LOW FERTILITY IN CONTEXT: THE CASE OF ITALY

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Abstract. Numerous studies have shown that fertility behaviour in Italy, as elsewhere, strongly depends on subnational contextual factors. With this study we add to that literature investigating how group-specific fertility rates differ across fine-graded local areas' characteristics. We utilize ISTAT micro-level vital registration records including all births registered in each Italian municipality for the year 2022 and information about parity and parents' age to construct age- and parity- specific fertility rates. We match fertility data with the municipalities' Inner Areas classification measuring the availability of (distance from) crucial services, and with other indicators of municipalities' socioeconomic conditions that may influence fertility, such as per capita income, the share of high-tech workers and the availability of public childcare services. First, we present a descriptive illustration of the most recent group-specific fertility rates in different kinds of local areas in terms of population size, geographical location, and inner area class. Second, we utilize linear regression models to investigate the association between local areas' characteristics and age- and parity-specific fertility rates.

1. Introduction

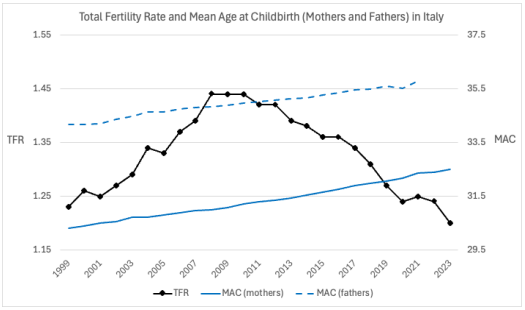
1.1. Recent developments in fertility in Italy

Persistently low birth rates contribute to population ageing and growing inequalities, posing a challenge to countries' social and financial sustainability. Italy registers a lowest-low level of fertility (Kohler *et al.*, 2002) with birth rates having decreased steadily in the past 50 years. In the more recent years, such long-term fertility descent produced a shrinking female population in reproductive age, which today contributes to the low number of births (Mencarini and Vignoli, 2018). Yet, part of the overall fertility decline is due to changes in childbearing behaviour, both in terms of *timing* and *quantity*. Figure 1 shows the Total Fertility Rate (TFR) and Mean Age at Childbearing (MAC) trends between 1999 to 2023. After an initial positive tendency at the beginning of the years 2000s due to the recuperation of births postponed during the 1990s, TFR declined sharply after 2010, going from 1.44 children per woman in 2010 to 1.20 children per woman in 2023. The MAC instead has been constantly increasing for both mothers and fathers since the 1990s, going from age 30.3 to 32.5 and from 34.2 to 35.8 respectively (Figure 1).

Several studies relate the onset of the fertility decline after 2010 to the consequences of the economic and financial crisis of 2008-09 (Sobotka *et al.*, 2011). It is worth noting

that the overall drop in TFRs was especially driven by declines in first order fertility rates and in the age-specific fertility rates of younger women, suggesting a delaying effect of the crisis on fertility schedules (Comolli, 2017). The postponement of the transition to parenthood to later ages was a consequence of the growing economic instability and labour market uncertainty during the first half of the 2010s. However, while usually as soon as the economy recovers couples recuperate births at least in part, many European countries including Italy, continued to register negative trends in the second half of the 2010s, long after the recovery. Nowadays, more than a decade after the Great Recession, fertility rates in Italy are getting closer to their historical minimum.

Figure 1 – *Total Fertility Rates and Mean Age at Childbearing in Italy 1999-2023.*



Source: Authors' elaboration based on ISTAT data.

