UNIVERSITY OF MESSINA

ECONOMICS DEPARTMENT

PhD in

ECONOMICS, MANAGEMENT AND STATISTICS

Curriculum of Statistics
XXXIV edition
SSD

The Effects of Early-Childcare Services and Flexible Employment on TFR in Europe

PhD thesis of:
Francesca Viviana Cocuccio

Supervisor:
Prof. Angelo Mazza

Co-Supervisor:
Prof. Massimo Mucciardi

A.A. 2020/2021

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Introduction

This PhD thesis work aims to deepen the demographic phenomenon of fertility analysing the joint effect of Childcare Services and Flexible Female Employment on fertility in Europe basing on the recent literature on this topics[1]. As is well known, in fact, fertility is a central theme in the European population's dynamics of study and it has assumed a primary importance especially since the 1970s, due to the gradual and progressive decrease in fertility rates and the social consequences that this can entail for the individual and society.

This is especially true in post-modern and globalized times such as ours, in which the dynamics of fertility, together with that of mortality, draw the consistency and structure of the population and the sub-populations that compose it, clearly describing important changes cultural, social and political and economic.

[1]For the complete discussion on the recent literature on the influence of Childcare Services on Fertility and of Female Employment on procreation choices, look at Chapter 2. The most recent paper considered in this research are Campisi (2020), Wood and Neels (2019), Salvati et al. (2020), Rindfuss (2017), Blum (2012), Gesano (2019) et al., see the references.

Low fertility over time can alter the *inter-generation dependency rate*[2], causing consequences also in the labour market and on welfare systems. In fact, with a reduction of the active population compared to the increasingly numerous, long-lived and tending to the chronicity of diseases, the sanitary, welfare and social security systems risk collapse, in spite of an increasingly insufficient contribution given the minority of the active population.

It is for this reason that I have chosen to analyse the fertility in Europe with a specific final focus on the Italian situation (see the Appendix at page 157) to analyse the peculiar characteristics and local differences of this phenomenon in these local contexts. Recent studies of Campisi[3] and Wood[4] evidence the different kind of influence of social and economic dynamics such as the GDP per capita, the female level of study and the female employment on the fertility local rates among the local territories. These demonstrations underline the importance of spatial analysis to deepen the peculiarities of fertility in Europe. I realized my research doing a spatial regression of the determinants related to the fertility rate of the local populations, according the literature on the topic. The purpose is to verify if there is any spatial variation of the influence of social and economic factors as the presence of childcare services and flexible female employment on the

[2] This rate measures the dependency rate between generations is given by the ratio between the inactive population (made up of people not in active age, i.e. minors under 15 and elderly post-retirement) and the population of active age (15 - 64 years).
[3] Campisi et al. (2020).
[4] Wood, Neels (2019).

fertility. These phenomena by recent literature[5] are the major factors responsible for the local low fertility rates. Campisi's research is one of the few analysis at European regional and provincial level on the fertility in 2010, but it is not possible to consider this as a longitudinal study for the unavailability of temporal data at this spatial level. This my analysis, gives a new contribution to Campisi's research confirming the positive influence of childcare services jointly to the female part-time employment on the TFR and considering at regional level new time units, analysing this influence in the 2014-2017 period: a more recent period and not limited to a single year as in the Campisi's study.

The methodology applied is the Geographically Weighted Regression (GWR), applied using the Ordinary Least Square (OLS) as a reference model to motivate the use of the GWR spatial model. The use of a spatial model shows to know how much it is different the weight of reconciliatory policies and employment measures on the fertility choices, as Wood confirms in his studies[6].

Through the GWR, it is possible to carry out a comparative analysis of the territorial data, in order to obtain information about the different kind of influence of socio-economic determinants on the phenomenon of fertility in some geographical areas rather than in others. This is in order to the

[5] Picchio (2018), Pezzulo (2017), Gesano (2019), Wood and Neels (2019), Campisi (2020), Sabotka (2013).
[6] Wood and Neels are two authors who applied the spatial methodology on the analysis of the fertility phenomenon in Belgio, a context characterized by many socio-economical variability (2019)

assumption of Campisi study and to the Toulemon recent one[7] who confirm the methodological choice of spatial analysis to know local influences of socio-economic dynamics on the fertility topic, which a global analysis may not reveal.

In particular, according to Toulemon's research which underlines the contextual influence of national welfare measures on the fertility choices[8], this analysis aims to deepen the spatial effects of Childcare Services for early childhood under 3 year old (CS) and Female Employment Flexibility policies and Income situation (GDP per capita) on Total Fertility Rate (TFR) within the different European spatial units. My research brings an innovation to the Toulemon's study analysing this influence at a more detailed spatial level: not only at national level but at regional level too, comparing both to know the local positive or negative correlations. This work gives another innovation respect to the previous analysis of Wood[9] about the influence of the female flexible employment (FFE) on fertility. Wood underlined the spatial variability of the influence of CS on the first and subsequent births at provincial level, but not jointly to the flexible female employment on the fertility local rates. My research considers this joint influence at local levels on TFR: this is another new contribution carried by my PhD thesis.

All of these studies derive by objectives enunciated in the 2002, at the Barcelona European Council. This council sets objectives with regard to the

[7] Toulemon et al. (2021).
[8] Toulemon (2021) analysed the *spatial* influences of the conciliatory policies and economic conditions on the young fertility and total fertility in Europe at national level (Nuts0).
[9] Wood, Neels (2019)

availability of high quality and affordable childcare facilities for pre-school children, to improve the female employment rate and the TFR's growth. Thus, the object of this PhD thesis is to analyse *how much* the influence of CS and female employment policies on TFR is determinant on the actual European TFRs, within the *local* differences between the member states, in according to the literature on the fertility phenomenon. This job carried on this purpose trying to denote the different influence of socio-economic and welfare factors on the procreative choices in different local contexts, according to the input of the previous literature on the importance of spatial models to study this systemic demographic phenomena.

About that, an interesting longitudinal spatial study on Fertility is of Salvati[10], who allows deepening the evolution of the phenomenon of fertility in relation to migratory, economic and labour phenomena. Unfortunately, in my research, it was not possible to build a panel or a court due to the unavailability of recent childcare services data and flexible female employment local rate data and for a sufficient number of European qualifications at the regional European level (Nuts2[11]). For this reason, it is not possible create a sufficient longer panel able to describes the demographic changes which is possible to observe, generally, almost in a period of ten years. Thus, I carried out my PhD research using two GWR models at Euro-Nuts2 and Euro-Nuts0 spatial levels in a period since 2014 to 2017. This is a

[10] Salvati L., Benassi F., Miccoli S., et. al., (2020).
[11] For a deeper description of Eurostat Nuts classification see paragraph 3.2

cross-sectional analysis rather than a longitudinal one, for unavailability of the data of interest, conditioning the time-selection on a period of four years. Thus, having a lack of data availability, I chose to consider the average period of the 2014-2017 to protect my dataset from abnormal annual fluctuations that should distort the research results (see paragraph).

