The Remote Control of fertility: Evidence from the transition to digital terrestrial television*

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Abstract

This paper investigates the unintended demographic consequences of the transition from analog to Digital Terrestrial Television in Italy. By exploiting the staggered rollout of Digital Television as an exogenous shock, I estimate its causal impact on fertility rates using a doubly robust difference-in-differences approach. The findings reveal a significant decline in fertility, particularly in municipalities characterized by low initial birth rates, high population density, and strong progressive political leanings. The study explores two potential mechanisms: time substitution between television consumption and reproductive activities, and a shift in gender norms due to exposure to new media content. Evidence suggests that the latter mechanism dominates, as women increased television ownership and engaged more in independent content selection. This shift was accompanied by greater female labor force participation and a more equitable distribution of domestic work.

JEL classification: J16, L82, D83
Keywords: Reproductive Decisions, Digital Terrestrial Television, Media Influence, Difference-in-Differences Analysis

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An expanding body of empirical research highlights the impact of media on societal behaviors and demographic trends (La Ferrara et al., 2012; Jensen and Oster, 2009; La Ferrara, 2016; Kearney and Levine, 2015). Despite growing evidence of media's influence on life choices, such as fertility, the underlying mechanisms remain unclear. This study examines how media influences social norms by shaping beliefs through gender role representations, ultimately affecting demographic outcomes. As argued by Goldscheider et al. (2015), shifts in demographic patterns are deeply intertwined with evolving social norms and expectations. A critical driver of these transformations is the way individuals form their views—not only through personal experience but also through mediated sources like television, which can reflect, reinforce, or even reshape behavioral patterns.

In this context, I investigate the impact of Italy's transition from analog to digital terrestrial television (DTT) on individuals' perceptions of gender roles and the subsequent implications for fertility rates. This transition, implemented across Italian provinces between October 2008 and July 2012, provides a unique natural experiment.[1] I utilize a difference-in-differences empirical strategy, and data from ISTAT, to explore this experiment. By doing so, I aim to provide new insights into the broader relationship between media exposure, cultural shifts, and demographic change.

Television remains a dominant media form in Italy, with individuals averaging three and a half hours of daily viewing in 2024, influencing consumption, education, and political participation (DellaVigna and La Ferrara, 2015). Italy serves as a valuable case study due to its high media saturation and demographic challenges. With a fertility rate of 1.25 births per woman in 2021, significantly below the replacement level of 2.1, and a life expectancy of 82.7 years, Italy faces population decline driven by low birth rates and an aging population.[2] These demographic trends raise critical economic and social concerns, particularly regarding pension system sustainability, workforce imbalances, and elder care provisions.

To examine this, the empirical strategy relies on a difference-in-differences approach, comparing fertility trends before and after the digital transition across different years and within municipalities. To address potential bias from varying treatment effects across provinces, the analysis employs a doubly robust estimator, as proposed by Callaway and Sant'Anna (2021), for staggered event studies with heterogeneous treatment effects. The study finds a significant negative impact of DTT on fertility, with an effect size of -0.5, against a control group baseline of 8.8 newborns per 1000 inhabitants.[3] This effect is particularly strong in areas with low pre-transition fertility, fewer

[1] The timing of the transition was determined by post-war infrastructure conditions, preventing local authorities or television networks from manipulating the transition for local advantage (Mastrorocco and Minale, 2018).

[2] https://ec.europa.eu/eurostat

[3] These findings align with existing research that demonstrates a similar magnitude of media impact on fertility

young couples with children, high population density, more taxpayers, and left-leaning political preferences. These findings suggest that the impact is most substantial in urban, progressive areas, where audiences appear more receptive to the diverse content introduced by DTT.

The study tests two key mechanisms: the substitution of television viewing for reproductive activities and a shift in gender norms due to increased exposure to diverse media. While women's TV consumption rose only modestly—offering limited support for the substitution effect—greater television ownership allowed for more individualized viewing experiences, likely amplifying exposure to varied content and influencing societal attitudes. Furthermore, the analysis of housework patterns supports the second mechanism. Following the introduction of DTT, men increase their contribution to housework while women reduce theirs, suggesting a shift in gender norms.

The transition from analog to digital terrestrial television significantly reshaped Italy's media landscape, expanding the range of available channels and programming. Prior to this transition, Italian television was highly centralized, dominated by a few major channels controlled by influential figures like Silvio Berlusconi. His Mediaset channels—Canale 5, Italia 1, and Rete 4—played a crucial role in shaping public perception, often portraying women in traditional, stereotypical roles, such as homemakers or decorative figures (Hipkins, 2011). The digital transition facilitated a more diverse media environment, exposing audiences to a broader range of perspectives and representations. This shift enabled engagement with content that challenged traditional gender norms, potentially reshaping attitudes toward women's work and fertility choices.

The impact of media on fertility decisions is shaped by several factors, including child-rearing costs, 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). Contemporary economic models of fertility account for neighborhood effects, income inequality, personal experiences, and cultural influences (Becker and Lewis, 1973; Kearney and Levine, 2014; Li and Zhang, 2009; Fernández and Fogli, 2006). Although television has been largely overlooked in prior fertility studies, research in related fields indicates that TV exposure can shape attitudes and behaviors relevant to fertility choices (Guetto et al., 2023; Morgan and Rothschild, 1983; Holbert et al., 2003; Becker, 2004; Chong and La Ferrara, 2009).

Recent economic studies have examined television's influence on fertility, focusing on family structures, women's status, and reproductive choices (Kearney and Levine, 2015; La Ferrara et al., 2012; Jensen and Oster, 2009; Bönisch and Hyll, 2023). While policy frameworks significantly

rates. For instance, La Ferrara et al. (2012) found that the introduction of Rede Globo in Brazil led to a 5% relative decrease in birth probability, corresponding to a 0.5 percentage point reduction. Similarly, Jensen and Oster (2009) showed that the introduction of cable TV in rural India reduced pregnancy rates by four percentage points.

shape fertility decisions in developed countries, the influence of television consumption on fertility in these contexts remains under-researched. This paper addresses this gap by analyzing the effects of television consumption on fertility within a developed nation. Furthermore, it contributes to the broader literature on media and fertility by focusing on the media's role in the evolution of social norms.