1.2. Analysing low fertility with fine-graded municipality-level data

In Italy as in other contexts, territorial sociodemographic and socioeconomic characteristics strongly influence population change (Benassi *et al.*, 2023) and fertility (Campisi *et al.*, 2023; Vitali and Billari, 2017). Notable sub-regional differences are overlooked when focusing on higher-levels geographic entities only. As noted elsewhere, in fact, the Italian territorial and demographic heterogeneity increasingly requires shifting the focus of investigation to the local level (Salvati *et al.*, 2020; Tomassini *et al.*, 2024). Municipality-level data are useful because they allow leveraging a large variation in contextual characteristics. The availability of TFRs at the municipality-level is rare; to our knowledge, in fact, these data have not been used before. Previous studies on Italy have analysed fertility trends and their determinants with TFRs at regional or provincial level and Crude Birth Rates (CBRs) at the municipality level (Salvati *et al.*, 2020; Benassi and Carella, 2023). These studies have focused, and have been extremely successful, in modelling spatial dependency in fertility behaviour across territories (often large subnational entities), while our aim is to describe how fertility varies by fine-graded local areas characteristics.

This is especially important in relation to the presence (or lack) of services that makes a community attractive, or on the contrary, vulnerable to social and economic

marginalization (Reynaud and Miccoli, 2018). A useful indicator of the degree of presence or lack of such services is the classification of municipalities into inner areas provided by the Annual Reports on the National Strategy for Inner Areas of the Department for Cohesion Policies[1] (Barca and Carrosio, 2020). Municipalities that are disadvantaged by the absence of and distance from essential services are classified as Inner Areas[2].

While no study has addressed the fertility differential between central and inner areas, a rich literature has investigated the urban-rural divide in fertility behaviour. The urban socioeconomic context generates educational, wealth and occupational opportunities especially for women, and a cultural environment that, compared to rural areas, favours postponement of childbearing to later ages and disincentivise having large families (Kulu *et al.*, 2007; Riederer and Buber-Ennser, 2019). Yet, the contrast urban-rural (as much as the dichotomy central-inner areas) does not fully cover the multifaceted spectrum of intermediate levels of urbanization-rurality (as much as the centrality-marginalization in case of inner areas). Cities, and especially metropolitan regions and capitals, tend to have lower and later fertility compared to less densely populated urban areas, like suburban centres (Buelens, 2021).

The current study's objective is twofold. First, we aim at providing an empirical overview of the most recent estimates of group-specific fertility rates in the Italian context, measuring them at a very fine-graded local level. Second, we describe how the observed group-specific fertility rates vary depending on the contextual socioeconomic conditions.

2. Data and Method

2.1. Data and Variables

We utilize restricted-use micro-level vital registration records including all births registered by municipality for the year 2022 from the Italian Institute of Statistics. For each live birth we have information about the birth' parity and about the mother's nationality and age. We select native Italian women[3], and using live births and resident women by 5-years age groups in reproductive age 15-49, we construct total (TFR), and age- (ASFR) and parity- (PSFR) specific (first and second order) fertility rates at the municipality level.

[1] https://politichecoesione.governo.it/it/politica-di-coesione/strategie-tematiche-e-territoriali/strategie-territoriali/strategia-nazionale-aree-interne-snai/le-aree-interne-2021-2027/

[2] Essential services include: (i) complete education system up to upper secondary school, (ii) hospitals with first-level Emergency and Acceptance Departments, and (iii) at least "Silver" level railway stations.

[3] Identical analyses could be conducted on foreign-born women but in sake of conciseness, we decided to limit our study to native Italian women.

Then, we match this dataset with municipalities' characteristics that may be relevant for fertility behaviour. First, we merge the 2020's classification of the inner areas provided by the Annual Reports on the National Strategy for Inner Areas (Department for Cohesion Policies) distinguishing between Centres (hub, intra-municipality hub, and belt) and Inner Areas (intermediate, peripheral, and ultraperipheral). Inner areas are identified based on an accessibility indicator, calculated in terms of travel minutes by car to the nearest hub municipality (a municipality offering essential educational, health, and rail transport services). Municipalities that are more than 27 minutes away from the nearest hub are identified as inner areas. Centres include belts, i.e., peri-urban areas that are less than 27 minutes away from the nearest hub. Inner areas are further divided into three groups: intermediate (between 27 and 40 minutes away from the nearest hub), peripheral (between 40 and 67 minutes), ultraperipheral (more than 67 minutes).