The first chapter of this thesis describes: a) the definition of Fertility and of the low-fertility concept, a description of the principal factors affecting fertility and the principal demographic theories on it; b) historical nods on Fertility in Europe; c) principal fertility measurements.

The second chapter get to the heart of the research question. There it is possible to find the recent scientific literature examined on the influence of flexible female employment and family care policies on TFR in Europe and the Research Hypothesis of this PhD Thesis. Starting from the literature examined, seems to be interesting to deepen these questions of research: do the Children Services influence TFR in Europe? If yes, do they influence TFR *jointly* to the Female Part-time Employment? In addition, *where* does it happen more? Thus, the object of research is to discover the local differences of the influence of the determinants chosen, to compare these results each other and with the previous literature on the topic. Therefore, it can allow monitoring the trend of the phenomenon in a spatial prospecting not generalized too. A scope of this local comparison about fertility determinants is to give support to reprogram new local reconciliatory policies to contrast the lowest-low fertility phenomenon.

The third chapter shows the methodological choices of this research. In particular, there I explain the description of the research methodology applied and of the determinants chosen. In this chapter too, I clarify the reasons for an analysis carried out on different spatial geo-level. In simple words, an analysis on different deeper geo-levels underlines the usefulness of spatial model application to explain the multifactoriality of socio-demographic phenomenon as the fertility. To understand this kind of constantly changing phenomena, it is useful to change the way to analyse the demographic phenomena from "macro" generalized point of view, to a "micro" and specified optical of research. An analysis in deeper geo-levels (European Nuts2 regional level, rather than European national Nuts0 level), has more disaggregated data, thus it allows to deepen local differences which cannot perform in superior geo-level. The explanatory variables used in Nuts0 European geo-level are the same used in Nuts2 European geo-level for comparison reasons. Only the determinants used in the adjunctive focus of research on Nuts3 Italian geo-level are different from the previous, due to the unavailability to have the same Eurostat indicators in DemoIstat, which not allow comparing the results with these of the previous two European levels. This is the reason because the Italian study on the fertility is an analytical focus. In this PhD thesis, this is only a focus on the Italian situation on the fertility at provincial geo-level (Nuts3 level) and not a comparative application of my analysis, for that reason you can find it only included in the appendix of this thesis as a supplementary study. I presented this

supplementary part of my research and its results at the Bocconi University in Milan on the occasion of the AISP Pop Days 2019 organized by SIS (*Società Italiana di Statistica)* in January 2019.

In the fourth chapter, there are the results of the European analysis on fertility, firstly at Nuts0 and Nuts2 geo-levels. This chapter starts with a descriptive analysis of the research indicators at Nuts0 level and a description of fertility condition by Nations to give the reader a clear vision of the conditions of the phenomenon and of the determinants of analysis among the different territories. The chapter continues with the explanation of determinants selection for the spatial model by the Multicollinearity test and the specifics of the dataset construction. Then there are the results of analysis at Nuts0 geo-level. The successive paragraph show the same analysis applied at Nuts2 European geo-level for deeper interpretative aims, with its methodological peculiarities and the results at Nuts2 geo-level.

The European analysis at Nuts0 euro-level is also my first paper published on the "Book of Short Paper" SIS 2020, published by Pearson, ISBN 9788891910776, 2020.

In the conclusions of this PhD thesis, reporting to the literature examined, I expose my interpretation among the socio-demographic deductions emerging from the research analysis results within the two different European regional geo-levels. From the comparison of the results of the two geo-levels, it is possible to confirm the thesis of Wood and Neels[12]

[12] Wood, Neels (2019).

on the positive significance of the presence of CS especially for women employed on the fertility local rates. This contribute confirms also the thesis of Rindfuss, Blums, Sabotka and Bernardi on the effect of the conciliatory policies on the fertility growth without repercussion on the female employment[13].

At last there is the Appendix, how I have explained before, it includes an additional focus of research on the Italian fertility situation. This analysis uses the methodology of the GWR spatial model too. This is a provincial study among the influence of local expenditure for conciliatory services and local services for early-childhood and the spatial variability of the influence of employment rate jointly to the influence of cultural provincial level[14] and to the provincial location monthly rent[15] on TFR at Italian provincial Nuts3 geo-level with the relative conclusions among the results[16].

[13] Rindfuss (2017), Sabotka (2013), Bernardi (2017), Blums (2012).
[14] Analysed through the indicator of presence of libraries per 1000 inhabitants, (LIB_16) as a proxy.
[15] I considered this kind of influence using the determinant of provincial position in 2016 for the "Monthly rent".
[16] This Italian analysis is a publication discussed on the SIS PopDays 2019.

CHAPTER 1

Fertility: concept and measures

1.1 Fertility definition and lowest-low fertility

Whenever a study process begins, it becomes of primary importance to define the object of study, the operational definition of the concept to analyse. With this purpose, in this paragraph I will define what is meant in demography by fertility.

Firstly, it is useful to distinguish “fertility” to “fecundity”. The two meanings are not interchangeable as they indicate very specific different concepts. “Fecundity” is the potential ability to conceive or generate, mostly used in the medical-biological field. In other terms, it is the biological aptitude to procreate. On the contrary, with the term of “Fertility” refers to the actual reproductive behaviour in its concreteness, so in other words to the effective quantity of children generated. In demography is therefore analysed not fecundity but fertility, which is measured through different fertility indicators.

Fertility is a common object of study for the well-known problem of the "lowest-low fertility"[17]. Historically there have already been periods of lowering fertility, think of the Second World War for example, but this is an epochal phenomenon for demographics. In a few years, this demographic emergency affects a large part of Europe and beyond. This lowering below the 1,3 threshold is very important for demographers because it has a historical meaning: if the TFR should remain below the 1,3 for a long time, it would result in an annual reduction in births of 50% and consequently, a halving of the population in less than 50 years.

The literature converges on identifying as the main causes of the lowest-low fertility, the postponement of childbearing and the reduction of the progression of the "second-order births", which is the quantitative dimension of the offspring. There are heterogeneous and multifactorial causes at the base of this phenomenon, different in every spatial context and therefore not generalizable (see paragraph 1.3). However, according to the literature on the topic, they all seem to have some salient features in common: ideological changes attributable to the "Second Demographic Transition" (SDT); the training hyper-specialization of women in school education and the postponement of transition to adult life linked to socio-economic and cultural reasons.