This study also adds to the literature on the effects of digital terrestrial television on viewers. Research on the digital TV rollout has documented its impact on beliefs, political preferences, mental health, obesity, labor supply, and academic performance in Italy (Mastrorocco and Minale, 2018; Barone et al., 2015; Belloc, 2018) and in the United Kingdom (Castro and Nieto, 2019; Nieto and Suhrcke, 2021; Nieto, 2023).

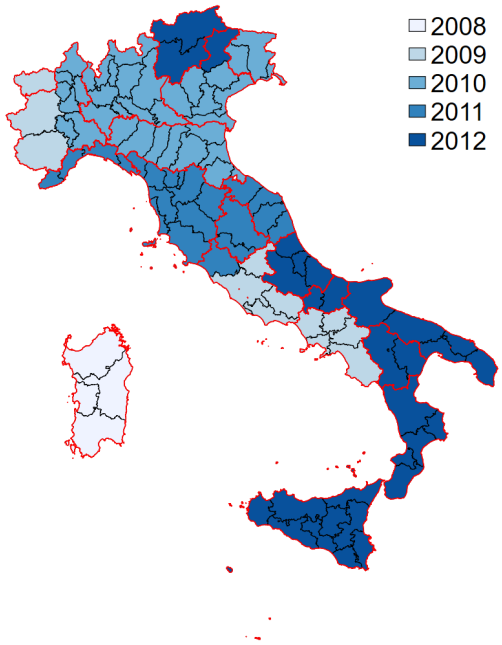
This article is structured as follows: Section 1 describes the transition from analog to digital TV. Section 2 outlines the dataset construction, while Section 3 details the empirical strategy. Section 4 presents the main results and heterogeneity analysis. In Section 5, the underlying mechanisms are discussed, while Section 6 interprets the findings. Finally, Section 7 provides concluding remarks.

1 From analogical to digital TV

The transition from analog to digital terrestrial television in Italy occurred gradually, following 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. This transition was implemented gradually across different provinces, adhering to a mandatory directive from the European Union (2007/65/EC). The law of November 29, 2007, No. 222, mandated that the "transition to digital" (terrestrial) be completed by December 31, 2012.

The division of Italy into 16 areas (see Figure 1), largely corresponding to regions, was based on the similarity of infrastructures from the 1950s. This division ensured that the switch-off deadlines were objectively determined, precluding manipulation by local politicians or interest groups. This approach aimed to mitigate geographic disparities by alternating between northern and southern regions. When the transition occurred in each region, the analog signal was deactivated, thereby removing households' access to old analog broadcasts. To receive the new digital TV signal, families were required to acquire a decoder, fully subsidized by the government through vouchers. This technology was user-friendly, as it could be connected to any television set with a scart socket (common at the time), and adding extra decoders was inexpensive, costing between 30 and 80

Figure 1. *Timing switch-off across Italian territories*



My elaboration on data from the Italian Ministry of Communications. The red lines represent the borders of the regions, while the black ones represent those of the provinces.

euros.[4]

Until 2007, Italy's television market was notably concentrated.[5] Through the analog signal, viewers had access to seven national channels, with the six major channels collectively holding approximately 85% of the total TV viewing shares. The Italian public broadcasting system (Rai) consisted of Rai 1, Rai 2, and Rai 3, while the privately-owned Rete 4, Canale 5, and Italia 1 were controlled by Mr. Berlusconi through his media conglomerate, Mediaset. A seventh channel, LA7, was also available.

Berlusconi's extensive control of the media, through both Mediaset and the appointment of public broadcasting executives, resulted in a de facto monopoly in television supply (Cornia, 2016). While the extent of Berlusconi's influence on television remains a subject of scholarly debate, research in political economics has indicated a considerable degree of political bias.[6]

Conversely, his presidency faced widespread criticism for perpetuating gender inequality. The dominance of men in politics and traditional views of women (Lombardo and Del Giorgio, 2013)

[4] https://www.famigliacristiana.it/articolo/dossier-tv-digitale-terrestre.aspx

[5] See, among others, Cornia (2016)

[6] Studies document slanted coverage favoring his coalition across Mediaset, with a weaker but present bias in public channels (Durante and Knight, 2012; Barone et al., 2015). Durante et al. (2019) finds a link between early Mediaset exposure and increased support for his party, and Padovani (2012) shows this influence persisted through the DTT transition.

hindered progress, worsened by Mediaset's "velina" figure, which reinforced a reductive, objectifying image of women.[7] His personal scandals further fueled the perception of politics as a "beauty contest" (Hipkins, 2011). This media environment normalized sexism and reinforced stereotypes, sparking backlash from Italian women, who mobilized to challenge its broader cultural and political implications (Benini, 2012).

The transition to DTT significantly impacted both the public broadcaster RAI and private operators (Mediaset and LA7). RAI was compelled to revamp its offerings, investing in new content and technologies to remain competitive in the evolving media landscape. Private operators also adapted, focusing on niche content creation and innovative services to attract and retain audiences. The Digital Reform resulted in the emergence of new channels primarily featuring TV shows, movies, children's programs, sports, educational/historical programs, and lifestyle shows.[8]

The introduction of new thematic channels like Cielo, Real Time, La5, and La7d diversified Italian television content, particularly targeting female audiences. This shift facilitated the rise of factual entertainment and reality shows that could challenge traditional gender norms. *Modern Family* exemplifies this transformation by depicting non-traditional families and fluid gender roles. The show features a homosexual couple raising a child and presents women in successful careers while portraying men as sensitive and empathetic (Ishii, 2017; Staricek, 2011).

Other programs focus on personal and domestic transformations, addressing various aspects of everyday life, from fashion to parenting.[9] They reflect contemporary anxieties and aspirations, balancing dissatisfaction with self-acceptance and expert intervention with personal agency, potentially influencing women's aspirations (Innocenti, 2013; Moseley et al., 2016; Weiss, 2017).

Finally, new shows focusing on key life stages, such as *Reparto Maternità*, *Primo Figlio*, and *Non sapevo di essere incinta*, explore the joys and challenges of first-time parenthood, potentially influencing perceptions of motherhood as depicted by Kearney and Levine (2015).