Then, we consider municipalities' demographic and socioeconomic indicators. First, we merge municipalities' population and territorial extension (km^2), and calculate population density (ISTAT 2022[4]). Second, we add income and educational attainment which are well-documented determinants of fertility (Brand and Davis, 2012; Van Wijk and Billari, 2024). We measure income with the average before tax per capita income in the municipality (Minister for the Economy and Finance, MEF), and gender-specific education with the municipality's share of men and women with tertiary education (Permanent Census of Population, Housing and Enterprises ISTAT). Finally, we include measures of welfare provisions and labour market conditions that are also crucial factors influencing fertility (Neyer, 2013; Comolli, 2017). We operationalize welfare support in the municipality through (i) public expenditure on social services (2020, Euros per capita) and (ii) public childcare uptake (2021, percentage of children age 0-2 enrolled in public childcare) (ISTAT's Survey on interventions and social services of individual and associated municipalities). We measure labour market conditions with (i) unemployment rates by gender (ISTAT's 2021 Permanent Census of Population and Housing) and (ii) the relevance of the high-tech sector in the economy measured as percentage workers in high-technology manufacturing and knowledge-intensive high-technology services in the municipality (2021 ASIA-UL Statistical register of local units).

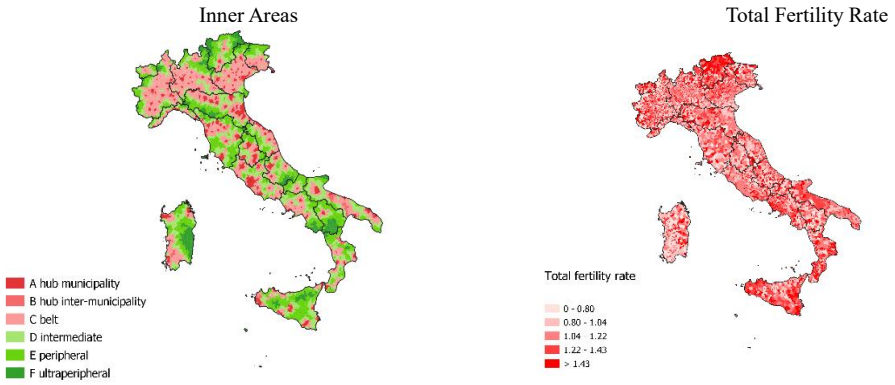
2.2. Method

TFRs have the fundamental advantage over CBRs of taking into consideration the age structure of the population for which we want to estimate fertility behaviour, providing a crucial indication of the intensity of the fertility behaviour in the population. Yet, estimating TFRs in very small areas can lead to unreliable measures insofar a small and exceptional number of live births in given years or age groups relative to a very small population of women in such age groups, can produce abnormal fertility levels. This is

[4] *Confini delle unità amministrative a fini statistici*, https://www.istat.it/it/archivio/222527.

the case for Italy which has a very large number of municipalities with overall population below 1,000 inhabitants (N=2,023) and with 1,001-5,000 inhabitants (N=3,507). To avoid such overestimation of fertility rates, we grouped together small municipalities (below 5,000 inhabitants) belonging to the same province and being of the same inner area class. After this regrouping we obtained 2,696 local areas, of which 2,374 are municipalities with a population of more than 5,000 individuals, and the remaining 322 are local areas obtained merging municipalities with a population of 5,000 individuals or less. This method is simple and transparent, although it has the limitation of reducing the number of local areas considered, and especially in those communities that are more strongly affected by the lack of services (small inner areas). We will address further this limitation in our conclusions. Table A.1 in the Appendix presents the distribution of all the variables considered in the analyses. We first show the territorial distribution of TFR, PSFR and ASFR by local area in 2022. Second, we present the results from a multivariate linear regression analysis which illustrates the differences in ASFR and PSFR by inner area class. Finally, we add the other socioeconomic indicators to investigate their role in the observed differences in fertility rates across types of local area.