[17] When we talk about "lowest-low fertility" we refer to the lowering of fertility below the 1.3 threshold of TFR, a negative threshold first reached in Europe by Italy and Spain in 1993 according to widely recognized estimates.

1.2 Demographic Transitions Theory

The postponement of procreation is a central element at the basis of the SDT theory, above all linked to an inversion of tendency on the ideological level, which moves towards an *individualistic* level. After the feminist ideologies of '68s and the individualistic and autotomizing ideologies of the '70s, the individuals and in particular the woman, have sought greater levels of autonomy and of refusal of institutional control[18]. Values associated with satisfaction have gradually established themselves higher order needs of the individuals, gratification and affirmation through social status and gender equality. These cultural changes have generated new fertility preferences, which from a sociological point of view that also changed the family and society in terms of structure, models, roles and values[19].

Many researchers link the high uncertainty experienced by young adults, in terms of opportunities and working conditions and economic stability, to a general delay of the phases that characterize the passage to adulthood. In southern Europe in particular, the lowest-low fertility has been associated with late transition to adulthood[20]. Thus, in presence of uncertain

[18] These new individual values these new values take shape from ideologies such as Marxism, which claim the rights of the proletariat and instigate the struggle against capitalism and the affirmation of the principles of freedom and equality between social classes.
[19] Saraceno C. (2019), Bernardi (2017), Mencarini (2018), Picchio (2018), see in references.
[20] Baizàn (2015), Rosina (2018), Billari (2004).

economic and working conditions, people tend to postpone the procreative choice and young people tend to extend the remaining period in the family of origin, especially in the southern European regions.

For definition, a "transition" implies a shift from an old to a new balance. This evolutionary dynamism presupposes the crossing and overcoming of crises. To know if we are in presence of a transition or in a condition of balance, we have to speak about the "population balance equation"[21]. The following formula can summarize it:

$$P_{t+1} = {}_tP + {}_tN - {}_tD + {}_tI - {}_tE \qquad (1)$$

Where ${}_tN$ represents the births in a specific time interval; ${}_tD$ are the deaths, ${}_tI$ denotes the immigrations and ${}_tE$ are the emigrations.
In this formula, we have to distinguish the natural balance ${}^nS = ({}_tN - {}_tD)$, from the migratory balance ${}^mS = ({}_tI - {}_tE)$, of the population.

From this equation derives that the population growth rate is equal to:

$$r = {}^nS + {}^mS \qquad (2)$$

Thus, in a population with absence of transition, there is a balance of nativity and mortality.

[21] This is a logistic classical equation used in demography. The "population balance equation" starts from the assumption of population's constant evolution. In this process, births and immigrations influence as incomes compensating for the outgoings of deaths and emigrations.

Before the Industrial Revolution, in the *ancient règime*, before the *First Demographic Transition (FDT)*, the population growth was very high due to the inexistence of birth control and mortality is very high too due to poor health conditions and high exposure to epidemics, plagues and famines. The period of passage from a phase of equilibrium to a phase of new equilibrium therefore is a "demographic transition". In the history of man, there have been several stages of transition from the Neolithic to the present. However, the only one documentable is the transition inherent the passage from the "ancient règime" to the contemporary Era. Historically it coincides with the period of the industrial revolution, urbanization and the sanitary revolution of the late 19th and early 20th century. From a demographic point of view, the FDT consists by two sub-transitions: health and reproductive. The expression *health transition* refers to the innovations and goals obtained in medicine, which made it possible to improve hygienic conditions, prevent and treat many causes of death at the end of the 19th century, causing the reduction of infant mortality[22], plagues and epidemics, reducing the total mortality rate. Instead, the reproductive sub-transition refers to the control of procreation, first of all through a cultural change in the way of understanding sex and only after through contraceptive methods which allowed the reduction of the number of children per couple. This sub-transition is a cultural revolution, which modified the concept of sexual intercourse. In fact, before the FDT, sex was exclusively a reproductive tool, after this it takes on

[22] The deaths of children in the first year of life (De Santis G., 2010).

different meanings associated with couple pleasure, feeling or personal freedom. This new consideration of sex caused the reduction of the TFR from over 5 children per woman to no more than 2: in particular, in 1870 in most of Europe the TFR was around 5 children per woman, until 1910 when it drops to 3.5 with the exception of Mediterranean countries where this decline is slow in coming. This reduction of TFR corresponds to the processes of industrialization and urbanization, which caused the affirmation of the bourgeois family, which abandons the logic of using offspring for family rural work and embraces the pedagogical principles of obligatory schooling. In this way, the offspring decreases quantitatively and progressively increases the expectations and qualitative attention towards them.

From the end of 1800 to the first decade of 1900, the industrial wellness due to the transition caused a very high growth of the population in the world and in particular in the European countries. This was the time of the beginning of the great migratory flows due to the development of the infrastructures and of the mass media and the communication development too. The FDT ended with the post-war period: the two world wars caused a high mortality of the generations born by the birth boom of the first transition and consumed a large part of the industrial tools produced. Therefore, the post-war period seemed to represent a new demographic balance with a generational replacement rate of just over two children per woman, sufficient to compensate for an average life expectancy of 65 years. This equilibrium became again in crisis in the last decades of the 1900s by the phenomenon of

the *aging of population*[23]. The causes of this new transition are cultural and social and depends from the new values of feminism, individualism and consumerism since the 70s and still evolving and affirming. These changes affect cultural values, gender roles, social and individual priorities that also modify the way of considerate the family and sexuality. All of these changes generate the *Second Demographic Transition* (SDT).

However, there exist also other theories which dispute the Demographic Transition's Theory: in 1963 started the "Princeton European Fertility Project", a Ansley Coale's research project to investigate the progress phases of the European transition[24], but allows to dispute the first demographic transition theory's assumption on the correlation between growth of birth and growth of mortality. From these studies emerged a great variety of processes that sometimes diverge with the demographic transition theory in terms of timing and rates of mortality or fertility. This seemed to be linked not only to economic and industrial factors, also to social, cultural and ideological factors that influenced reproductive behaviours and individual life choices (micro factors). Therefore, exogenous and endogenous factors influence fertility[25].

The SDT cannot be finish yet, because it moves on new peculiarities as the *individualism*, an ideology and an engine of behavioural choices. In

[23] which consists in a sudden decrease in fertility flanked by a progressive lengthening of the duration of life.
[24] Coale A.J. (1965).
[25] Look at paragraph 1.3 .

this transition of post-modernity, the supporting cultural values are utilitarianism, consumerism also applied to the human relationships[26].