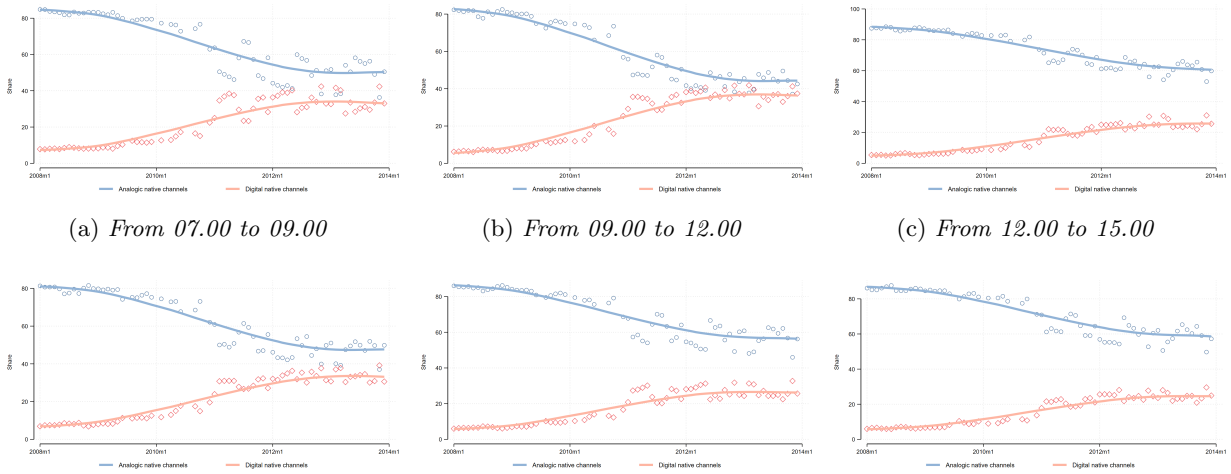
The expansion of digital television introduced a wide array of programming beyond lifestyle content, resulting in a significant shift in prime-time viewership. The combined share of the seven major traditional channels decreased from approximately 80% in 2008 to 60% in 2012, while digital channels surpassed 20% share in the same year. This trend is illustrated in Figure 2, which displays the monthly viewer share between analog and digital native channels in different time slots, using

[7] Veline are young, attractive women who perform dance routines and hand news sheets to hosts, serving a decorative role.

[8] Table A1 in the appendix provides an overview of the programs introduced with DTT and traces their evolution over time, while Figure A1 illustrates the evolution of their viewer share over time.

[9] These shows include *Extreme Makeover: Home Edition, Cerco casa disperatamente, Vendo casa disperatamente*, *Ma come ti vesti?*, and *Project Runway*.

Figure 2. *Share of analogue and digital channels by time slots*



(a) *From 07.00 to 09.00* (b) *From 09.00 to 12.00* (c) *From 12.00 to 15.00*

(d) *From 15.00 to 18.00* (e) *From 18.00 to 20.30* (f) *From 20.30 to 22.30*

Figure 3. *This figure illustrates the evolution of monthly television viewing shares from 2008 to 2013, as measured by AUDITEL, contrasting the aggregated traditional analogue channels (Rai, Mediaset, LA7) with new digital channels, and presented according to distinct time slots.*

AUDITEL data.[10]

The share trend of analog native TV channels decreases over time in all time slots, reaching close to 50% in morning and afternoon times by 2012. Conversely, the share of digital native channels increases in all time slots, reaching approximately 40% in morning and afternoon times. These trends illustrate a dramatic shift in viewing habits following the introduction of DTT, with a clear substitution of digital channels for analog ones.

2 Data

In Italy, the Italian National Institute of Statistics (ISTAT) compiles newborn data in the "Bilancio Demografico" (Demographic Balance), a comprehensive administrative database. This database covers approximately 8,000 Italian municipalities from 2002 to 2018. The breadth and depth of these data facilitate detailed analyses of demographic trends and patterns across the country. To obtain precise municipal-level information, data from the 2001 Census are utilized. The Census provides detailed demographic information, serving as a robust foundation for municipal-level analyses. This data ensures accurate capture and understanding of demographic dynamics within individual municipalities.

[10] https://www.auditel.it/en/tv-audience/

In addition to demographic data, income information is sourced from the Ministry of Economic and Financial Affairs. This income data is crucial for understanding economic conditions and disparities within and between municipalities. Integrating income data with demographic information allows for the examination of potential interactions between economic factors and demographic trends, providing a more comprehensive understanding of population changes. Furthermore, provincial-level data is acquired from ISTAT to account for characteristics that vary over time.[11] This provincial-level data is essential for capturing temporal variations and trends that may not be apparent at the municipal level.

Additionally, the ISTAT multi-purpose household survey provides data that enhances the analysis by allowing for the study of the mechanisms underlying the main effect. 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, "Aspects of Daily Life," offers granular insights into the daily activities of individuals and households. This representative survey also collects detailed information on demographics, household 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, data spanning from 2006 to 2015 was harmonized and merged.

Finally, to better understand potential mechanisms, the study uses data retrieved from ISTAT's Labor Force Survey. This survey provides official estimates of employment and unemployment, along with detailed information on labor supply aggregates, occupations, economic sectors, hours worked, contract types and durations, and educational attainment in Italy.

3 Identification strategy

This analysis leverages an identification strategy similar to that employed by Mastrorocco and Minale (2018). This approach shares 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 respective research contexts in Italy.

To analyze the effects of the staggered implementation of DTT and capture the changes before

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

and after its introduction, a Difference-in-Differences (DiD) approach is employed. This method compares 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 well-suited to the staggered nature of the DTT switch-off. The staggered DiD model extends this framework by incorporating multiple periods and allowing for the varying initiation of treatments across provinces.

The study then estimates Equation 1 using the doubly robust methodology proposed by Callaway and Sant'Anna (2021) to mitigate potential biases that may arise from the classic Two-Way Fixed Effects-Difference in Differences method. If the treatment effect is assumed homogeneous across units, biases can arise, resulting in negative weights for units treated in earlier periods but observed in later periods, and producing imprecise weights that are higher in the middle part of the panel.[12] The study selects this methodology over the classic DiD design due to the variable timing of the DTT switch-off. The Callaway and Sant'Anna approach provides greater flexibility for heterogeneous treatment effects with variation in treatment time, requires minimal parallel trend assumptions

[12]The Callaway and Sant'Anna 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.

to identify the ATT, allows for the inclusion of covariates in a flexible form, different estimation procedures, and various aggregation schemes to summarize the treatment effects.[13]

4 The effect of DTT on fertility

Table 1 reports 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), the study presents the dynamic aggregated treatment effect, which captures the treatment's impact over successive periods.