Figure 2 – *Inner areas and Total Fertility Rates by municipality in Italy 2022.*



Source: Authors elaboration based on ISTAT data.

3. Results

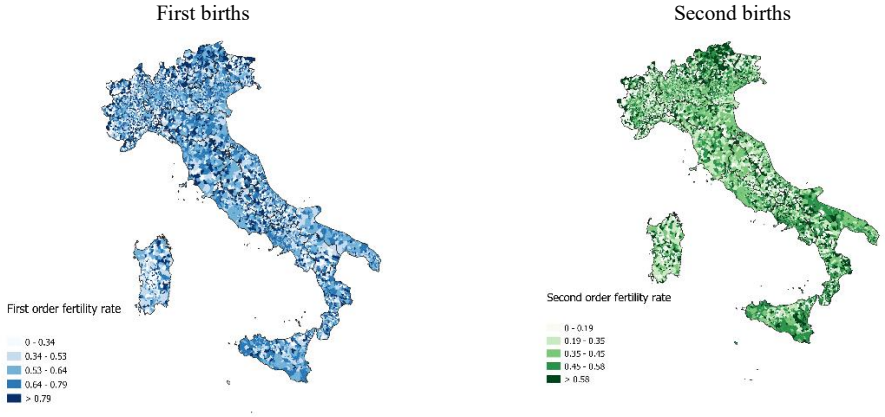
3.1. Descriptive analyses

Figure 2 (left panel) maps municipalities by their classification as Centres (hub, inter-municipality hub, and belt) or Inner Areas (intermediate, peripheral, and ultraperipheral). Almost half (48.5%, N=3,834) of Italian municipalities fall into at least one of the inner areas' typologies, mostly located along the Alpine and Apennine arc but also in plains

and coastal areas, from North to South. Among inner areas, 1,928 municipalities (24.4%) are classified as intermediate, 1,524 are peripheral (19.3%), and finally 382 are ultraperipheral (4.8%).

Figure 2 (right panel) presents a map of municipalities' TFRs in 2022, highlighting the territorial heterogeneity within regions and provinces in overall number of children per woman. We notice a strong territorial variation also in the fertility by parity (first and second order fertility rates) presented in Figure 3. These figures demonstrate the importance of exploiting municipality-level data and group-specific (e.g. parity) fertility rates. While there are some municipalities with similar first and second order fertility rates (e.g. high first and second order fertility rates, like in the province of Vercelli), we also see municipalities with relatively high first but low second order fertility rates (like in other provinces of Piemonte like Alessandria, Asti, or Cuneo).

Figure 3 – *First and Second Births Total Fertility Rates by municipality in Italy 2022.*



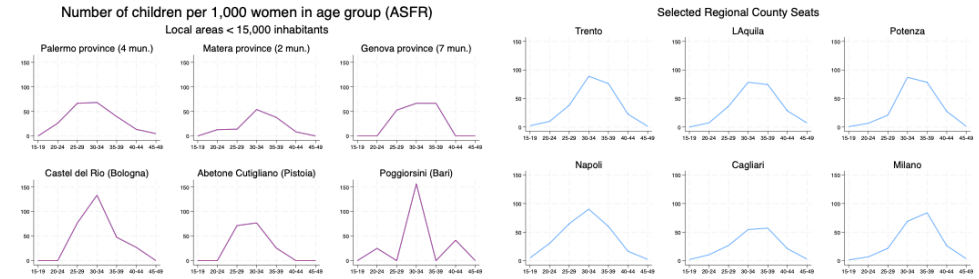
Source: Authors elaboration based on ISTAT data.

