assumption that the treatment effect is homogeneous across units, resulting in negative weights for units treated in earlier periods but observed in later periods, and producing strange weights that are higher in the middle of the panel. The Callaway and Sant'Anna (CS) methodology addresses these issues by breaking down the problem into 2x2 DIDs, using only reliable comparisons. This approach identifies smaller causal effects and aggregates them using non-negative weights. This methodology is selected over the classic DiD design due to the variable timing of the DTT switch-off. The CS approach offers greater flexibility for heterogeneous treatment effects with variation in treatment time, minimal parallel trend assumptions to identify the ATT, and allows for the inclusion of covariates in a flexible form, different estimation procedures, and various aggregation schemes to summarize the treatment effects. By controlling for these variables, we aim to isolate the impact of DTT switch-off from municipality-specific demographic factors that could also affect fertility decisions. This ensures that the observed effects are attributable to DTT switch-off and not conflated with external influences. Furthermore, this analysis incorporates the assumption of the irreversibility of treatment. Once a municipality receives DTT, the effects of this intervention are considered permanent. The subsequent fertility rate trajectory is analyzed under the premise that the impact of DTT cannot be undone or reversed.

5 The effect of DTT on fertility

In Table 1, I report the primary aggregate results on the influence of DTT on fertility decisions estimated using the doubly robust DiD estimator based on stabilized inverse probability weighting and ordinary least squares. Following (Callaway and Sant'Anna, 2021), I present the dynamic aggregated treatment effect, which captures the treatment's impact over successive periods. This approach offers a more detailed understanding of how DTT influences fertility over time, providing a richer perspective than a simple average by reflecting the cumulative effect of the rollout.

The analysis begins with a model that includes only demographic controls from the 2001 Census, such as altitude, whether the municipality is a provincial capital, the share of the young population, education, study mobility, and female labor force participation. In model 2), I add total income at the municipality level, while model 3) incorporates province-level lagged variables such as marriage rate, female life expectancy at birth, natural growth rate, average age at childbirth, and migration rate. The results are negative and significant, with an effect size of approximately -0.5 in the first model, which has a control mean of about 8.8 newborns per 1000 inhabitants in T-1. Similar results found in models 2) and 3) reassure the robustness of these findings.

Given the staggered treatment, it is worth emphasizing the dynamic effect of DTT over time.

Table 1. *The effect of DTT on fertility*

Dep. variable:	Newborns per 1000 inhabitants in T-1		
	(1)	(2)	(3)
ATT	-0.503***	-0.495**	-0.392**
	(0.194)	(0.193)	(0.174)
Mean	8.834	8.833	8.824
Observations	69533	69481	68913
Census controls	yes	yes	yes
Municipality income	no	yes	yes
Province controls	no	no	yes
Pre Trend	-0.0358	-0.0371	-0.0744
	(0.111)	(0.111)	(0.0934)

*This table illustrates the doubly robust estimated effect of DTT on the Newborns per 1000 inhabitants in the previous year (T-1), robust standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included in column (1) are altitude, whether the municipality is a provincial capital, the share of the young population, education, study mobility, and female labor force participation. In column (2), total municipal income is added. Column (3) further incorporates lagged provincial-level variables, including the marriage rate, female life expectancy at birth, natural growth rate, average age at childbirth, and migration rate.*

Figure 2 presents the main estimates obtained in the study. The figure displays point estimates represented by dots, with the corresponding 95% confidence intervals depicted as shaded areas. Each panel presents estimation results using all three model specifications detailed in Table 1. The estimations are replicated for three different dependent variables measuring fertility: newborns per 1000 inhabitants in the previous year (T-1), newborns per 1000 fertile females in the previous year (T-1), and the inverse hyperbolic sine transformation of the number of newborns.[9]

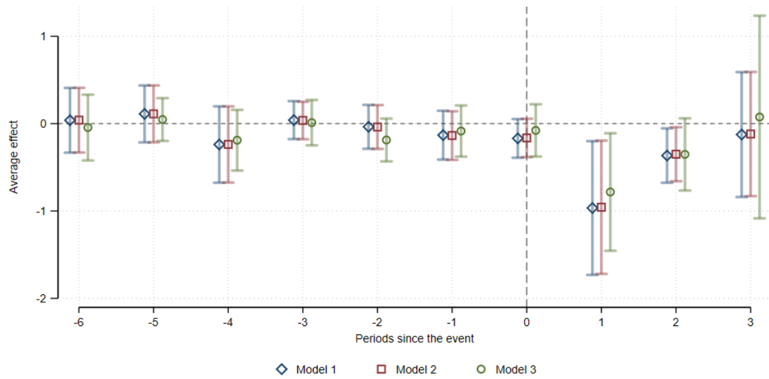
Panel a) of Figure 2 shows the estimates obtained using our main dependent variable: the number of newborns per 1000 inhabitants in that municipality the year before. Panel b) presents the results using the number of newborns per 1000 female inhabitants in that municipality the year before, while Panel c) shows the results using the inverse hyperbolic sine (IHS) transformation.

In all specifications, there is a clear decline in births in time T+1, which becomes weaker but still significant in the second period and reaches zero in the third period.[10] These findings align with similar analyses conducted in developing countries, where the introduction of television has been

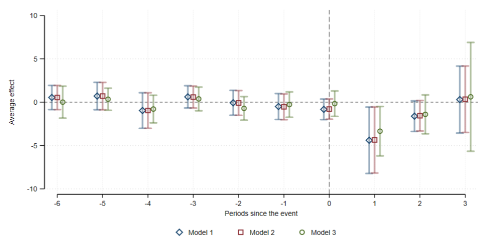
[9]The inverse hyperbolic sine is used for its ability to handle zero and negative values and is computed as follows: $\sinh^{-1}(y) = \ln(y + \sqrt{y^2+1})$. It shares similar properties with the logarithmic transformation, making it particularly useful in econometric analyses. Coefficients obtained from the IHS transformation can be interpreted similarly to those from a logarithmic transformation, indicating approximate percentage changes.

[10]The event study demonstrates a short-run impact, suggesting that the initial differences between treated municipalities dissipate once all areas have adopted the treatment. However, this does not indicate a reversion to baseline birth rates. Figure A1 presents the dynamics of the average number of newborns per 1000 inhabitants and per 1000 fertile females as a function of time since treatment. The observed change in the slope of the birth rate trend after treatment implementation in each municipality suggests a persistent effect on fertility beyond the immediate post-treatment period.

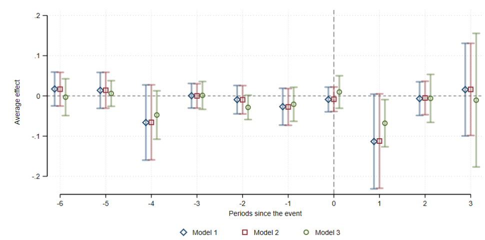
Figure 2. *Event study*



(a) *Newborns per 1000 inhabitants*



(b) *Newborns per 1000 fertile female*



(c) *IHS of newborns*

This figure presents event study estimates and 95% confidence intervals for the baseline specification. Dependent variables: (a) Newborns per 1000 inhabitants in the previous year (T-1); (b) Newborns per 1000 fertile females in the previous year (T-1); (c) Inverse hyperbolic sine transformation of the number of newborns. Controls: Model (1) includes altitude, a dummy for provincial capital status, the share of the young population, education levels, work-study mobility, and female labor force participation. Model (2) adds total municipal income. Model (3) further incorporates lagged province-level variables: marriage rate, female life expectancy at birth, natural growth rate, average age at childbirth, and migration rate.

associated with a decrease in birth rates. Hence, this result highlights the influence of television on birth rates in developed countries as well.[11] Since the difference-in-differences strategy relies on the identifying assumption that trends in fertility decisions would have been the same in treated and untreated municipalities in the absence of the treatment, it is reassuring that before the treatment takes place, none of the coefficients are different from zero. This supports our assumption and alleviates concerns about potential selection into the treatment. This finding reassures the validity of the causal inference, as the absence of pre-trends suggests that the treatment effect is exogenous and not driven by confounding factors.