The collective vision of values that placed the homeland, men exchange the focus from family and peers to the egocentric and individual, point of view: starts a narcissistic human prospective. This new focus takes place in the middle the plasticity of appearances and the "liquidity of human relationships". In this extremist perspective of the individualism towards which contemporary occidental society tends, fertility becomes a secondary choice respect to personal work and social fulfilment, pleasure and the preservation of beauty. The demographic effects are increasingly lower TFR and increasingly postponed fertility in the woman's biological Chrono-program. A possible answer to this decrease of TFR can be the migration fluxes and their childbearing, but it would not be enough to recreate demographic balance yet[27].

[26] About these concepts Zygmut Bauman speaks about "liquidity relations" as a kind of relationship labile, timeless, relationships based on the immediacy of contact and "consumability", devoid of deep and real knowledge of the human essence (Bauman, 2012).
[27] Bonifazi, 2017.

1.3 The main factors affecting fertility

There exist several kind of aspects affecting the reproductive choice[28]. This happens in the SDT too, thus it is important understand how many elements a researcher have to analyse.

It is common used dividing the factors affecting fertility in *endogenous* and *exogenous* factors.

First, among the endogenous factors there is the biological ability to procreate, the *fecundity*. It depends from the biological age of the woman and can depend by a more or less high degree of male, female or couple sterility. In today's transition, in this regard, as exogenous factors that interfere on this type of endogenous factors, we have to consider the adoption of *assisted procreation* and *biogenetics*, new frontiers of increasingly used procreative medicine. However, there is an ambivalent factor: it is possible to consider the desired number of children as a factor endogenous and exogenous both. In fact, it is true that it is a personal need but it arises from expectations induced by the socio-cultural context of reference, inherent in the social status and the conditions of economic and social well-being in which the individual lives. It depends on the purchasing power of the woman and on the value associated with children-care too, that are factors relating to cultural models influencing individual decision-making capacity (exogenous determinants).

[28] Coale (1965).

Another social phenomenon that influences the procreative choice is also divorce and separations too, that create dead-times in the procreative period of the woman. Furthermore, from a research on post-divorce or post-separation fecundity[29], it emerges that women in new post-divorce relationships have a lower propensity to procreate than men seem to show. Probably there are endogenous variables related to the woman's low confidence in second relationships.

An important factor that affect fertility choices is *the increase in child survival* caused by the health's progresses of the twentieth century. This phenomenon changed the conception of offspring, changing the economic value of the prole from the source of income and labour for investment reasons. This new orientation associates the reproductive choice with a cost-benefit balance both in economic terms and in terms of time and care.

According with Becker[30] reproductive choice depends mainly on three factors: family income, the cost of children and resource allocation preferences. From this, it would derive that in affluent family contexts the number of children depends on the family's ability to maintain and educate them in terms of investment of money and care time. This model would impose a gender inequality in the subdivision of family roles, which would allow the fostering of fertility if the woman devoted herself to family care and the man to economic sustenance. Nevertheless, in contemporary society this

[29] Bavel (2012).
[30] Becker (1981).

model is not feasible as it clashes with the needs of a woman's social and working self-realization. Hence, the *reconciliation policies* become central for the problem of low fertility, which in this sense becomes an institutional and cultural problem. Institutions must become able to smooth out gender inequalities in the work, economic and family spheres by creating childcare services and tax breaks for female workers and above all by proposing new cultural models of gender equality between the sexes in family and social contexts. These are not only the presence of services or forms of incentives for female work, but support policies in the gender division of care actions in the domestic life. According to these considerations, these "cultural factors" affect fertility. These phenomenon certainly include the postponement of the entry of young people into adult life due to cultural and social dynamics inherent the extension of the period of study and specialization. On this one, are influent also the increasingly postponed retirements and the consequent difficulty in finding a job for the younger people, from which also derive economic difficulties due to the escape from the original familiar nucleus and, last but not least, the prolongation of the adolescent phase of clouding of the responsible choices[31].

The conciliation policies can reduce gender inequalities in the division of domestic and care roles but they can also concern youth policies facilitating entry into the world of work or housing policies to facilitate exit from the family home. Again, welfare policies have to be able to avoid

[31] Bauman (2012).

burdening families with the care needs of the aging population due to the longevity of the older generations and the chronicity of diseases that once led to less late deaths. In this sense, policies can influence the reproductive behaviour as exogenous factors too. Just thinking at countries with high fertility rate, there are good family policies to conciliate work needs and family care needs (see paragraph on the literature on fertility) and at the contrary, in other oriental countries there exist birth control policies to control excessive birth rates, think of the Republic of China for example.

1.4 Some socio-demography history on Fertility in Europe

At territorial level, many dynamics and factors explain the significant decrease in fertility in the Italian context. Firstly, we must distinguish the possible reasons for the decline that has occurred in most advanced development countries since the second half of the 1960s from those that triggered the decrease in births during the first demographic transition. Furthermore, we have to recognize that the dynamics of the decline in Northern European countries are different from those of the decline in

Southern European countries, although there are similarities and common factors.

Among the determining factors for the reduction of fertility there are some structural ones, others socio-economic ones and others cultural ones. The drop in fertility has short-term causes, such as the shift of age towards childbirth and causes linked to welfare, economic, socio-cultural dynamics, expectations, ideologies and values, which have gradually evolved from the end of the nineteenth century to today. The trigger for these transformations of reproductive behaviour was the transition from "natural" fertility to one defined as "controlled" introduced as early as the second half of the 19th century[32]. This one gradually replaced forms of control of less incisive births, such as the extension of the breastfeeding period and the postponement of marriage, with practices frequently used in the early nineteenth century to limit births and distance them over time.

The real revolution in reproductive behaviour, however, occurred with the acquisition of importance attributed to the desire to control the numerical dimension of the family, which materializes through *contraception*[33]. The spread of contraception is a socio-cultural factor linked to the processes of *modernization* and *urbanization* that consolidated in the twentieth century. These phenomenon, have transformed the lifestyle of the masses from the smallest to the greatest habits of everyday life. The entry of women into the

[32] Rosina et al. (2014).
[33] Livi Bacci (1998).

world of work, which has increasingly taken place in different sectors and in more ways, has gradually begun to make the family care roles of large families less compatible.

The increase in education levels for both men and women has also prolonged the *duration of the training process*. To increase the growth of child support costs was the increase in literacy and the reduction of early school leaving compared to what happened previously. These costs are duplicate if we consider that the schooling of children replaced a child labour force that contributed to the support of the poorest families.

Another socio-cultural factor that affected the FDT was the *advancement of medical-scientific progress* and the consolidation of the basic *health hygiene practices* of the masses. The result was a rapid drop in infant mortality from which followed the futility of generating a high quantity of offspring to assure a prole to their families[34].