Figure 4 presents Age-specific Fertility Rates (ASFR) in 12 local areas selected because of different size, location and class of inner area. The left panel illustrates the age profile of fertility behaviour in six selected local areas with less then 15,000 inhabitants. The first three include very small municipalities grouped together due to their very low population. The three local areas include respectively four belt municipalities in the province of Palermo[5], two intermediate municipalities in the province of Matera[6], and seven ultraperipheral municipalities in the province of Genova[7]. The three areas include 11,799, 5,524, and 2,067 individuals. The other three

[5] Cerda 4,942, Lascari 3,674, Sciara 2,569 and Scillato 614 inhabitants.
[6] Calciano 667 and Tricarico 4,857 inhabitants.
[7] Fascia 73, Fontanigorda 244, Gorreto 94, Propata 113, Rondanina 60, Rovegno 492 and Santo Stefano d'Aveto 991 inhabitants.

graphs show ASFR in other small municipalities from Northern (Bologna), Central (Pistoia) and Southern (Bari) Italy. In terms of population, they range from 1,291 inhabitants in Poggiorsini to 1,902 in Castel del Rio. All three are inner areas but they are in different classes (Castel del Rio intermediate, Abetone Cutigliano ultraperipheral, Poggiorsini peripheral). Finally, the right panel illustrates the ASFRs in six selected regional county seats with populations ranging from 65,000 (Potenza) to 1.3 million (Milan) individuals. All county seats are classified as hubs.

Figure 4 – *Age specific fertility rates (ASFR) by local area in Italy 2022.*



Source: Authors elaboration based on ISTAT data.

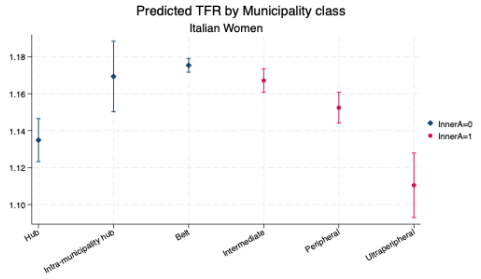
Figure 4 shows that fertility schedules differ quite substantially over local areas[8]. We do not observe strong patterns either along the more typical lines of enquiry (i.e. large vs. small area, southern vs. northern, etc) nor when distinguishing between centres and inner areas. The highest peak in ASFR is registered in the peripheral municipality of Poggiorsini in the province of Bari at 150 births per 1,000 women aged 30-34, while the lowest ASFR is observed in the intermediate municipalities in the province of Matera and in Cagliari, the county seat hub of Sardegna, at around 50 births per 1,000 women. The age at which the peak in fertility rates is observed varies from the late-twenties/early-thirties in the belt municipalities of the province of Palermo to the late-thirties in the big city hub of Milan.

3.2. Multivariate analyses

This section presents the results of multivariate linear regression models analysing the association between the inner area detailed class and the TFRs and group-specific fertility rates (ASFR and PSFR). Figures 5-6 present predicted fertility rates by local area class, net of population density in the area, share of men and women with tertiary education and regional dummies.

[8] The irregularities in small municipalities (e.g. Poggiorsini) are due to the low number of women in certain age groups and the year-to-year fluctuation in number of births to these women (see Method section).

Figure 5 – *Total Fertility Rates by local area class. Italy 2022.*



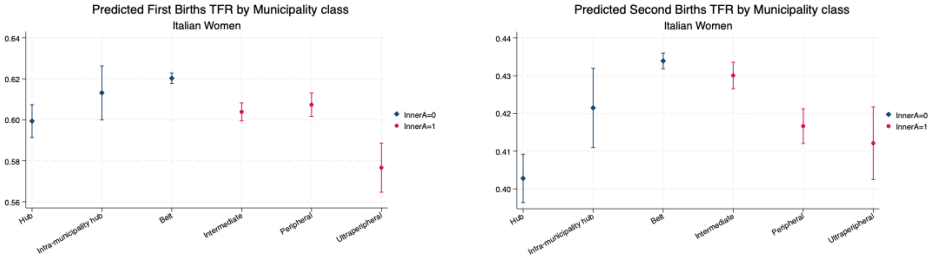
Source: Authors elaboration based on ISTAT data.