Section A.1 ensure about the robustness of results by verifying the absence of confounding factors, confirming covariate balance, and validating the parallel trends assumption. Sensitivity

[11]To see the dynamic aggregated treatment effect look at table A3 and table A4 in the appendix

analyses show stable coefficients when excluding provinces or regions, while placebo tests with simulated treatments confirm no violations of assumptions. Additional robustness checks using Rambachan's methodology demonstrate that findings hold up to substantial deviations from parallel trends, confirming the reliability of the Difference-in-Differences framework.

5.1 Heterogeneity

The main result reveals a statistically significant negative impact of the DTT rollout on fertility rates. To investigate the heterogeneous nature of this effect, I conducted a comprehensive analysis across various dimensions within my dataset. I partitioned municipalities based on the distribution of socioeconomic characteristics. Specifically, I employed a median split approach, dividing the data into two groups—above and below the median—for each characteristic of interest, subsequently estimating my baseline model within these sub-samples.

My initial approach involved using 2002 birth data to categorize municipalities into low and high pre-treatment birth rate groups. Subsequently, I incorporated Census data to obtain insights into several key socioeconomic indicators: the proportion of young couples with children, gender disparities in higher education attainment, population density, and female employment rates. The results of the DTT impact estimates on fertility within these sub-samples are presented in Table 2.

The analysis reveals a statistically significant effect in municipalities characterized by low pre-treatment birth rates. When municipalities are divided based on the proportion of young couples with children, the effect remains statistically significant in both sub-samples, but is notably stronger in municipalities with a lower proportion of such couples. Furthermore, the effect is stronger and statistically significant in municipalities with higher population density and a smaller gender gap in higher education. Conversely, partitioning the sample based on female employment leads to a loss of both statistical significance and effect size.

Furthering my exploration of heterogeneity, I examined the role of socioeconomic and political characteristics to determine whether the DTT rollout had differential impacts across municipalities with varying profiles. I focused on two key economic indicators: the number of taxpayers per capita and income per taxpayer. Data on the distribution of these variables within municipalities was obtained from the Ministry of the Interior. To capture political characteristics, I utilized municipal-level data on political preferences from the 2006 national elections, also provided by the Ministry of the Interior. Again employing a median split, I categorized municipalities into those above and below the median for each political indicator and re-estimated my baseline model. The results of these estimations are detailed in Table 3.

Table 2. *Heterogeneity by demographic characteristics*

	Dep. variable: Newborns per 1000 inhabitants in T-1				
Splitting variables:	Birthrates	Young couples with children	Gender gaps in H. ed.	Pop Density	Female occupation
	(1)	(2)	(3)	(4)	(5)
Panel a.			**Above median**		
ATT	-0.234	-0.365***	-0.472	-0.936***	-0.153
	(0.160)	(0.137)	(0.337)	(0.301)	(0.223)
Mean	9.965	9.757	8.425	9.893	9.782
Observations	34981	34135	34965	35017	35053
Pre Trend	0.0997	0.161	-0.0916	-0.156	-0.0277
	(0.107)	(0.132)	(0.147)	(0.125)	(0.0986)
Panel b.			**Below median**		
ATT	-0.531**	-0.827***	-0.402**	-0.139	-0.197
	(0.253)	(0.315)	(0.176)	(0.176)	(0.134)
Mean	7.694	7.877	9.255	7.791	7.926
Observations	34666	34281	34945	34893	34484
Pre Trend	-0.0625	0.0967	0.0492	0.0286	-0.0398
	(0.142)	(0.146)	(0.0980)	(0.142)	(0.123)

*This table illustrates the doubly robust estimated effect of DTT on the Newborns per 1000 inhabitants in the previous year (T-1), robust standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included are altitude, whether the municipality is a provincial capital, the share of the young population, education, study mobility, and female labor force participation. Panel (a) illustrates the estimates obtained using observation above the median of the splitting variable, while Panel (b) shows the estimates using observation below the median of the splitting variable*

When the sample is partitioned by income level, statistical significance is lost in both sub-samples. However, when focusing on the number of taxpayers, the effect is stronger and statistically significant in municipalities with a higher number of taxpayers, mirroring the result observed for population density. The effect is also more pronounced and significant in municipalities with stronger vote preferences for center-left parties and weaker preferences for center-right parties. However, partitioning the sample based on voter turnout results in a loss of significance in both sub-samples.

In summary, my heterogeneity analysis indicates that households residing in left-leaning, high-density areas characterized by a large number of taxpayers experienced a more substantial decrease in fertility rates following the DTT introduction. Considering pre-existing fertility patterns, this effect is also stronger in areas with historically low fertility rates and a smaller proportion of young couples with children. These findings suggest that the DTT rollout had a greater impact in urban and more progressive areas, potentially exacerbating pre-existing inequalities in fertility rates.

Considering these heterogeneous effects, the observed impact on fertility is unlikely to be driven

Table 3. *Heterogeneity by political socio-economic characteristics*

	Dep. variable: Newborns per 1000 inhabitants in T-1				
Splitting variables:	Taxpayers	Income	Center-right	Center-left	Turnout
	(1)	(2)	(3)	(4)	(5)
Panel a.			**Above median**		
ATT	-0.702***	-0.160	0.0815	-0.916**	-0.302
	(0.231)	(0.249)	(0.294)	(0.426)	(0.253)
Mean	8.459	9.505	9.333	8.529	9.651
Observations	34927	34999	35305	32758	35325
Pre Trend	-0.159	-0.0564	-0.189	0.0392	0.00264
	(0.116)	(0.100)	(0.185)	(0.307)	(0.0991)
Panel b.			**Below median**		
ATT	-0.124	-0.240	-0.931**	-0.298	-0.275
	(0.186)	(0.169)	(0.405)	(0.193)	(0.205)
Mean	9.206	8.194	8.417	9.235	8.029
Observations	34395	34323	31545	34569	34211
Pre Trend	0.231	0.0251	0.0139	-0.0783	-0.154
	(0.144)	(0.144)	(0.291)	(0.171)	(0.133)

*This table illustrates the doubly robust estimated effect of DTT on the Newborns per 1000 inhabitants in the previous year (T-1), robust standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included are altitude, whether the municipality is a provincial capital, the share of the young population, education, study mobility, and female labor force participation. Panel (a) illustrates the estimates obtained using observation above the median of the splitting variable, while Panel (b) shows the estimates using observation below the median of the splitting variable*

by economic factors, a conclusion supported by the robustness checks presented in A.1, which demonstrate that these economic variables were not affected by the DTT rollout. Instead, the most pronounced differences are observed in municipalities where women may be less constrained by traditional family structures and social conservatism, such as those with high housing density, smaller gender gaps in higher education, and stronger support for progressive political parties. Finally, the lack of significance when partitioning by female employment suggests that women's labor market opportunities were not a primary driver of fertility decisions in the context of the DTT rollout.