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.*

The analysis begins with a model that includes only 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. Model 2) adds 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 analysis reveals a statistically significant negative impact, with an effect size of approximately -0.5 (as observed in model 1). This is relative to a baseline fertility rate of 8.8 newborns per 1000 inhabitants in the control group at time T-1. The consistency of these findings across models 2 and

[13]This analysis assumes 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.

3 strengthens confidence in the reported effect.

Given the staggered treatment, the dynamic effect of DTT over time warrants emphasis. Figure 4 presents the main estimates obtained in the study. The figure displays point estimates represented by dots, with the corresponding 95% confidence intervals depicted as capped spikes. 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, newborns per 1000 fertile females in the previous year, and the inverse hyperbolic sine transformation of the number of newborns.[14] Panel a) of Figure 4 shows the estimates obtained using the 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.[15]

In all specifications, a clear decline in births occurs in time T+1, weakening but remaining significant in the second period, and reaching zero in the third period.[16]

These findings align with similar analyses conducted in developing countries, where the introduction of television has been associated with a decrease in birth rates. Hence, this result highlights the influence of television on birth rates in developed countries as well. This is also consistent with existing work on the effects of media exposure, which typically finds rapid changes (within a few months, in many cases) in behaviors such as contraceptive use and pregnancy (Pace, 1993; Valente et al., 1994; Rogers et al., 1999; Jensen and Oster, 2009; Kearney and Levine, 2015).

The DID strategy relies on the identifying assumption that fertility decision trends would have been the same in treated and untreated municipalities in the absence of the treatment. Therefore, the absence of coefficients different from zero before the treatment takes place is reassuring. This finding reinforces 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.

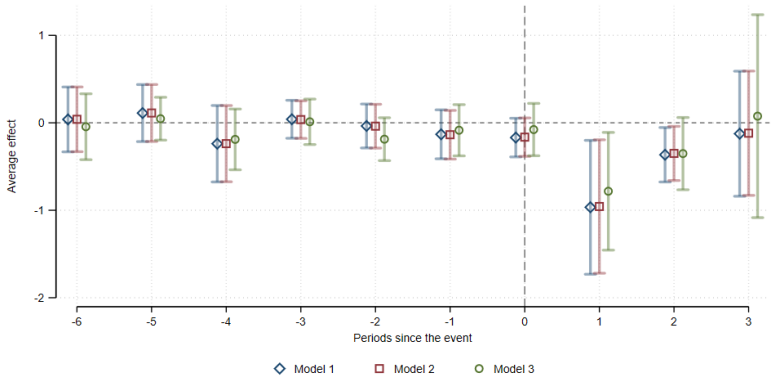
Section A.1 provides evidence to ensure the robustness of results by verifying the absence of

[14] 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.

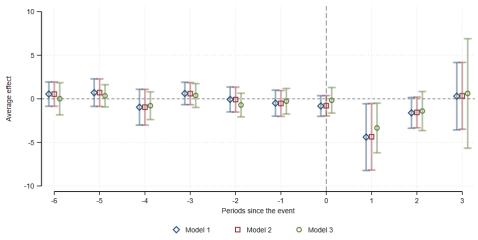
[15] To see the dynamic aggregated treatment effect look at table A3 and table A4 in the appendix

[16] 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 A3 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.

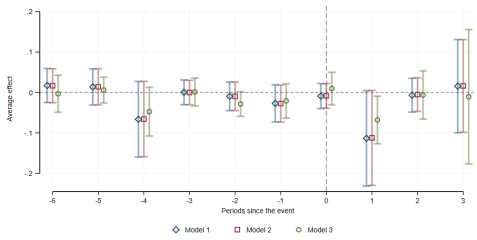
Figure 4. *Event study*



(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.

confounding factors, confirming covariate balance, and validating the parallel trends assumption. Sensitivity analyses show stable coefficients when excluding provinces or regions, while placebo tests with simulated treatments confirm no violations of the parallel trend assumptions. Additional robustness checks using Rambachan's methodology demonstrate that findings hold up to substantial deviations from parallel trends, confirming the reliability of the DID framework.

4.1 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, the study conducted a comprehensive analysis across various dimensions within the dataset.

This analysis aims to determine whether DTT induces a fundamental change in fertility behavior

Table 2. *Heterogeneity by demographic characteristics*

Splitting variables:	*Dep. variable:* Newborns per 1000 inhabitants in T-1				
	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*

for all individuals or disproportionately influences the most susceptible groups—those already more prone to such changes. Municipalities were partitioned based on the distribution of socioeconomic characteristics. Specifically, a median split approach was employed, dividing the data into two groups—above and below the median—for each characteristic of interest, subsequently estimating the baseline model within these sub-samples.

The initial approach categorized municipalities into low and high pre-treatment birth rate groups using 2002 birth data. Subsequently, Census data provided 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. Table 2 presents the results of the DTT impact estimates on fertility within these sub-samples.

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. Conversely, partitioning the sample based on female employment leads to a loss of both statistical significance and effect size. Taken together, these results suggest that the impact on fertility was strongest among those initially less likely to have children and thus more susceptible to changing their decision. Moreover, this effect was most pronounced in highly urbanized areas, where people are more likely to postpone pregnancy and prioritize their careers.

Furthermore, the study examines the role of socioeconomic and political characteristics to determine whether the DTT rollout has differential impacts across municipalities. It focuses on two key economic indicators: the number of taxpayers per capita and income per taxpayer. Data on the distribution of these variables within municipalities comes from the Ministry of the Interior. To capture political characteristics, the study utilizes municipal-level data on political preferences from the 2006 national elections, also provided by the Ministry of the Interior. Employing a median split, municipalities are categorized into those above and below the median for each political indicator, and the baseline model is re-estimated. Table 3 details the results of these estimations.

When the sample is partitioned by income level, statistical significance is lost in both subsamples. 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 this case, the result on the number of taxpayers aligns with the findings on population density heterogeneity, reinforcing the idea that the effect is stronger in areas where individuals aspire to higher career achievements. Meanwhile, the political evidence points to a stronger impact in progressive municipalities, where conservative family ideals struggle to gain influence.