Figure 5 shows that the predicted TFR is higher in the belt municipalities and lowest in the ultraperipheral areas. The latter are only a few, so confidence intervals are quite large, and they overlap with the predicted TFR for the hubs so we cannot definitely conclude that in the ultraperipheral areas fertility is lower than in the large urban cities. Figure 6 shows, however, that first order fertility rates are significantly lower in ultraperipheral areas compared to any other kind of class of municipality while in the hubs what is lowest is the progression to a second child. The advantage of the belts also appears when we look at the predicted fertility rates for second births which are higher in those areas compared to any other.

If we look more specifically at the predicted ASFR in the different areas (Figure 7) we see childbearing delayed to later ages in hubs and belts relative to ultraperipheral areas, especially for first order fertility (Figure 8). Women living in ultraperipheral areas display similar fertility rates to belt areas until the late 20s (except for first order births to women 25-29 which are slightly higher in the ultraperipheral areas). However, from age 30 women display significantly lower fertility (early thirties in first order and late thirties in second order fertility rates).

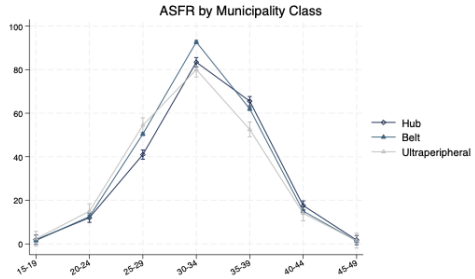
Finally, Table 1 shows that the differences in TFRs across class of local area do not entirely depend on socioeconomic municipality characteristics. Controlling for local areas' economic and labour market conditions (income levels, men's and women's unemployment rates, share of workers' high-tech specialization) and welfare support (share of children aged 0-2 in public childcare, expenditure on social policy) only modestly reduces TFRs' differences by local areas' class (Model 2).

Figure 6 – *First and Second order Fertility Rates by local area class. Italy 2022.*



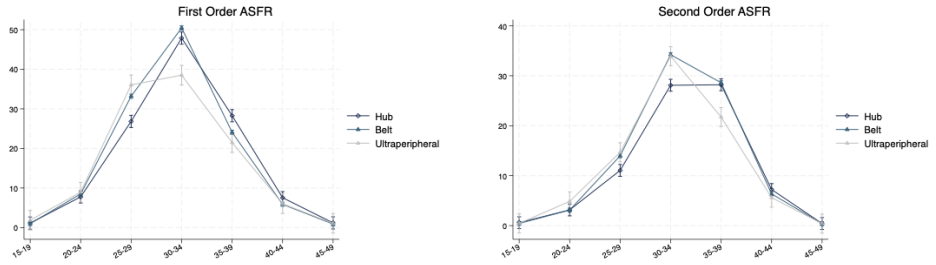
Source: Authors elaboration based on ISTAT data.

Figure 7 – *Age-specific Fertility Rates by Municipality Class. Italy 2022.*



Source: Authors elaboration based on ISTAT data.

Figure 8 – *Age- and Parity- specific Fertility Rates by Municipality Class. Italy 2022.*



Source: Authors elaboration based on ISTAT data.

Table 1 – *Total Fertility Rates, local area class and socioeconomic indicators. Coefficients from linear regression models. Italy 2022.*