6 Possible mechanisms

This section aims to provide a cohesive interpretation of the previously presented results by proposing a potential mechanism driving the observed impact of the DTT rollout on fertility. To this end, I introduce a new dataset and develop a framework for understanding the relationship between DTT adoption and fertility decisions. To investigate the potential mechanism underlying the DTT effect on fertility, I utilize data from the Italian National Statistical Institute's (ISTAT) annual Multipurpose Household Survey. This survey collects information on household opinions across a wide range of topics, while also gathering detailed data on family composition and housing characteristics. A specific module within the survey, "Aspects of Daily Life," provides granular insights into the daily activities of individuals and households. This representative survey also collects detailed information on demographics, house labor participation, education, and media consumption habits. The survey is conducted annually in March using a repeated cross-sectional design, representative of the Italian population at the regional level. The sample comprises approximately 48,000 individuals each year, corresponding to roughly 19,000 households. To capture the period of the DTT rollout and its potential consequences, I harmonized and merged data spanning from 2006 to 2015.

Given the observed negative effect of DTT on fertility, I propose two potential underlying mechanisms. The first is a substitution effect between television viewing and activities related to reproduction. This suggests that individuals may have reallocated time from activities potentially conducive to reproduction to increased television consumption. The second hypothesis posits that exposure to new media content facilitated by DTT may have influenced prevailing gender norms, leading to changes in family planning decisions and ultimately contributing to reduced fertility.

The first explanation centers on the idea that the advent of digital terrestrial television might have triggered a substitution effect. The expanded channel offerings and improved viewing experience associated with DTT could have attracted a larger television audience, leading individuals to spend more time watching television and consequently less time on activities related to family formation. To analyze this potential time reallocation, I focus on the amount of time individuals spent watching television, using microdata from the Multipurpose Household Survey to assess changes in television consumption patterns following the introduction of DTT. This allows for a direct examination of whether DTT adoption in related with increased television viewing, particularly among specific demographic groups.

Table 4 presents the results of a Difference-in-Differences analysis using the doubly robust DiD estimator to account for potential issues related to staggered treatment adoption. In column (1), I focus specifically on families of childbearing age (defined as those in which the woman is between the ages of 18 and 55). In column (2), I restrict the sample to childless couples, as this group represents those actively considering or postponing family formation. Finally, in column (3), I present results for childless couples. This allows for a comparison between the broader group of childbearing-age families and the more specific group of childless couples, potentially revealing heterogeneous effects

Table 4. *Time substitution - Minutes spent watching TV during the day*

	Dep. variable: Minutes spent watching TV during the day		
Splitting variables:	Whole fertile households	No child couple	1 child couple
	(1)	(2)	(3)
Panel a.		**Whole sample**	
ATT	1.414	-4.795	1.720
	(1.713)	(4.806)	(1.859)
Mean	166.9	174.1	164.6
Observations	91883	12293	73197
Pre Trend	0.610	6.055	0.621
	(1.464)	(3.896)	(1.616)
Panel b.		**Below 35 years**	
ATT	0.101	-5.308	-0.458
	(2.515)	(7.287)	(2.653)
Mean	170.0	168.2	170.1
Observations	43283	4846	37438
Pre Trend	-1.490	-2.373	0.127
	(2.182)	(6.109)	(2.436)
Panel c.		**Above 35 years**	
ATT	2.701	-1.001	3.633*
	(1.904)	(6.095)	(2.015)
Mean	165.7	178.4	162.4
Observations	71033	7879	58315
Pre Trend	1.140	9.192*	-0.0170
	(1.712)	(5.013)	(1.821)

*This table illustrates the doubly robust estimated effect of DTT on the minutes spent watching television, standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included are household size; gender, education, no household, couple without children, single mother, age, inactive, unemployed, self-employed income, employed income and maintained income dummies.*

within these populations

However, my analysis did not reveal statistically significant differences in television viewing time between treated and untreated individuals. Furthermore, even when focusing specifically on young families or families with children, no clear patterns emerged. The only exception is observed within families where the woman is older than 35 and has a child. For this specific subgroup, a statistically significant effect is found at the 10 percent level, but the magnitude of the effect is very small, amounting to only 3.6 minutes out of an average daily viewing time of 162.4 minutes. This small effect size suggests that the DTT rollout did not substantially alter television viewing habits even within this specific demographic.

To gain a more nuanced understanding of the potential changes in television viewing behavior

Table 5. *Time substitution - Minutes spent watching TV during the day by gender and age*

	Dep. variable: Minutes spent watching TV during the day				
Splitting variables:	Whole fertile households	18-24	25-34	35-44	45-55
	(1)	(2)	(3)	(4)	(5)
Panel a.			**Male**		
ATT	0.0150	-2.202	3.506	0.222	-3.775
	(2.018)	(6.107)	(4.051)	(3.412)	(3.699)
Mean	150.1	155.4	148.6	147.4	152.0
Observations	49866	6701	12152	15945	14406
Pre Trend	2.779	-0.165	1.301	6.737^{**}	1.971
	(1.813)	(5.479)	(3.718)	(3.051)	(3.422)
Panel b.			**Female**		
ATT	3.975^{*}	-3.685	6.229	8.583^{**}	0.666
	(2.412)	(6.413)	(4.549)	(3.943)	(4.443)
Mean	170.5	170.6	167.0	164.5	180.0
Observations	47725	6516	12123	16303	15215
Pre Trend	-0.407	0.0309	-3.542	-1.291	3.734
	(2.076)	(6.606)	(4.055)	(3.405)	(3.953)

*This table illustrates the doubly robust estimated effect of DTT on the minutes spent watching television, standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included are household size; gender, education, no household, couple without children, single mother, age, inactive, unemployed, self-employed income, employed income and maintained income dummies.*

within Italian households, I disaggregated the sample by gender and further divided it into narrower age groups. I then replicated the previous estimations, again using minutes spent watching television as the dependent variable. This approach allows for a more granular examination of potential heterogeneous effects across genders and age cohorts. Table 5 presents the results of this refined difference-in-differences analysis using utilize the doubly robust DiD estimator to address potential issues arising from staggered treatment adoption across different regions. Panel a. of Table 5 reports the results for males, while Panel b. presents the corresponding results for females. Within each panel, I further stratify the analysis by age group. Column (1) focuses on individuals of childbearing age, defined as those in the 18-55 age range. Column (2) narrows the sample to individuals aged 18-24, representing the youngest cohort potentially considering family formation. Column (3) presents results for individuals aged 25-34, a key period for family building. Column (4) focuses on those aged 35-44 and column (5) includes individuals aged 45-55 representing individuals who are approaching the end of their reproductive years. This stratified analysis allows me to assess whether the potential substitution effect, whereby time is reallocated from reproductive activities to television viewing, varies significantly across different age groups and between genders.