In summary, the heterogeneity analysis demonstrates that the impact of DTT on fertility is not uniform, but rather contingent upon distinct socio-economic and cultural contexts. In municipalities characterized by low pre-treatment birth rates, high urbanization, and progressive values, the effect of DTT on fertility is more pronounced. This suggests that individuals in these areas, often prioritizing career advancement and economic activity, are more susceptible to external influences affecting their reproductive decisions. Conversely, in municipalities where traditional conservative family ideals are deeply rooted, the influence of DTT on fertility disappears. This highlights the role of cultural and ideological factors in shaping individual responses to media changes. The effect with

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*

taxpayer numbers further underscores the link between economic ambition and the responsiveness to factors influencing fertility decisions.

Finally, the absence of results on the income division clarifies any doubts regarding the potential impact of the sovereign debt crisis on fertility. Although the crisis is believed to have affected fertility rates in Italy, its effects may not have emerged until after 2012.[17]

5 Possible mechanisms

This section aims to interpret the previously presented results by proposing a potential mechanism driving the observed impact of the DTT rollout on fertility. To this end, the study introduces a new dataset and develops a framework for understanding the relationship between DTT adoption and fertility decisions.

To investigate the potential mechanism underlying the DTT effect on fertility, the study utilizes

[17] Comolli and Vignoli (2021) use a regression discontinuity design (RDD) centered on November 2012 to show that the 2012 economic crisis led to a 1.5 to 5 percent decline in birth rates due to increased economic uncertainty.

survey data from the Italian National Statistical Institute's (ISTAT) annual Multipurpose Household Survey.

Given the observed negative effect of DTT on fertility, the study tests two potential underlying mechanisms. The first is a substitution effect between television viewing and sexual activity. This implies that individuals may have reallocated time from sexual activities 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 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 procreation. To analyze this potential time reallocation, the study focuses 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 is associated with increased television viewing, particularly among specific demographic groups.

Table 4 presents the results of a DID analysis using the doubly robust estimator to account for potential issues related to staggered treatment adoption, with the minutes spent watching TV during the day as the dependent variable. In column (1), the analysis focuses specifically on families of childbearing age (defined as those in which the woman is between the ages of 18 and 55). Column (2) restricts the sample to childless couples, as this group represents those actively considering or postponing childbearing. Finally, column (3) presents results for all childless individuals. 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 within these populations.

However, the 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 potential changes in television viewing behavior within

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

Splitting variables:	*Dep. variable:* Minutes spent watching TV during the day		
	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	0.610	6.055	0.621
	(1.464)	(3.896)	(1.616)
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.*

Italian households, the study disaggregated the sample by gender and further divided it into narrower age groups. The previous estimations were then replicated, using minutes spent watching television as the dependent variable. Table A5 in the appendix presents the results of this refined DID analysis. The results 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. Therefore, a simple substitution effect does not appear to be the primary mechanism driving the

observed fertility decline. However, they do suggest a tiny change 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 traditional prime-time television viewing is often dictated by the preferences of men and children, DTT's technological advancements may have loosened previously rigid family TV schedules (Moseley et al., 2016). The ability to independently access preferred channels could lead to greater selective exposure, favoring information that confirms pre-existing beliefs, including gender norms.[18] This may reduce exposure to potentially sexist content prevalent in mainstream media, particularly for individuals actively seeking alternative programming previously unavailable. This interpretation aligns with the observed heterogeneous effects of DTT adoption, where areas with historically low fertility rates, smaller proportions of young couples with children, and left-leaning, high-density populations experienced a more pronounced decrease in fertility.

Therefore, the study proposes a second hypothesis regarding the underlying mechanism: DTT's increased channel diversity facilitates selective exposure to role models and narratives that are less rooted in patriarchal norms. This may have pushed toward a polarization of gender norms, affecting fertility decisions. This hypothesis suggests that the impact is not merely a result of increased television viewing time, but rather the content consumed and its potential to shape attitudes and beliefs about gender roles. The availability of alternative programming may provide viewers, especially women, access to perspectives and representations that challenge traditional gender roles, influencing their beliefs and, ultimately, their fertility choices. The shift in content consumption, driven by DTT's expanded channel offerings, could be the key mechanism through which technological change impacts social and demographic outcomes.

To test this hypothesis, the study first investigates whether DTT indeed expanded viewers' ability to choose their preferred channels independently, rather than being limited to shared family

[18] While selective exposure is often studied in the context of political polarization, its application to gender norms is equally relevant. Steppat et al. (2022) demonstrate that while social media amplifies selective exposure, traditional media like television also plays a significant role, particularly in fragmented media landscapes. Increased channel availability facilitates self-selection, limiting exposure to diverse perspectives and potentially reinforcing existing biases. Schneider-Strawczynski and Valette (2025) highlight how television, even without explicit bias, can contribute to polarization by shaping issue salience. Increased salience reinforces pre-existing beliefs, prompting individuals to seek confirmatory information, a phenomenon consistent with Gentzkow and Shapiro (2011) and Dejean et al. (2022). Their research, though focused on online news, is applicable to television, especially regarding salient and emotionally charged issues.

viewing. 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, the Multipurpose Household Survey data is utilized 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 5 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), the study focuses specifically on families of childbearing age, defined as those in which the woman is between the ages of 18 and 55. In column (2), the sample is restricted to childless couples. Finally, column (3) presents results for all childless individuals.

Table 5. *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)
	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.*

Table 5 shows 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 evaluate the second hypothesis regarding the underlying mechanism driving the observed fertility changes, this study examines several factors related to gender roles within Italian society. This analysis aims to determine whether the shift in fertility patterns can be attributed to alterations in intra-familial gender roles, drawing upon the theoretical frameworks outlined by

Goldscheider et al. (2015); Basten (2010); Esping-Andersen and Billari (2015). 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, the study analyzes domestic labor dynamics before, during the transition to DTT. This allows for a direct examination of potential shifts in household labor division following the DTT rollout.

Table 6 presents the results of a Difference-in-Differences analysis utilizing the doubly robust DiD estimator. Panel a. of Table 6 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, the study examines 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 6 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. The robustness of this result is further supported by the event study depicted in Figure 5, which displays doubly robust estimates with domestic work as the dependent variable, both for the entire sample and separately for male and female subsamples.