These factors changes the TFR in the first and second transitions still in progress, but they are different in time and space and have aroused the interest of numerous researchers interested in understanding the employment or childcare dynamics, youth and family and gender policies in working environment underlying the local variations of the phenomenon of fertility. Important demographic dynamics are linked to these, such as local differences in the more or less delayed *entry of women into the labour market*,

[34] Rosina et al. (2014).

immigration and emigration to foreign countries or to local areas with a better level of employment and quality of life.

Among the main determinants that many studies have associated with the contemporary decline in fertility are both factors related to Western individualist ideology and socio-political factors. First, the *postmodern ideology of consumerism and individualism*, which since the twentieth century has been a firm guide for the wester men behaviour. That one have contributed to induce a growing need for personal and professional self-fulfilment in women. This leads her to nurture employment and career expectations, which equate her training and employment needs with those historically associated with the male gender. This inevitably leads to an extension of study and career time, which makes it necessary to have specific family and childcare policies in support of family to facility the reconciliation of employment and reproductive needs.

Before the Urbanism, the *gender role* associated with women was mainly that of taking care of the offspring, home hygiene and elderly members of the family (often numerous and intergenerational). Today the role expectations induced by the current ideological models described above cause the prevalence of increasingly equal and interchangeable gender roles within the couple and a reduction in intra-family care activities.

Therefore, the choice regarding the number of children and the postponement of maternity are increasingly conditioned by the *presence of public or private welfare services* (present and accessible).

Another important factor were the new gender models that contributed to untie procreation from the marriage institution. This has led to a greater *precariousness of relationships*, which often seems to influence the delay or the choice of motherhood itself.

From what we have said before, another significant factor compared to the drop in fertility in South European Countries is the generalized shortage of *family and housing policies*, more critical in some territorial areas (Italy, Greece and Spanish too). It represents a further problem for young people who intend to leave the family unit of origin to form a new one. To this disadvantage, there are additional precarious working conditions like in Italy, for example, after the modification of art. 18 of the Workers Statute. These factors do not give a *perception of security* that pushes parenting by undermining the ability to carry out long-term projects[35]. At the same time, there is still few flexibility in terms of spreading tools such as part-time for working mothers: instead replaced by rigid working hours that do not allow a good conciliation between work and family[36].

The differences existing in past years seem to be attenuating by a process of convergence of different levels of fertility between the European geographical areas. In recent years, this change seems to be determined by opposite dynamics of the various territories. Since the mid-1990s, fertility in the Centre-North Europe has experienced a slight increase, which then

[35] De Rose (2008), Modena and Sabatini (2012).
[36] De Rose et al. (2008), Matysiak and Vignoli (2013).

stopped in the late 2000s, while in the Mediterranean area the decline was continuing.

This convergence process is taking place despite the persistence of still strong economic and social imbalances between those, which make up the two main geographical realities (central-north VS south Europe). Thus, it is fundamental for this analysis to know which determinants generate these geo-local differences, which therefore represent the main reason that pushed this study towards the choice of a spatial type methodology (see chapter 2).

1.5 Principal Fertility Measurements

Since 1662, when John Graunt gave the basis of the formal demography with his mortality tables, the demography was an analytical science that study phenomena about population behaviour from a "macro" point of view. On this prospective, this kind of analysis require processing that starts from elaboration of data obtained from sources that collect massive data. Only in the seventies of the twentieth century, demography methodology had an important progress: the "World Fertility Survey"[37] that changed the way to analyse the demographic behaviours. In this new kind of

[37] It was a "cross sectional surveys", realized since 1974 from 1982. It consists in a series of transversal sample surveys (thus, individual and random) which introduced a new kind of demographic analysis based on individual prospective as object of study.

analysis, the researcher investigate on the previous reproductive individual behaviours and choices inherent also the formative and professional sphere. The characteristic is that the units of analysis are single individuals. This change of perspective in the demographic methodology is important because it extends the object of study of the demographic analysis from a "macro" plan, which considers through aggregate data the phenomena as homogeneous events for a completely specific population of individuals, to a "micro plan" in which, instead, heterogeneity becomes central. In this new viewpoint, the demographic event must be studied paying attention to the relationship between events and context with an explanatory and multivariate methodology. However, it is possible to say that in demographic analysis there exist two prospective of analysis: *transverse* and *longitudinal*. An analysis conducted according to the transversal perspective tends to analyse the phenomenon of study by observing the object of study from a historical-causal point of view. Instead, a demographic study carried out using the longitudinal perspective concentrates the study focus on the multifactorial context that conditions the changes of a specific generation.

Even in the 1970s, Cox[38], with a paper on the "Regression models and life-tables" initiates the use of the statistical method of regression (OLS model) in the demographic context for the systemic explanatory analysis of individual behaviours.

[38] Cox (1972).

The perspective changes starting from Becker's "Treatise on the family" in 1981[39], according to which events can be analysed based on the study of individual rational choices. Therefore, demography redefines its analysis methodology tending to connect the phenomena of study (macro dimension) with individual biographical events (micro dimension) which must contextualize with external factors in a systemic logic, historical, social, political and economic. This research moves its methodological steps in this systemic perspective of fertility analysis with possible specific explanatory determinants.

To study the fertility phenomenon in demography we usually use several kind of indicators. It is possible to distinguish them in *intensity* indicators and *cadence* indicators. The first measure the frequency of the phenomenon, precisely quantify it, and the latter contextualize and distribute the data of the phenomenon by periods, generally by age. In the study of fertility, a well-known indicator of cadence is the *average age of woman at the first childbirth* (W_{AGE}), given by the sum of the products between the central values (median) of each female age (x^c) expressed in annual or multi-year age classes for the respective specific fertility rate ($TFRs_x$) divided by the sum of all specific rates (i.e. the TFR) :

$$W_{AGE} = \sum(x^c * TFRs_x) / \sum TFRs_x \qquad (3)$$

[39] Becker (1981).

The most commonly used indicator in demography to measure the final offspring of a generation is the Total Fertility Rate (TFR). Others are the Specifics Fertility Rate (TFRs)[40], the quantification of live births within a collective of population units and the woman age at first childbirth (W_{AGE}). To compensate for infant mortality and ensure generational replacement, according with the "population balance equation" (see before), the average number of children per woman needed to generate is equal to 2.1. This threshold conventionally is called the "*generational replacement rate*" and represents the minimal quote of birth that ensures the stability of a population.

In demography, we have to distinguish two kind of rates: *specifics* and *generics*. The specific rates allow grasping the heterogeneity of the analysis units; on the contrary, the generic rates tend to consider them as homogeneous with an inevitable consequent loss of information.