The results presented in Table 5 reveal no significant change in television viewing time for males following the DTT rollout. However, there appears to be a small increase in television consumption among females, averaging approximately 4 minutes compared to an average daily viewing time of 170 minutes. The most pronounced effect is observed within the 35-44 age group, where there is an increase in TV viewing of 8.5 minutes. These findings suggest that any change in television viewing time is primarily attributable to women, although the magnitude of this change remains relatively small. These results indicate that a simple substitution effect—where time is directly reallocated from reproductive activities to television viewing—does not appear to be the primary mechanism driving the observed fertility decline. However, they do suggest a subtle shift in women's approach to television.

While the previous analysis suggests a limited change in the overall time women dedicate to television, the nature of this change may extend beyond mere time allocation to encompass the type of content consumed. The increase in available broadcast channels brought about by DTT may have provided women with a wider selection of content, allowing them to find programming more aligned with their specific interests.

Given that domestic television consumption, particularly during prime time, is often influenced by the preferences of men and children, the technological innovations introduced by DTT may have contributed to a loosening of the rigid patterns of TV usage that traditionally structure daily family life (Moseley et al., 2016). The ability to independently access preferred channels may have reduced exposure to potentially sexist content prevalent in traditional media for those individuals seeking alternative programming that was previously unavailable. This interpretation aligns with the heterogeneity results, which indicate that households residing in areas with historically low fertility rates, a smaller proportion of young couples with children, and left-leaning, high-density areas characterized by a large number of taxpayers experienced a more substantial decrease in fertility rates following the DTT introduction.

Consequently, I propose a second hypothesis regarding the underlying mechanism: greater access to diverse role models and narratives less rooted in patriarchal norms, facilitated by the increased channel availability of DTT, may have contributed to shifting gender norms and, consequently, impacting fertility decisions. This hypothesis suggests that the change is not about simply spending more time watching television, but about the content being consumed and its potential influence on attitudes and beliefs.

To test this hypothesis, I first investigate whether DTT indeed expanded viewers' ability to choose their preferred channels independently, rather than being limited to shared family viewing.

Table 6. *The effect of the DTT rollout on the number of TV sets at home*

	Dep. variable: Tv sets at home		
Splitting variables:	Whole fertile households	No child couple	Couple with child
	(1)	(2)	(3)
Panel a.		**Whole sample**	
ATT	0.0444**	0.114**	0.0148
	(0.0224)	(0.0575)	(0.0276)
Mean	1.828	1.637	1.940
Observations	52953	7648	38389
Pre Trend	-0.0348	-0.0641	-0.0324
	(0.0216)	(0.0523)	(0.0272)

*This table illustrates the doubly robust estimated effect of DTT on the number of TV sets per household, standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included are household size; gender, education, no household, couple without children, single mother, age, inactive, unemployed, self-employed income, employed income and maintained income dummies.*

An increase in the number of televisions per household would provide supporting evidence for the idea that DTT facilitated more individualized viewing experiences, allowing household members to watch different content simultaneously. To directly investigate this, I utilize the Multipurpose Household Survey data to examine whether there was a change in the number of televisions owned within families following the DTT rollout. The dependent variable in this analysis is the number of TV sets reported by each household.

Table 6 presents the results of a Difference-in-Differences analysis, employing the doubly robust DiD estimator to address potential issues related to staggered treatment adoption. In column (1), I focus specifically on families of childbearing age, defined as those in which the woman is between the ages of 18 and 55. In column (2), I restrict the sample to childless couples. Finally, in column (3), I present results for childless couples.

It can be seen from Table 6 that treated families tended to increase their ownership of televisions, and this effect is notably stronger for couples without children. These results support the second hypothesized mechanism, confirming that DTT broadened viewers' ability to independently choose preferred content by prompting families to acquire additional televisions, enabling simultaneous viewing of different channels within households.

To further test my second hypothesis regarding the underlying mechanism—that DTT exposure influenced attitudes towards gender norms—I examine several factors related to gender roles within Italian society. One significant phenomenon closely linked to gender stereotypes in Italy is the traditionally low participation of men in housework and the consequent disproportionate burden of domestic responsibilities falling on women. Research by Kan et al. (2011) demonstrates a substantial divergence in domestic work participation (cooking, cleaning, and laundry) between males and females in Italy. Furthermore, Signorielli and Kahlenberg (2001) notes that rigid gender stereotypes regarding appropriate domestic and work roles can be particularly detrimental for women seeking to balance both career and family life.

Using the Multipurpose Household Survey data, I analyzed domestic labor dynamics before, during, and after the transition to DTT. This allows for a direct examination of potential shifts in household labor division following the DTT rollout. Table 7 presents the results of a Difference-in-Differences analysis utilizing the doubly robust DiD estimator.

Panel a. of Table 7 displays the results using the full sample. Panel b. presents results specifically for males, while Panel c. shows the corresponding results for females. Within each panel, I examine several dimensions of domestic work. Column (1) uses minutes spent per week on domestic work as the dependent variable, providing a measure of the overall time commitment to household tasks. Column (2) utilizes a dummy variable indicating the prevalence of light work in domestic activities (e.g., dusting, tidying), while Column (3) uses a dummy variable identifying the prevalence of heavy work (e.g., cleaning, laundry). Finally, Column (4) reports the weekly hours of any paid domestic worker employed by the household. This comprehensive approach allows for a detailed analysis of potential changes in the division of household labor and the reliance on external domestic help following the DTT rollout.

Table 7 presents a detailed analysis of the impact of the DTT rollout on domestic labor dynamics. The results indicate no significant effect on the aggregate time spent on housework. However, when disaggregated by gender, a positive and significant effect is observed for males, indicating that men increased their time spent on housework. Conversely, there is a negative and significant effect for females, suggesting that women decreased their time spent on housework. Additionally, there is a notable positive and significant increase in the prevalence of light housework tasks both in aggregate and for each gender separately. This implies that both men and women have become more engaged in lighter domestic chores following the DTT rollout. In contrast, no significant effect is found for heavy housework tasks, indicating that the transition to digital terrestrial television has not influenced the distribution of more strenuous domestic work. Finally, regarding the employment of domestic workers, the analysis shows no significant effect overall. However, there is an exception for men, where a significant increase in the usage of domestic workers is observed. This suggests that men are more likely to employ domestic help following the DTT rollout, possibly to balance the increased time they spend on housework with their other responsibilities.