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 sig-

Table 6. *The effect of the DTT rollout on the domestic labor attitudes*

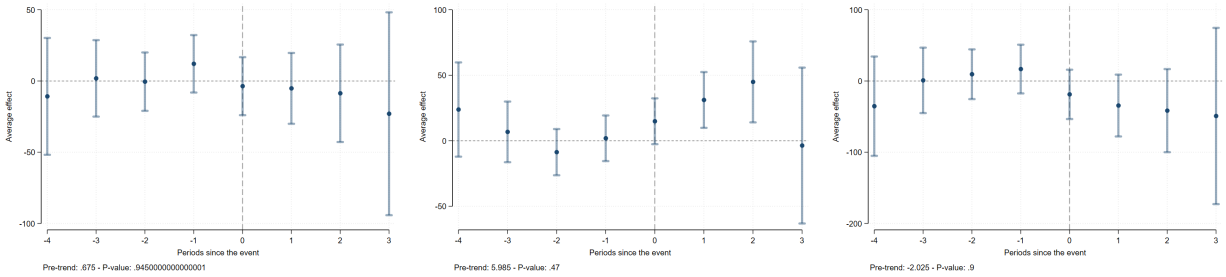
Dep. variables:	Domestic work	Low physical activity DW	High physical activity DW	Domestic helper
	(1)	(2)	(3)	(4)
Panel a.		**Whole Sample**		
ATT	-5.358	0.0225***	-0.00248	0.0305
	(10.06)	(0.00590)	(0.00447)	(0.0381)
Mean	946.3	0.281	0.129	0.490
Observations	235349	174894	174894	273740
Pre Trend	0.677	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.*

nificant 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.

The introduction of DTT appears to have catalyzed a redistribution of domestic labor within households, rather than altering the total workload. This shift is evidenced by an increase in male participation and a corresponding decrease in female involvement, suggesting a change in established gender roles. The observed effects potentially reflect broader behavioral and cultural shifts, possibly driven by increased exposure to evolving norms regarding domestic work through television content. This redistribution of tasks indicates a departure from traditional family structures, with women increasingly moving away from conventional gender roles.

Figure 5. *Domestic work event study*



(a) *Whole sample* (b) *Male* (c) *Female*

This figure presents event study estimates and 95% confidence intervals for the baseline specification. The dependent variable is amount of domestic work in a week. Panel a. displays the results using the full sample. Panel b. presents results specifically for males, while Panel c. shows the corresponding results for females. 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.

5.1 Evidence from provincial level data

To further investigate the potential influence of DTT on gender roles within Italian society, the study extends 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, data at the provincial level is utilized from two primary sources. First, data is drawn from the Demographic Indicators section of ISTAT's demography website, which provides comprehensive demographic information at the provincial level.[19] Second, data is utilized from the ISTAT 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.[20]

Therefore, the study analyzes 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 for the exploration of 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

[19] https://demo.istat.it/

[20] 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.

Table 7. *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.*

might have influenced women's roles in the workforce, which is closely intertwined with gender stereotypes.[21]

Table 7 presents the results of a DID analysis, using the doubly robust estimator.

In Panel a. of Table 7, 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.

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

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.[22] 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.

6 Discussion

The mechanism results strongly suggest that the second proposed mechanism—that exposure to DTT influenced attitudes toward gender norms and empowered women—provides the most compelling explanation for the observed effects.

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 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 (selective exposure). 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). Television affects long-term social views, including sex roles (Minnesota) and women's rights (Chicago), as shown in Morgan and Rothschild (1983) and Holbert et al. (2003).

[22] 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.

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.

Demography research consistently remarks on the influence of media, particularly television, on shifting gender norms and subsequent fertility trends (Goldscheider et al., 2015; Basten, 2010; Esping-Andersen and Billari, 2015). These studies highlight how media portrayals of modern, career-oriented women and egalitarian family structures accelerate the evolution of societal expectations. By showcasing alternative lifestyles, where women prioritize independence and professional achievement, television challenges traditional gender roles and expectations. This exposure leads to a reconsideration of family roles, contributing to delays in marriage and a subsequent reduction in fertility rates. While this initial shift often results in a decline in birth rates, particularly as women prioritize personal and career development, the long-term impact is more nuanced.

7 Conclusions

This study investigates the causal impact of the transition from analog to digital terrestrial television (DTT) on fertility rates in Italy. By leveraging the staggered implementation of DTT between 2008 and 2012, the study identifies 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, 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, the study controls for various confounding factors, ensuring that the observed effects are attributable 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.

The 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 is not uniform across the population; more substantial effects are observed in urban, progressive areas. This suggests that communities more attuned to progressive social issues, such as gender equality and education, are also more receptive to the diverse programming and content made available by DTT.

The study explores 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. The analysis of time spent watching television reveals 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, the study finds evidence of increased television ownership within households, especially among childless couples.

Crucially, the findings suggest a significant shift in gender roles following the DTT rollout. The study observes 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 contribute 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 plays a crucial role in this shift.

In conclusion, this study provides compelling evidence that the DTT rollout in Italy has significant social and cultural consequences beyond its technological and economic impacts. By facilitating access to more diverse media content, DTT appears to contribute 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.

During the preparation of this work the author used Gemini in order to improve text readability. After using this service, the author reviewed and edited the content as needed and take full responsibility for the content of the publication.