Some common intensity measurements of an event as the "generic rates"[41], have the limits to not shows the age differences at which study events occur and this can lead to important distortions when comparing data of populations with different structures of age or sex, etc. For these reasons, generally demographers prefer to use specifics rates and total rates[42]. The TFR is the summation of all TFRs. Where, TFRs is the quotient between the

[40] The Specific Fertility Rate is a measure of frequency that allows to analyse the age distribution of the phenomenon.
[41] A "generic rate" in demography is given by the quotient between events that occurred in a given year and the average population of that specific year and it is generally indicated as the number of events per thousand inhabitants.
[42] In simple words, a Total Rate is the summation of the specifics ones.

number of births produced by women of a specific age (B_{wa}) and the average number of women of that age (M_{wa}):

$$tfr_s = B_{wa} / M_{wa} \qquad (4)$$

Thus

$$\text{TFR} = \sum tfr_s \qquad (5)$$

In this way, we have as many TFRs as there are years of the woman's fertility period (conventionally coincident with the period from 14 to 49 years).

The phenomenon of birth rate in a given territorial context in demographic analysis starts by the study of TFR a variable that represents the average number of children delivered by women in their reproductive period.

As said before, it is possible to calculate the TFR through the formula:

$$TFR = \sum_{x=\alpha}^{\beta} f_x \qquad (6)$$

Where

α = minimum age for which women can have children, usually approximated to 14 years;

β = maximum age for which women can have children, conventionally associated with 49 years;

f_x = the specific fertility rate for age x, hence the average number of children had by women at that specific age.

It is usual for the birth rate and the total fertility rate both, to be object of study in the drop-birth analysis[43]. TFR is one of the most widely used demographic indicators, since its study can reveal the state of well-being of a population, as well as it studies the monitoring about the productive processes and development power of a nation.

The TFR is constantly object of statistical analysis in numerous policy areas (employment, economic, industrial, welfare, socio-health, housing, etc.), historically carried out on a national scale, but today on subsidiary governance too. Although, it may be useful to analyse TFR on a national scale (Nuts0 level) for comparative purposes with other national realities, it involves a significant loss of information regarding socio-economic, demographic and political subnational factors. These factors vary in each local context due to the presence of significant differences and the effective understanding of social phenomena we should consider it.

Another indicator of fertility is the *Total Fertility Rate at the Moment* (TFRm)[44]. Thus, it represents a snapshot of the birth in a specific moment, because each specific TFRm is the compute of all the birth generated by all the woman generations for a specific year and the Total TFRm is their summation.

[43] Instead the birth rate can be defined as the indicator given by the ratio between the live births of a population in a given time and the total number of the population (for convenience it is represented as the frequency of births in a time x per 1,000 inhabitants).
[44] which is the average number of all birth in a specific period (generally a year) generated by the average of fertility of all women in reproductive age

Another usual measurement of fertility is the Coale's index[45]. Until the 1960s, in demographic analyses on fertility, an important slice of the population was not object of survey: women who procreate out of wedlock. Thus, fertility indicators overcome the distortion of fertility data given by the conventional association between fertility and social status of the procreative woman. Infact, the Coale's index allows measuring the overall fertility of all women, independently of their status: the fertility of all women at childbearing age (*If*), the fertility of the current married women (*Im*), and the fertility of the non-married women (*Inm*). "Each of these indexes shows the fertility of the specified group relative to what it would experience if it had the highest set of fertility rates by age on reliable record" and "the index of proportion married (*Ip*) is a fertility weighted aggregate index of nuptiality among women of childbearing age. This means that, if all women from 15 to 50 years are married, the index has value of 1"[46]. Thus, a value equal to 1 represents the highest fertility on record.

The advantages of the Coale's indexes of general fertility, marital fertility and the simple proportion married among women in childbearing age is that these kind of indexes allows to incorporate an indirect standardization for age distribution within the childbearing interval. Furthermore, the value of the Coale's fertility indexes have a direct intuitive meaning because its

[45] Coale (1965).
[46] Coale (1973).

value refers to the maximum-recorded value. Therefore, the fertility index for Coale is given by:

$$I_f = I_p * I_m + (1 - I_p) * I_{nm} \qquad (7)$$

It is an index, obviously more performant than the previous one, now this consider married and unmarried women's fertility.

CHAPTER 2

The influence of the flexible female employment and family childhood policies on the TFR

2.1 Some recent scientific literature on influence of employment and family policies on TFR in Europe. Determinants Choice according to the literature.

There exists interesting studies on the influence of childcare services and employment on European fertility rates. How we have said above, many researchers have shown the positive determinacy of childcare policies on the female employment and on the grown of TFR both, as shows firstly Rindfuss[47]. With *Childcare Policies*, we mean policies that support families like family allowances, public and private Childcare Services (CS), parental

[47] Rindfuss et al. (2007).

leaves and tax exemptions. There exists three types of family policy instruments: cash benefits, services and tax breaks for families[48].

There are different types of classification of social policy systems that have followed one another in the last decades of the 20th century. The first bifurcation dates back to the mid-twentieth century and is characterized by the differentiation between the Universalist Beverdgean model (typical of Anglo-Scandinavian countries) and the employment model (adopted in continental European countries). The main distinguishing criterion between the two is the coverage format, i.e. the rules of access to the main social protection schemes such as pensions and health care which establish who to include in the protection schemes.

One of the contemporary fathers of social policy, Esping-Andersen[49], created one of the best-known classifications of a social policy system, distinguishing between three social inclusion welfare regimes: *liberal*, *conservative-corporate* and *social democratic*. The three regimes differ in the different modalities and quantities of inclusion. Briefly, the liberal regime (tipic of the U.K. regions), is based on proof of means and which stretches towards a private-type insurance welfare system. The conservative-corporate regime (common in Germany, Austria, French and Oland), in which public insurance schemes linked to the employment position predominate and the calculation of benefits depends on the contributions paid. At the contrary, the

[48] OECD 2011, Blum (2012).
[49] Esping Andersen (1990).

social democratic regime (Sweden, Norway and Finland) is based on universalistic and guaranteed publicist social security systems for all citizens.

More recently, on the basis of the principle of horizontal and vertical subsidiarity on which Westernist policy stands (implemented in Italy by Law 328/2000), welfare mix models are proposed, in which public and private protection systems are combined with forms of coordinated mixed governance at multiple levels (supranational, national and local).

Based on the type of welfare regime to which a national policy refers, the population may perceive a different perception of social security and for this can behave differently in their personal choices like fertility.