Table 7. *The effect of the DTT rollout on the domestic labor attitudes*

Dep. variables:	Domestic work	Low physical activity DW	High physical activity DW	Domestic helper
	(1)	(2)	(3)	(4)
Panel a.		**Whole Sample**		
ATT	-5.358	0.0225***	-0.00248	0.0305
	(10.06)	(0.00590)	(0.00447)	(0.0381)
Mean	946.3	0.281	0.129	0.490
Observations	235349	174894	174894	273740
Pre Trend	0.677	0.0193***	-0.00235	-0.0113
	(9.524)	(0.00562)	(0.00415)	(0.0352)
Panel b.		**Male**		
ATT	25.52***	0.0386***	0.000892	0.104**
	(8.513)	(0.0115)	(0.00436)	(0.0525)
Mean	347.7	0.471	0.0390	0.482
Observations	112880	66649	66649	133758
Pre Trend	5.987	0.0324***	-0.00655*	-0.0309
	(8.297)	(0.0106)	(0.00394)	(0.0470)
Panel c.		**Female**		
ATT	-28.96*	0.0126**	-0.00353	-0.0372
	(17.31)	(0.00629)	(0.00677)	(0.0562)
Mean	1507.2	0.165	0.183	0.498
Observations	121678	108245	108245	139982
Pre Trend	-2.027	0.0113*	-0.000494	0.0113
	(16.22)	(0.00608)	(0.00642)	(0.0520)

*This table illustrates the doubly robust estimated effect of DTT, standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - Dependent variables: (1) Domestic work (2) low physical activity domestic work (3) high physical activity domestic work (4) have a domestic helper. The controls included are household size; gender, education, no household, couple without children, single mother, age, inactive, unemployed, self-employed income, employed income and maintained income dummies.*

6.1 Evidence from provincial level data

To further investigate the potential influence of DTT on gender roles within Italian society, I extend the analysis to other relevant factors beyond domestic labor. These factors, including female labor force participation, the average number of children per mother, the marriage rate, and the average age at childbirth, are also influenced by prevailing gender stereotypes and provide a broader picture of societal changes.

To this end, I utilize data at the provincial level from two primary sources. First, I draw data from the Demographic Indicators section of ISTAT's demo website, which provides comprehensive demographic information at the provincial level. Second, I utilize data extracted from the ISTAT

Table 8. *Evidence at provincial level*

	(1)	(2)	(3)
Panel a.		**Labor Force Participation**	
Dep. variables:	Participation rate	Female participation	Women VS Men
ATT	0.00107	0.00717**	0.0190**
	(0.00644)	(0.00323)	(0.00854)
Mean	0.436	0.401	0.675
Observations	808	808	808
Pre Trend	-0.00133	0.00456	0.0121
	(0.00249)	(0.00289)	(0.00790)
Panel b.		**Demographic characteristics**	
Dep. variables:	N. of children	Marriage rate	Age at childbirth
ATT	-0.0188**	0.0982	0.0908**
	(0.00945)	(0.0939)	(0.0392)
Mean	1.350	4.068	31.00
Observations	824	824	824
Pre Trend	0.0133	-0.108**	-0.0391
	(0.0102)	(0.0489)	(0.0467)

*This table illustrates the doubly robust estimated effect of DTT, standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - Dependent variables: in panel a. (1) total participation rate, (2) female participation rate and (3) women-to-men ratio in labor force; in panel b. (1) the average number of children per mother, (2) the marriage rate and (3) the average age at childbirth. The controls included are lagged variables: Marriage rate per thousand population, total life expectancy at birth, mortality rate per thousand inhabitants, and total migration balance per thousand inhabitants.*

Labor Force Survey. This survey provides official estimates of employment and unemployment figures, along with detailed information on key labor supply aggregates, occupations, economic sectors, working hours, contract types and durations, and educational attainment in Italy.[12]

Therefore, I analyze the average number of children per mother, the marriage rate, and the average age at childbirth at the provincial level to estimate the effect of the DTT rollout on broader fertility behaviors and on gender-based disparities in labor participation. This approach allows me to explore the potential for DTT to have impacted not just the timing of births, as previously discussed, but also the overall desire for children and the social context surrounding family formation. Furthermore, examining labor force participation provides insight into how DTT might have influenced women's roles in the workforce, which is closely intertwined with gender stereotypes.[13]

Table 8 presents the results of a Difference-in-Differences analysis, using the doubly robust DiD estimator.

[12] Data is collected directly by ISTAT through quarterly interviews with a representative sample of approximately 60,000 households, encompassing 110,000 individuals residing in Italy, even if temporarily abroad.

[13] Scanzoni (1982) posit that observing women in lower-status positions than men in workplace and domestic settings perpetuates gender stereotypes.

In Panel a. of Table 8, column (1) presents the Difference-in-Differences results using the overall labor force participation rate as the dependent variable. Column (2) reports the female labor force participation rate, and column (3) presents the women-to-men ratio in the labor force. As expected, there is no significant effect on the overall participation rate, as DTT would primarily affect the distribution of participation between genders, not necessarily the overall level. However, for the gender-specific parameters (female participation rate and the women-to-men ratio), the effect is positive and statistically significant. This indicates that DTT adoption led to an increase in female labor force participation relative to male participation. In Panel b., we observe that DTT led to a decrease in the average number of children per mother and an increase in the mother's age at childbirth, but no statistically significant effect on the marriage rate at the provincial level.

These results indicate an increase in female labor force participation in provinces covered by digital terrestrial television, providing suggestive support for the hypothesized mechanism driving the main results. On one hand, these findings are consistent with existing literature on fertility and labor participation in Italy.[14] On the other hand, the general desire to have children appears to be decreasing, and the choice to have children seems to be postponed by mothers, reinforcing the trend of delayed childbearing.

7 Discussion

The mechanism results strongly suggest that the second proposed mechanism—that exposure to DTT influenced attitudes toward gender norms, empowering women, and affecting career aspirations and household workload—provides the most compelling explanation for the observed effects. These findings, combined with the results from the Multipurpose Household Survey, offer converging evidence for this mechanism.

The observed increase in female labor force participation aligns with existing research demonstrating a link between female employment and delayed childbirth in Italy, further suggesting a potential influence on fertility rates. A notable shift has also emerged in the division of domestic work. While the total time spent on housework remained relatively stable, the gender distribution of this labor changed. Men undertook a greater share of light housework, indicating a move toward a more equitable division of household responsibilities. This shift was facilitated by the increased

[14] Caltabiano (2016) found that female employment, which significantly increased in Italy during the 1990s and 2000s, was positively related to fertility postponement. The turning point in Italian fertility was closely linked to the innovative behaviors of more educated women, who were the first to postpone births and union formation in Italy. As this behavior became widespread, the effect of education weakened.

supply of channels and the subsequent rise in the number of televisions available within households, allowing individuals to access content more aligned with their personal interests. This interpretation aligns with the heterogeneity results, which indicate that households residing in areas with historically low fertility rates, a smaller proportion of young couples with children, and left-leaning, high-density areas characterized by a large number of taxpayers experienced a more substantial decrease in fertility rates following the DTT introduction.

By increasing the diversity of media content, the transition to DTT likely influenced prevailing gender norms and fertility decisions. The dilution of potentially sexist content from traditional channels allowed for greater exposure to less patriarchal role models, which research suggests can promote counter-stereotypical behaviors and aspirations (Olsson and Martiny, 2018; Pingree, 1978; Pike and Jennings, 2005). As Knobloch-Westerwick et al. (2016) shows, media representations of professional women correlate with delayed childbearing and career focus, while portrayals of traditional homemakers reinforce traditional family values. While individual factors moderate these effects (Lauzen et al., 2008), the shift towards more diverse media representations facilitated by DTT likely played a role in the observed changes in fertility-related behaviors.

In conclusion, the case of Italian DTT highlights the significant potential of media to influence social norms and contribute to shifts in gender equality. The increased availability of diverse content challenged traditional representations of women, potentially weakening previously reinforcing stereotypes.

8 Conclusions

This study investigates the causal impact of the transition from analog to digital terrestrial television (DTT) on fertility rates in Italy. Leveraging the staggered implementation of DTT between 2008 and 2012, I identify a statistically significant negative effect on fertility within treated municipalities. This transition provides a unique natural experiment, offering insights into how changes in media consumption can influence broader societal behaviors, particularly regarding family planning and fertility decisions. The expansion of television channels and the increased diversity of content facilitated by DTT plausibly altered viewers' attitudes and behaviors.