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A Appendix

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

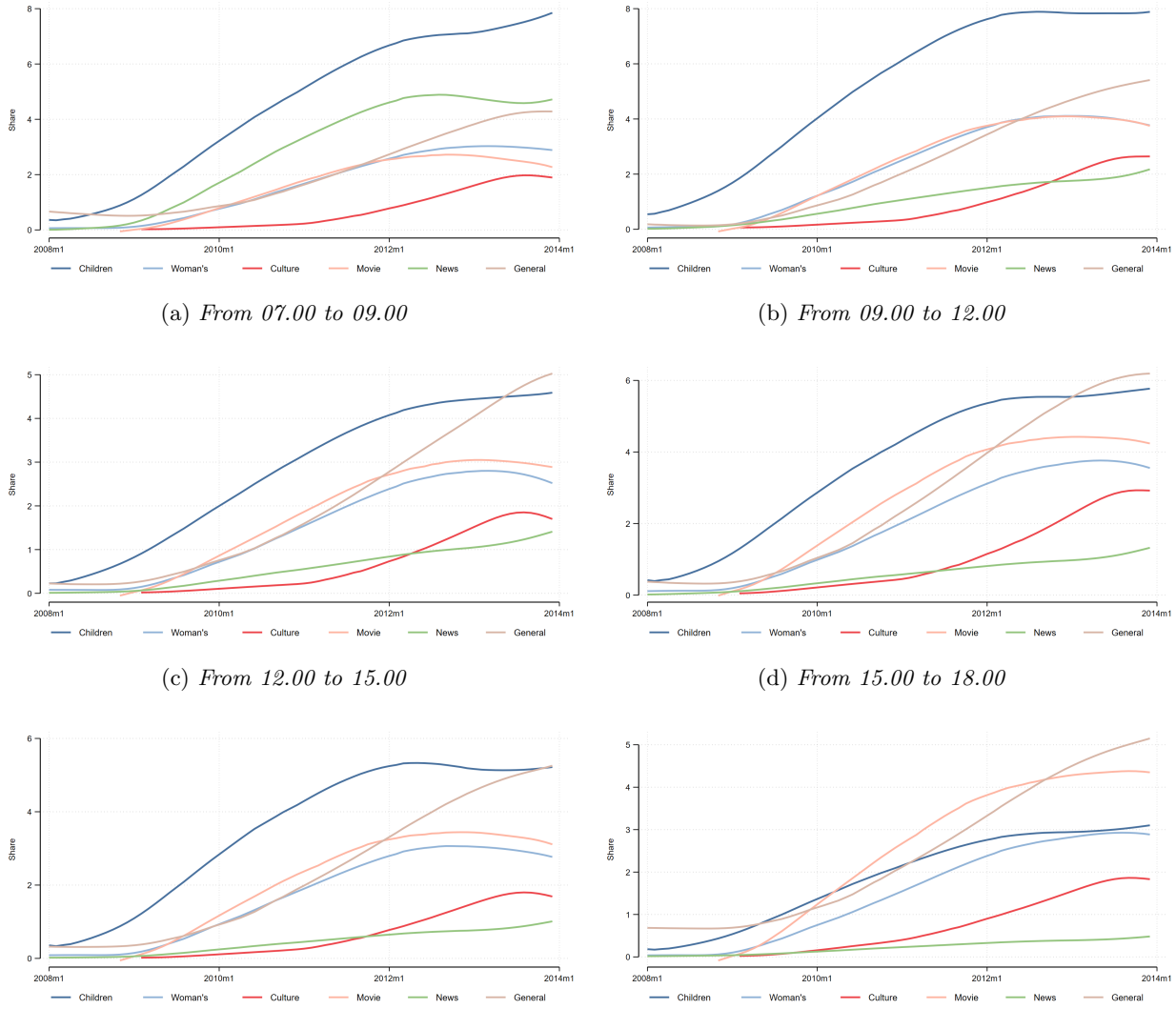
Name of the Channel	Owner	Analog	Digital	Content	Avl. in 2010	Avl. in 2011	Avl. in 2012
Rai 1	RAI	X		General	X	X	X
Rai 2	RAI	X		General	X	X	X
Rai 3	RAI	X		General	X	X	X
Rai 4	RAI		X	Children	X	X	X
Rai 5	RAI		X	Culture	X	X	X
Rai Sport 1	RAI		X	Sport	X	X	X
Rai Sport 2	RAI		X	Sport	X	X	X
Rai News 24	RAI		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
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

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**
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

Figure A1. *Share of digital channels by type*



(a) *From 07.00 to 09.00*

(b) *From 09.00 to 12.00*

(c) *From 12.00 to 15.00*

(d) *From 15.00 to 18.00*

(e) *From 18.00 to 20.30*

(f) *From 20.30 to 22.30*

Figure A2. *This figure illustrates the evolution of monthly television viewing shares from 2008 to 2013, as measured by AUDITEL, divided by channel type (as detailed in Table A1) and presented according to distinct time slots.*

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)

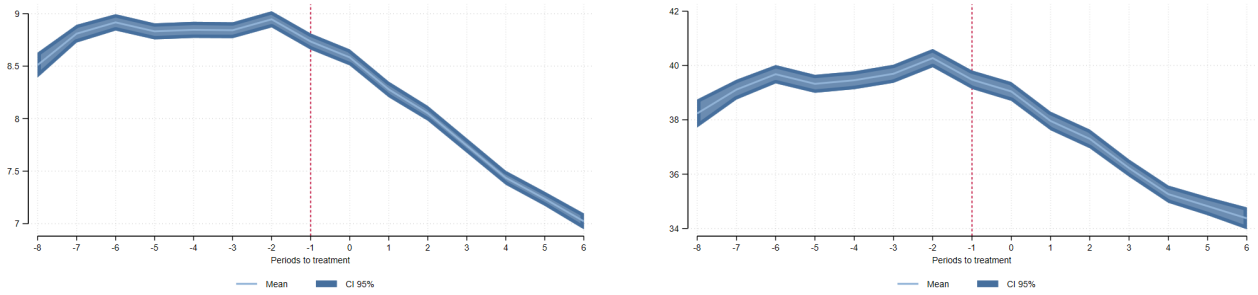
*This table illustrates the doubly robust estimated effect of DTT on the Newborns per 1000 fertile females in the previous year (T-1), robust standard errors in brackets, clustered at municipality level - *** p<0.01, ** p<0.05, * p<0.1 - The controls included in column (1) are altitude, whether the municipality 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.*

Table A5. *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. Panel a. reports the results for males, while Panel b. presents the corresponding results for females. Within each panel, I 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.*

Figure A3. *Newborns evolution*



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

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

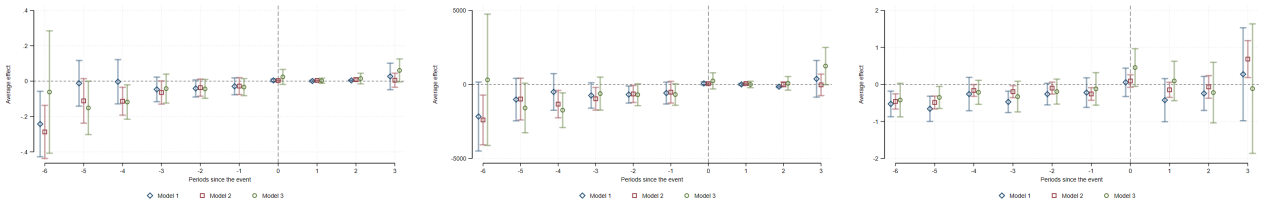
A.1 Robustness checks

This section undertakes a comprehensive analysis to substantiate the credibility of the preceding results and the foundational assumptions upon which they are based.