According to a study by Sobotka[50], the decline in fertility in some southern European countries seems to depend from cultural factors and from the typology of family and employment policies both. According to this research, great part of Europe today has achieved low fertility rates, which however vary from region to region, as do the reasons under the different fertility behaviour among the countries. Belgium, France and the Netherlands form the highest fertility band in Europe with a fertility of about two children per woman, along with Ireland and the United Kingdom, while the Mediterranean countries as Spain, Italy, etc., sign the lowest fertility rates of ever[51]. In particular, Sobotka in this research based on the cohort study, highlights how the difference in spatial fertility rates in Europe seems to

[50] Sobotka (2013).
[51] For an analytical description of fertility situation by European countries, look at first and second paragraphs of chapter 4.

correlate this to the presence of pro-elderly welfare policies that are detrimental to young people under 30 years old. Less stable employment contracts, falling wages, unemployment, absence of youth employment policies and insufficient policies to reconcile family and work needs, are political conditions that cause a growth in the phenomenon of postponement of first births and a preference for mono-procreation by family unit. Thus, these results let denote that these kind of policies can be influent on the perception of secureness and the sequential behaviour of the young people in the early stage of family decision-making[52].

At support of the spatial variability of fertility in Europe, a recent paper of Campisi[53] made in Belgium in 2010 applying three methods of spatial models, demonstrates the demographic relevance of studying fertility using spatial analysis able to show the differences of local socio-economical dynamics under the procreation choice. The assumption of Campisi is that each local context has social and economic peculiarities that affect differently on the fertility choice and his spatial analysis confirm this hypothesis. The recent penel study of Salvati[54] have confirmed the Campisi thesis too, asserting that spatiality of fertility trends are related to local economic conditions and to the local effects of recession of 2002-2018 period. Moreover, Salvati's paper explains the importance to consider the influence of migratory fluxes studying the fertility rates in panel, in which the local

[52] Vanhuysse (2013), Sobotka (2013).
[53] Campisi, Kulu, Mikolai, et al. (2020).
[54] Salvati, Benassi, Miccoli et al. (2020).

differences about fertility rates should derive from the fertility of foreign immigrant groups that compensate for the decline in fertility due to youth emigration. For Salvati it is an important prospective to investigate using spatial analysis too almost at level Nuts2.

Regarding per capita income as a possible determinant of the fertility rate, there is an interesting research by Wood[55] about the local correlation between female level of study, income availability and fertility. This work underlines the impact of families' purchasing power on the choice of having children subsequent to the first. According the results of this research, Wood asserts that the GDP per capita is the principal factor that influences on the procreation choice. The results of Wood's analysis, in fact, show that women with a high level of education in contexts of economic well-being perceive greater security in being able to guarantee a comfortable quality of life for their offspring and this seems to represent an incentive for parenthood. On the contrary, women with low cultural levels in the same affluent economic contexts perceive the inadequacy of their work resources to guarantee their offspring the expected standard of living, so in that case this represents for them a deterrent to a large parentage. This study in particular, it is useful to demonstrate how can be useful a spatial study of joint determinants in theme of fertility which can depends from several kind of social and economic factors.

[55] Wood and Neels (2019).

Even Wood in another his recent research on fertility, deepens the correlation between formal childcare services and fertility[56], especially for the first childbearing. In his spatial analysis at level Nuts3 in Belgium, Wood confirms the usefulness of a spatial research able to find the local positive significance of the presence of formal childcare services to impact on the female fertility desires and choices. This significance, indeed, basing on Wood thesis, would seem to change according to the different welfare policies of the various contexts examined, thus the spatial analysis it is essential to check the demographic variability of the fertility phenomenon in the politic and social space.

Beyond the spatial dynamics, also the temporal dynamics assumes considerable importance in the field of fertility. For this reason, many researchers use research tools such as panel or temporal data cohorts compatibly with the data available in relation to the determinants of interest. In this perspective, the recent research of Beaujouan and Toulemon[57] has compared the younger fertility and late fertility analysing the woman average age at childbirth and the TFR at level Nuts1 (European macro-areas). This comparison starts from the hypothesis of delayed fertility and failure to recover late fertility, on which it can affirm that many European countries with a strong decline in early pregnancy have the greatest increase in the number of live births in old age. Therefore, fertility trends after 30 of age

[56] Wood and Neels (2020).
[57] Beaujouan, Toulemon et al. (2021).

seem to be due to different logics in very dissimilar contexts. The study assumes that among these there are the contraceptive efficacy that allows young couples to opt for fertility at a young age with greater safety in terms of control of subsequent procreation. Another reason is the postponement of the procreative choice in order to ensure a better employment position facilitating a better quality of life, as in the case of France and the Nordic countries. On the contrary, there are countries where adverse economic conditions and the insufficient presence of family and conciliatory policies affect the delay in fertility and the drop in TFR such as in Italy and Spain. In the countries of Eastern Europe, however, the study highlights the impact of cultural factors as the strong rigidity of parental roles, which for women causes the incompatibility between family care and work that force them to opt for early but not proliferating fertility. Thus, according to the study by Beaujouan and Touleomn, it underlines a fundamental relevance of conciliatory and early childhood care policies in the current trend of women over thirty to enter in the employment market. In fact, in European countries that facilitate the reconciliation of care needs with employment needs fertility is high, at the contrary, where these policies are scarce fertility appears to be decreasing.

In addition to higher employment rates and the presence of early childhood CS, cultural aspects too can influence can influence fertility ideals such as gender equality and a more equitable distribution of family care

roles[58]. Bernardi, like other demographers of the last decade, embraces the Social Network approach to investigate the factors that affect fertility behaviour. This approach interprets procreation as a social choice influenced by beliefs, ideals and social structures. Hence, the need to observe the correlations between the desire for procreation, and the social, cultural and economic expectations on family decision-making.

The assumption of Bernardi's approach is that social mechanisms such as expectations, opportunities and services, influence individual perceptions and beliefs that govern the choice to have children. This thesis refers to the sociological concept of "social or emotional contagion" which refers to the ability of the social context to influence an idea and the ability to put pressure on individual choices. Thus, some studies on this approach speaks that it is not only the growing female employment rate or the growing insecurity of the labour market that affects the decline in post-modern fertility, but a real cultural change in terms of role parenting and social learning[59].

After the economic boom and the social changes of feminism, the control of procreation through contraception, the affirmation of the will of women in the family and social world, have made childlessness a voluntary choice. Occidental society has gradually assimilated this change of perspective, making possible the "social contagion" on this possibility of

[58] Bernardi (2017).
[59] Kreyenfeld et al. (2012).

preference. The "emotive contagion" seems to affect the choice. These studies, demonstrate that social interaction seems to influence the choice of having children. Infact, among the reasons that push the couple to make the decision to procreate there are the presence of social support to the parents in caregiving actions and the recent experience of an empirical contact with pregnancies that results in stimulating the desire for procreation.