The empirical strategy employed, based on a difference-in-differences framework, allows for a robust analysis of the causal link between the DTT transition and fertility. By comparing fertility rates before and after the digital switchover across different municipalities, I control for various confounding factors, ensuring that the observed effects can be attributed to the changes in television access and content. The use of the doubly robust estimator further strengthens the validity of the findings by mitigating potential biases arising from heterogeneous treatment effects.

My analysis reveals a statistically significant negative effect of DTT adoption on fertility, particularly pronounced in areas characterized by low pre-treatment fertility rates, a smaller proportion of young couples with children, high population density, a large number of taxpayers, and left-leaning political preferences. These heterogeneous effects indicate that the impact of DTT was not uniform across the population, with more substantial effects observed in urban, progressive areas. This suggests that communities more attuned to progressive social issues, such as gender equality and education, were also more receptive to the diverse programming and content made available by DTT.

I explored two potential mechanisms driving this observed effect: a substitution effect between television viewing and activities related to reproduction, and a shift in gender norms due to exposure to more diverse media content. My analysis of time spent watching television revealed only a modest increase among women. This suggests that a simple time substitution effect is unlikely to be the primary driver of the observed fertility decline. However, I found evidence of increased television ownership within households, especially among childless couples. This finding suggests that DTT facilitated more individualized viewing experiences, potentially enabling greater exposure to diverse content.

Crucially, my findings suggest a significant shift in gender roles following the DTT rollout. I observed an increase in female labor force participation and a move towards a more equitable distribution of domestic work, with men taking on a larger share of light housework. These changes suggest that DTT, by increasing the diversity of available media content, may have contributed to challenging traditional gender stereotypes and empowering women in both their professional and domestic lives. This interpretation is consistent with existing literature highlighting the influence of media on gender role perceptions and aspirations. The dilution of potentially sexist content from traditional channels, coupled with the emergence of new channels offering diverse narratives and role models, likely played a crucial role in this shift.

In conclusion, this study provides compelling evidence that the DTT rollout in Italy had significant social and cultural consequences beyond its technological and economic impacts. By facilitating access to more diverse media content, DTT appears to have contributed to shifts in gender norms, influencing female labor force participation, the division of domestic work, and ultimately, fertility decisions. This analysis suggests that media innovations, while often considered primarily in terms of their technological and economic impacts, can also have profound and lasting social and cultural consequences, impacting fundamental aspects of society such as gender roles, family structures, and individual aspirations. Future research could explore the long-term effects of these changes and investigate similar phenomena in other contexts undergoing media transformations.

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A Appendix

Table A1. *Available channels in Italy 2010-2012*

Name of the Channel	**Owner**	**Analog**	**Digital**	**Content**	**Avl. in 2010**	**Avl. in 2011**	**Avl. in 2012**
Rai 1	RAI	X		General	X	X	X
Rai 2	RAI	X		General	X	X	X
Rai 3	RAI	X		General	X	X	X
Rai 4	RAI		X	Children	X	X	X
Rai 5	RAI		X	Culture	X	X	X
Rai Sport 1	RAI		X	Sport	X	X	X
Rai Sport 2	RAI		X	Sport	X	X	X
Rai News 24	RAI		X	News	X	X	X
Rai Scuola	RAI		X	Culture	X	X	X
Rai Storia	RAI		X	Culture	X	X	X
Rai gulp (also +1)	RAI		X	Children	X	X	X
Rai movie	RAI		X	Movie	X	X	X
Rai premium	RAI		X	General	X	X	X
Rai yoyo	RAI		X	Children	X	X	X
Rai HD	RAI		X	General	X		
Canale 5 (also +1 and HD)	Mediaset	X	X	General	X	X	X
Italia 1 (also +1 and HD)	Mediaset	X	X	General	X	X	X
Rete 4 (also +1)	Mediaset	X	X	General	X	X	X
Boing (also +1)	Mediaset		X	Children	X	X	X
Iris	Mediaset		X	Culture/ Movie	X	X	X
La5	Mediaset		X	Woman's	X	X	X
Mediaset Extra	Mediaset		X	General	X	X	X
ME	Mediaset		X	Shopping	X		
TG Mediaset	Mediaset		X	News	X		
La7	Telecom Italia Media	X		General	X	X	X
La7D	Telecom Italia Media		X	Woman's	X	X	X
MTV	Telecom Italia Media	X		Music	X	X	X
MTV Music	Telecom Italia Media		X	Music	X	X	X

Table A1. *Available channels in Italy 2010-2012*

Name of the Channel	**Owner**	**Analog**	**Digital**	**Content**	**Avl. in 2010**	**Avl. in 2011**	**Avl. in 2012**
Odeon 24	Profit Group	X		General	X	X	
Canale Italia	Canale Italia	X		General	X	X	
7Gold	Italia 7 Gold			General	X	X	
TG Norba 24	Telenorba		X	News	X		
Cielo	Sky Italia		X	General	X	X	X
Real Time (also +1)	Discovery		X	Lifestyle	X	X	X
Nuvolari	SitCom		X	Cars	X	X	
K2	Switchover		X	Children	X	X	X
Frisbee	Switchover		X	Children	X	X	X
Poker Italia 24	Magnolia		X	Sport	X		
Rtl 102.5	RTL		X	Music	X		
Coming Soon	Anica		X	Movie	X	X	X
Class News	Class		X	News	X	X	X
SportItalia	Interactive		X	Sport	X	X	X
SportItalia2	Interactive		X	Sport	X	X	X
SportItalia24	Interactive		X	Sport	X	X	X
QVC	QVC		X	Shopping	X		
Wedding TV	Wedding tv		X	Woman's		X	
Deejay TV	Gr. Editoriale L'Espresso		X	Music		X	X
DMAX	Discovery		X	Man's		X	X
Italia 2 Mediaset	Mediaset		X	Children		X	X
Repubblica TV	Gr.Editoriale L'Espresso		X	News		X	X
TG Norba 24	Telenorba		X	News		X	
TgCom24	Mediaset		X	News		X	X
Focus	Switchover/ Discovery		X	Culture			X
Giallo	Switchover/ Discovery		X	Culture			X

Source: AGCOM, Relazione annuale, various issues. Digital includes DTT, satellite and IPTV. HD denotes that the channel was available in both low and high-definition formats, whereas +1 indicates the presence of an additional channel broadcasting the same content with a one-hour delay

Table A3. *IHS*

Dep. variable:	Inverse hyperbolic sine of newborns		
	(1)	(2)	(3)
ATT	-0.0488*	-0.0479*	-0.0230
	(0.0290)	(0.0289)	(0.0188)
Mean	3.768	3.768	3.761
Observations	77303	77243	68913
Census controls	yes	yes	yes
Municipality income	no	yes	yes
Province controls	no	no	yes
Pre Trend	-0.0118	-0.0119	-0.0154
	(0.0197)	(0.0197)	(0.0138)