	Model (1)		Model (2)	
	Coeff.	CI	Coeff.	CI
Local area classification - Reference category: Belt				
Hub	-0.040***	(-0.053 - -0.028)	-0.039***	(-0.051 - -0.026)
Intra-municipality hub	-0.006	(-0.026 - 0.013)	-0.005	(-0.024 - 0.015)
Intermediate	-0.034***	(-0.042 - -0.027)	-0.028***	(-0.036 - -0.020)
Peripheral	-0.049***	(-0.059 - -0.039)	-0.037***	(-0.047 - -0.027)
Ultraperipheral	-0.091***	(-0.109 - -0.073)	-0.072***	(-0.091 - -0.054)
Population Density	0.019***	(0.015 - 0.022)	0.015***	(0.012 - 0.019)
Men with tertiary education (%)	-0.001	(-0.003 - 0.000)	-0.003***	(-0.005 - -0.002)
Women with tertiary education (%)	-0.003***	(-0.004 - -0.002)	-0.004***	(-0.005 - -0.002)
Per-capita Income (per 10 thousand Euros)			0.008***	(0.007 - 0.010)
Male Unemployment Rate (%)			-0.006***	(-0.009 - -0.003)
Female Unemployment Rate (%)			0.004***	(0.002 - 0.007)
High-tech specialization (%)			0.002***	(0.002 - 0.003)
Children (age 0-2) in childcare (per 10% increase)			-0.003**	(-0.006 - -0.000)
Public Social Expenditure per capita (per 100 Euros)			0.009***	(0.003 - 0.016)
Regional dummies	YES		YES	
Constant	1.271***	(1.251 - 1.291)	1.122***	(1.078 - 1.167)
Observations	18,872		18,865	
R-squared	0.179		0.188	

Source: Authors elaboration based on ISTAT data.

4. Discussion

The study suffers from a few limitations. First, the aggregation of the smaller municipalities reduces the advantage of disposing of municipality-level data and the variability in the area characteristics. We prioritize the correct estimation of the fertility rates over the exploitation of the variety of the over 7.9 thousand Italian municipalities. Future research could elaborate on our analyses and, for instance, gathering more time points data, estimate fertility rates in very small municipalities by averaging live births and women by age groups over a few years to avoid small fluctuations in live births having a large and implausible impact on TFR estimates. Second, for the sake of conciseness here we did not look at variation over time although it would be important to investigate time trends in fertility in response to changes in the characteristics of municipalities, especially from before to after the Great Recession, when the fertility decline started. Finally, the R^2 in Table 2 is quite low, suggesting that other variables not included in our models also contribute to the variation in TFRs across local areas. Our aim was not to fully explain the territorial variation in TFR, however, we acknowledge the low overall explanatory power of the model. Despite these limitations, our study points to the relevance of local area characteristics and especially the accessibility as an

important determinant of fertility behaviour. We stress the importance of investigating group-specific behaviour which informs not only about the levels of fertility but also about the timing and parity progression of fertility. Building on our findings, possible avenues for future studies concerns the role of the interaction between local area type and socioeconomic structures and its change over time in shaping group-specific fertility.

Appendix

Table 1 – *Descriptive statistics.*

Variable	Obs	Mean	Std. Dev.	Min	Max
TFR	2,696	1.167	.217	0	2.5
First Order FR	2,696	.613	.138	0	2.5
Second Order FR	2,696	.428	.117	0	.934
Km^2	2,696	784.306	1,650.848	10.795	18,296.012
TOT popres2021	2,696	153,825.07	498,652.9	1071	19,391,582
Population density	2,696	622.94	965.86	1.006	11,766.31
Public childcare 0-2	2,696	13.898	12.297	0	100
High-tech Specialization	2,696	2.581	3.749	0	48.368
% Men Tertiary Edu	2,696	18.709	5.206	5.769	47.097
% Women Tertiary Edu	2,696	28.94	6.152	3.448	56.075
Public Social Expenditure	2,696	20,206.135	3,776.182	11,274.424	48,385.574
Income PC	2,695	111.151	78.343	0	618.802
Men Unemployment (%)	2,696	7.552	3.563	1.029	24.939
Women Unemployment (%)	2,696	10.832	4.314	1.613	25.189
Inner Area Class					
Hub	182	6.75%			
Intermunicipal Hub	59	2.19%			
Belt	1,546	57.34%			
Intermediate	529	19.62%			
Peripheric	309	11.46%			
Ultraperipheral	71	2.63%			

Source: Authors elaboration based on ISTAT data.

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