It is essential to first demonstrate the absence of confounding factors that could compromise the interpretability of the results by obscuring 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 follows the intuition outlined in Pei et al. (2019) and 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 A4, where I present the event study parameters of the Callaway and Sant'Anna estimates, incorporating these new dependent variables.[23]

Figure A4. *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.

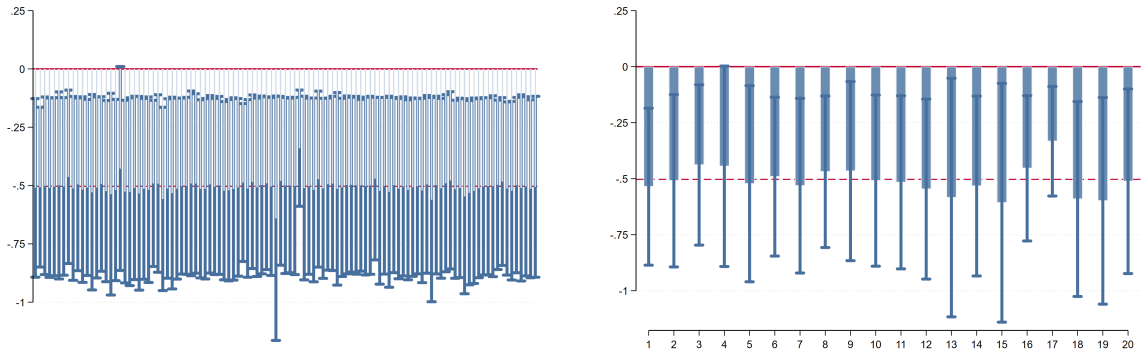
A key consideration in Difference-in-Differences analysis is the potential influence of specific regions or provinces on the overall results. To mitigate this concern, a sensitivity analysis is conducted where individual regions or provinces are sequentially excluded from the dataset. This approach aims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

The methodology systematically removes one province at a time and re-estimates 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 a reference is Model 1, derived from Column 1 of Table 1. Figure A5 presents the sensitivity analysis results. 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

[23] 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.

at a time. Each iteration records the coefficients of interest, allowing for direct comparison with the baseline coefficient.

Figure A5. *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 remains 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, we can be reassured about the validity of the presented results. 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.

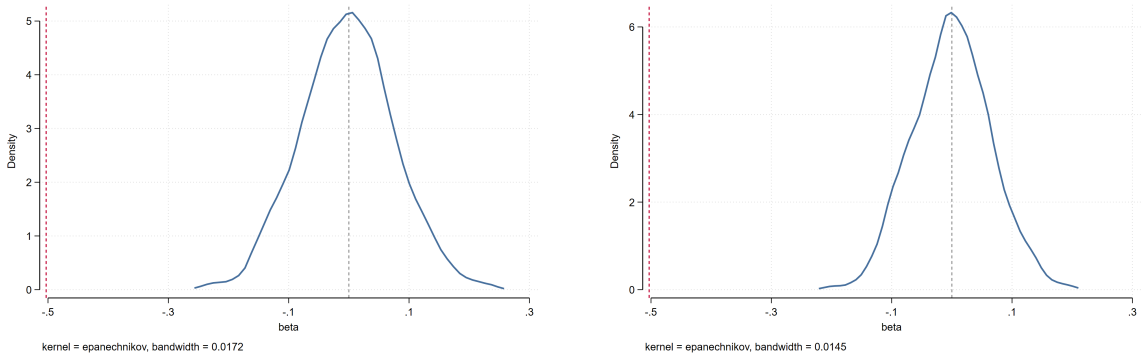
One concern frequently discussed in the literature on Difference-in-Differences models is the possibility that observed results are heavily influenced by the underlying study design, as noted by (Bertrand et al., 2004). Another critical issue is the challenge of conclusively proving or empirically testing 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 DTT in Italy. Following the methodology proposed by Chen et al. (2023), I introduce multiple randomly selected pseudo "treatment" groups and periods and repeat the DiD estimation process 1,000 times, each time constructing a distinct "Treated" variable. This iterative process allows us 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 A6 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, and panel (b) shows results following the rollout.

Figure A6. *Placebo tests*



(a) *From 2002 to 2008*

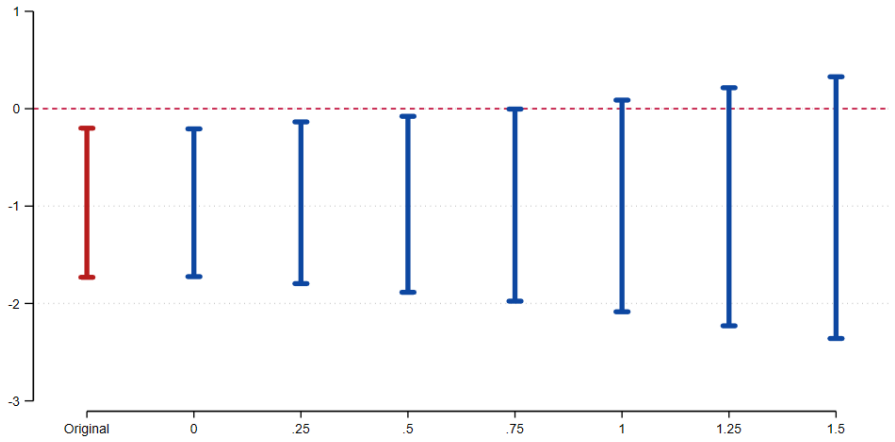
(b) *From 2012 to 2018*

Figure A7. *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, Figure A8 depicts 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 A8. *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 demonstrates 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.