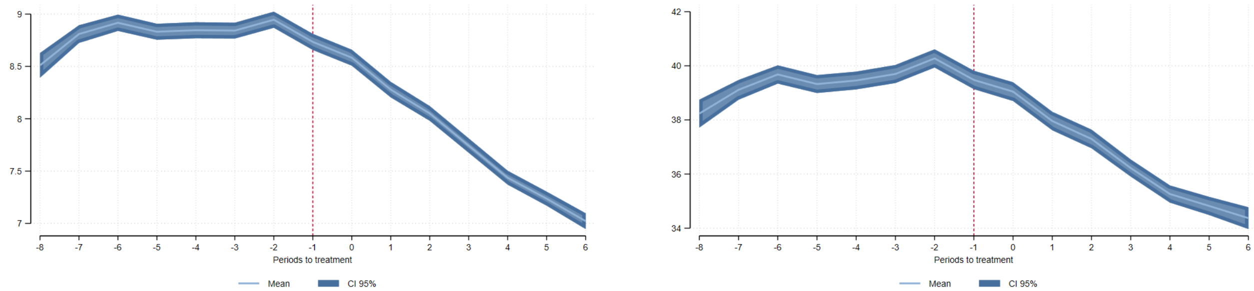
*This table illustrates the doubly robust estimated effect of DTT on the Inverse hyperbolic sine transformation of the number of newborns, robust standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included in column (1) are altitude, whether the municipality is a provincial capital, the share of the young population, education, study mobility, and female labor force participation. In column (2), total municipal income is added. Column (3) further incorporates lagged provincial-level variables, including the marriage rate, female life expectancy at birth, natural growth rate, average age at childbirth, and migration rate.*

Table A4. *Newborns per 1000 fertile females inhabitants in T-1*

Dep. variable:	Newborns per 1000 fertile females in T-1		
	(1)	(2)	(3)
ATT	-2.286**	-2.249**	-1.590**
	(0.982)	(0.978)	(0.780)
Mean	39.50	39.50	39.47
Observations	69533	69481	68913
Census controls	yes	yes	yes
Municipality income	no	yes	yes
Province controls	no	no	yes
Pre Trend	0.0542	0.0407	-0.178
	(0.534)	(0.532)	(0.457)

*This table illustrates the doubly robust estimated effect of DTT on the Newborns per 1000 fertile females in the previous year (T-1), robust standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included in column (1) are altitude, whether the municipality is a provincial capital, the share of the young population, education, study mobility, and female labor force participation. In column (2), total municipal income is added. Column (3) further incorporates lagged provincial-level variables, including the marriage rate, female life expectancy at birth, natural growth rate, average age at childbirth, and migration rate.*

Figure A1. *Newborns evolution*



(a) *Newborns per 1000 inhabitants in T-1*

(b) *Newborns per female 1000 inhabitants in T-1*

A.1 Robustness checks

In this section, a comprehensive analysis is undertaken to substantiate the credibility of the previous results and the foundational assumptions upon which they are base.

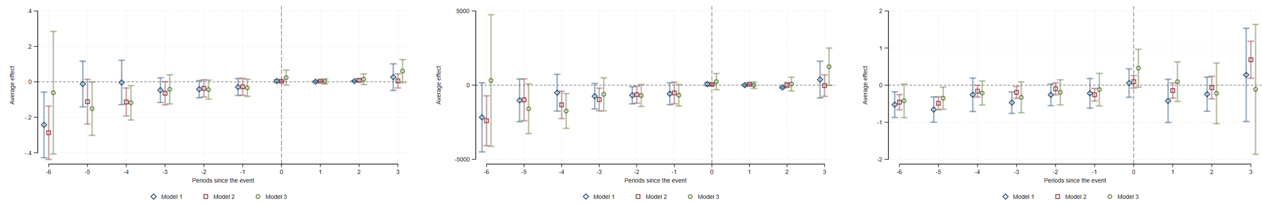
It is essential to first demonstrate that no other confounding factors are present that could compromise the interpretability of the results by polluting the distinct effects of individual variables. Specifically, if variables such as gross total income, number of taxpayers, and death rates exhibit significant coefficients in relation to the treatment of interest—the DTT rollout—they may introduce ambiguity in causal inference. To address this concern, it is essential to ensure that the DTT rollout does not produce coefficients significantly different from zero across all tested outcomes. Accordingly, I undertake a rigorous examination of these variables to confirm that the treatment does not significantly affect them, thereby preserving the clarity and validity of the empirical findings.

This exercise is carried out following the intuition outlined in Pei et al. (2019), and it is grounded in the balancing tests commonly conducted using baseline characteristics in randomized control trials. To this end, I perform a similar test and uncover promising evidence indicating that the covariates are well-balanced. This is demonstrated in Figure A2, where I present the event study parameters of the CS estimates incorporating these new dependent variables.[15]

An important consideration in Difference-in-Differences analysis is the potential influence of specific regions or provinces on the overall results. To mitigate this concern, a sensitivity analysis is conducted where individual regions or provinces are sequentially excluded from the dataset. This approach aims to assess the robustness of the DiD results by examining how the estimated coefficients vary when different units are omitted. The methodology involves systematically removing

[15]In these estimations, Model 2 cannot be employed because it extends Model 1 by incorporating income variables. However, for the purposes of this analysis, Model 2 will be redefined to include only the morphological characteristics of the municipality.

Figure A2. *Threat to validity*

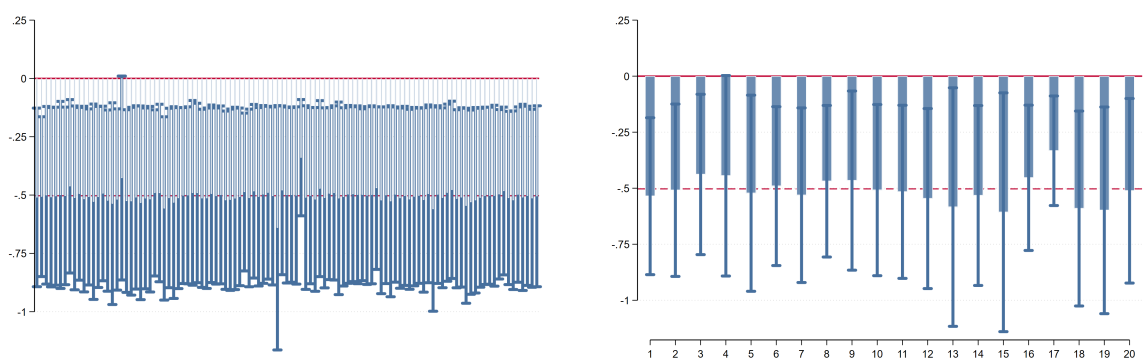


(a) *Taxpayers per capita* (b) *Income per capita* (c) *Deaths per 1000 inhabitants*

This figure presents event study estimates and 95% confidence intervals for the baseline specification. Dependent variables: (a) Taxpayers per capita; (b) Income per capita; (c) Deaths per 1000 inhabitants in T-1. Controls: Model (1) includes altitude, a dummy for provincial capital status, the share of the young population, education levels, work-study mobility, and female labor force participation. Model (2) adds total municipal income. Model (3) further incorporates lagged province-level variables: marriage rate, female life expectancy at birth, natural growth rate, average age at childbirth, and migration rate.

one province at a time and re-estimating the DiD model for each subset of the data. Similarly, this process is repeated by excluding entire regions from the analysis. The baseline model used as reference is the Model 1, the one derived from Column 1 of Table 1. In Figure A3, the sensitivity analysis results are presented. Panel (a) illustrates the estimates obtained when one province is excluded at a time, while Panel (b) shows the estimates when one region is excluded at a time. Each iteration records the coefficients of interest, allowing direct comparison with the baseline coefficient.

Figure A3. *Sensitivity Analysis*



(a) *Excluding One Province* (b) *Excluding One Region*

This figure presents ATT estimates and 95% confidence intervals for the baseline specification. The dependent variable is newborns per 1000 inhabitants in the previous year (T-1). Control variables include altitude, a dummy variable for provincial capital status, the share of the young population, education levels, work-study mobility, and female labor force participation. Panel (a) illustrates the ATT estimates obtained excluding one province at a time. Panel (b) shows the ATT estimates obtained excluding one region at a time.

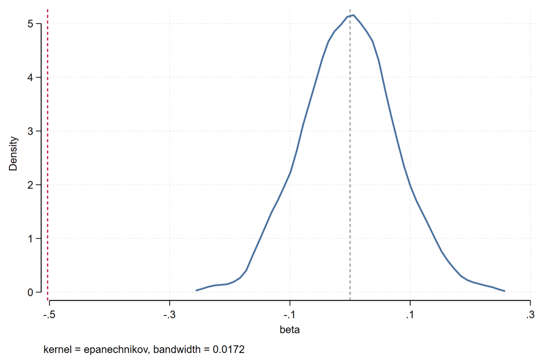
The coefficient from the baseline model is approximately -0.5, and it is quite similar to those obtained from each subset. Performing a sensitivity analysis by dropping one province at a time in a Difference-in-Differences framework helps to check the robustness of the results. By ensuring that no single province disproportionately influences the results, it is possible to be reassured about the validity of the results presented. The coefficients remain relatively stable and close to the baseline coefficient, indicating that the DiD results are robust to the exclusion of any province or region.

One concern frequently discussed in the literature on Difference-in-Differences models is the possibility that observed results are heavily influenced by the underlying study design, as noted by (Bertrand et al., 2004). Another critical issue is the challenge of conclusively proving or empirically testing the assumption of parallel trends. However, researchers can provide supporting evidence that lends credibility to the plausibility of parallel trends as an assumption, as highlighted by (Huntington-Klein, 2021).

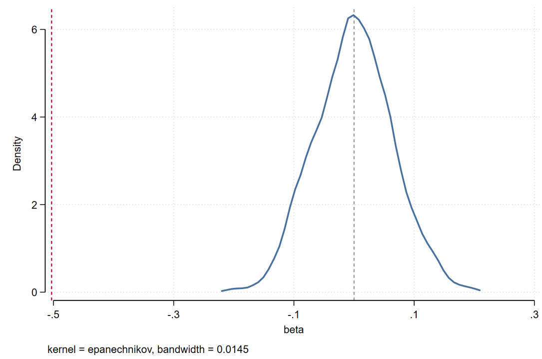
To address these concerns rigorously, I employ a placebo test methodology. This approach entails conducting a series of DiD estimations using simulated ”fake” treatment periods. Specifically, I use data from periods both preceding and subsequent to the actual rollout of the DTT in Italy. Following the methodology proposed by Chen et al. (2023), I introduce multiple randomly selected pseudo ”treatment” groups and periods ans repeat the DiD estimation process 1,000 times, each time constructing a distinct ”Treated” variable. This iterative process allows to compare the estimated effect of the genuine DTT rollout with the distribution of effects observed under the null hypothesis, where no true treatment effect exists. If the DiD estimates derived from these pseudo-treatment periods yield statistically significant effects, it may suggest potential violations of the parallel trends assumption.

Figure A4 illustrates the outcomes of these placebo tests. The distributions of the estimated effects for the pseudo treatments are depicted in blue, while the real estimated baseline effects are shown in red. Panel (a) presents results based on data preceding the treatment, while panel (b) shows results following the rollout.

Figure A4. *Placebo tests*



(a) *From 2002 to 2008*



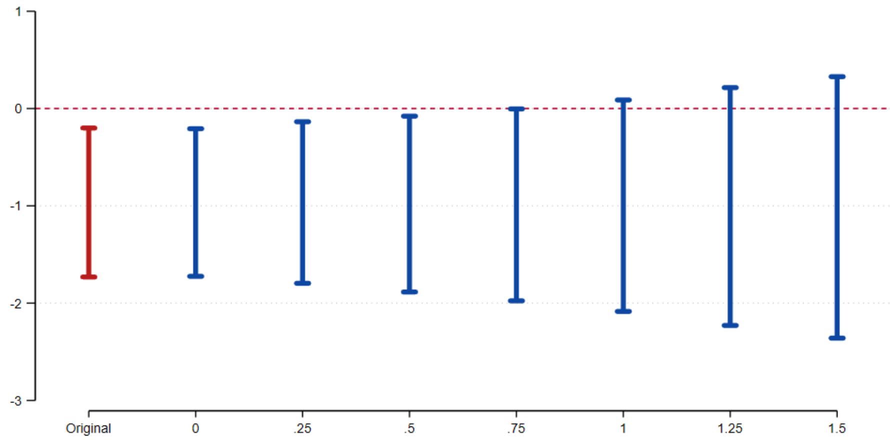
(b) *From 2012 to 2018*

Figure A5. *This figure presents the distributions of the estimated effects for the pseudo treatments that are depicted in blue, while the real estimated baseline effects are shown in red. Panel (a) presents results based on data preceding the treatment, while panel (b) shows results following the rollout. The dependent variable is newborns per 1000 inhabitants in the previous year (T-1). Control variables include altitude, a dummy variable for provincial capital status, the share of the young population, education levels, work-study mobility, and female labor force participation*

The absence of statistically significant effects in the pseudo-treatment scenarios (distribution centered on 0) provides robust support for the validity of the parallel trends assumption. This approach enhances the credibility of the causal inference drawn from the DiD analysis by mitigating concerns about the influence of study design and supporting the assumption of parallel trends in the data.

Finally, to further validate the robustness of the findings, I conducted additional checks to ensure that they are not compromised by potential violations of the parallel trends assumption. Specifically, I applied the methodology outlined by Rambachan and Roth (2023), which estimates bounds on how deviations from parallel trends could impact the results. Following their approach, in figure A6, I depict alternative confidence intervals for the coefficient at t+1 under different assumptions of M, where M represents the factor by which the maximum pre-treatment deviation is scaled. The focus on the t+1 coefficient is motivated by the fact that in the context of fertility, observable effects cannot be expected at t=0 . I tested values of M ranging from 0.25 to 1.5, corresponding to varying degrees of sensitivity to deviations from the parallel trends assumption.

Figure A6. *Placebo tests*



This figure analyzes potential violations of the parallel trend assumption using the honest approach to parallel trends of Rambachan and Roth (2023). Figure shows alternative 95% confidence intervals for the t+1 coefficient under varying assumptions about M (scaling factor for maximum pre-treatment deviation).

The figure demonstrate robustness up to 75% of the largest pre-treatment deviation. While the findings remain statistically significant even when accounting for deviations as large as the maximum observed pre-treatment deviation, they lose significance at $M = 1$, indicating that the results hold as long as deviations do not exceed the largest pre-treatment deviation.