The social support, formal or informal is important on the fertility choice. About the childcare services and the reproductive behaviour of the European States (NUT0 geo-level), some researcher explains the evident stabilization of the phenomenon of fertility's decline in Europe in the last decades[60]. Besides the cultural causes of adaptation, however, there is the efficiency of early childhood CS on the growth of the TFR. According with this hypothesis, the surveys included in the *Eurobarometer* 2006[61], shows that, who said of not having fulfilled their desires on the childbearing, often said not having the availability of a parental leaves and childcare, thus the presence of formal or informal childcare resources seems to be determinant on the decision-making of make or not make children. To prove that assumption there are studies of many researchers who affirm that. For instance, a cross-national study of 21 OECD countries[62] shows a statistical positive correlation between the fertility behaviour of the European female employed and the presence of formal CS in their territory[63]. The hypothesis

[60] Lutz and Skirbekk, (2007).
[61] Eurostat, Testa (2006).
[62] Castels (2003).
[63] Blum (2012).

supported by several demographic researcher on the influence of childcare policies on TFR is that, the initial negative correlation between the female employment and the TFR shown in Europe in the 70th and 80th years, in some countries has a good political response. After that period, where was introduced policies directed at the reconciliation of work and family life, as paid parental leaves, the TFR was grown.

In another interesting research, Sobotka[64] explains the correlation between the low TFR and the difficulty of reconciling the female career and parenthood. In the presence of inefficient childcare services and inflexible working conditions, there is a significant decline of number of children per woman and with later pregnancies. At the contrary, this research shows how in State where there are efficient childcare services as the Scandinavian Country, Switzerland and the UK, there is a significant growth of TFR.

The precursor model of Scandinavian countries is also confirmed by the Persson' research[65], which denotes the determinacy of the presence of law and politics that helped the positive trend of fertility growth in Sweden. This study describes how women born in the 70s, being helped by valid flexible work policies and CS, have made a clear change in the trend of births. This data was linked to the trend of higher levels of education achieved, that it is another change of trend in cultural female model of these years.

[64] Sobotka (2013).
[65] Persson (2014).

Miettinen underlined this importance of social phenomenon on the fertility behaviour, as cultural determinant on the low fertility rates in Europe[66]. This study shows that in countries where there are fewer children, as the States of the Mediterranean area, there are later marriages and a higher age of the woman at the first childbirth. The researcher observed a greater presence of these determinants in cultures strongly centred on individualistic values. This result emphasises the significant influence of cultural and social dynamics on the fertility choice as in ever-human behaviour.

As said before, in demographic research the human behaviour seems to be important to deepen the possible correlations between different objects of study. For example, Bavel's research on fertility and divorce explains clearly the prominence of social behaviour models on the actions.

According to this study, the status is determinant on the fertility: one of the result of Bavel' research is that the divorce has an inhibiting effect on the number of biological children, excluding age, age at first marriage and educational level.

Furthermore, there are significant gender differences in the second fertility of "re-partnering[67]" after divorce: men show a greater propensity for second fertility than women, who need to feel more secureness perception from the new union. Another interesting result shows that there is a positive correlation between the number of children in a second re-partnering and the

[66] Miettinen (2015).
[67] Bavel uses this term to identify people separated or divorced who starting a new relationship (Bavel J.V., Jansen M., Wijckmans B., 2012 working paper. See the references).

kind of union, which seems to be better in presence of new marriage, especially for women. This means that woman needs to percept more secureness to make new choice of procreation after a divorce experience. Interesting is also the correlation between second marriage and employment and welfare policies: according with the Bavel's study, in some European areas there are trade union and employment motivations that lead to having children or remarrying in post-divorce unions. One of these motivations are, for example, family allowances and tax relief for workers with families with children, which have positively correlation with the number of children in a second re-partnering.

The Scandinavian countries represent an example of this good influence of childcare services on TFR, as is proven by some recent literature.

Rindfuss[68] in a paper on the fertility phenomenon in Norway has shown, with the use of comparative and spatial statistical models, just how CS more efficient can grow statistically the TFR and made facility to female work stability, as well as of her level of study, training and professional performance. In particular, in Rindfuss and other colleagues showed that in Norway there was a growth of children for women of child-bearing age equal to 0.5 and 0.7 in correspondence with the implementation of child policies-care aimed at preschool children, that was a real welfare response favourable to the working woman and consequently to the family. These conciliation policies, together with the new gender cultural models, have contributed to

[68] Rindfuss (2007).

facilitating an increase in female university education and female workforce. Thanks to the increase in the level of study, women have also achieved more prestigious employment positions, greater stability, and economic independence[69].

In Germany, because of the aging of the population, has decided to prevent the catastrophic socio-economic consequences of this phenomenon by implementing policies in Nordic style. One of these policies was the choice to realize the right to child-care for all preschool children by 2013[70]. Which one consist to ensure that all children under 3 years of age have access to childcare services. A fertility study in Germany by Bauernschuster[71] shows that there is a correlation between the existence of more childcare services and the growth of local fertility rates, especially in counties with a high level of education and cultural attitudes less conservative. This would also explain the reason for the internal migrations of pregnant women workers or mothers moving to counties with more universalistic and guaranteed childcare policies, to benefit from better child-care services more compatible with their work needs. These flows have appeared constant over all the time examined in the analysis here. Therefore, not only in the Scandinavian countries but also in countries similar to Italy in culture and social conditions such as Germany, the strategy of implementation of policies for assistance for under

[69] Apps and Rees (2004), Mandel and Semyonov (2005), Spiess and Wrohlich (2008).
[70] Coneus et al (2008), Dorbritz (2008).
[71] Bauernschuster et al. (2012).

3 years children's old presents itself as a winning solution to the problem of low fertility.

A recent paper by P. Baizàn[72] supports the hypothesis of the positive correlation between early childhood care policies and growth in fertility rates in the Spanish case.

Baizàn's analysis shows a strong statistical dependence between the growth of the Spanish TFR and the implementation of welfare services for children under 2 years old. This study highlighted important territorial provincial differences growth: public childcare services grew more frequently in regions of the Spain where there was a higher rate of female employment, followed by a growth in fertility rates in these regions. In addition, that effect can be a better possibility of reconciliation of women's work activities with child-care activities, policies that make the motherhood a less prohibitive phenomenon for the working-woman. Thus, the possession of stable employment appears to be positively significant, because to affect a recovery in fertility rate in Spain it emerged that in part it is also determinant a cultural component linked to an evolution of gender roles that has seen a real increase in the sharing of family care actions between the sexes. Baizàn shown that these factors seem to be determinants on the choice of procreation.

About the phenomenon of the largest Russian demographic decline of contemporaneity saw the national population decline from 148.3 million inhabitants to around 140 million from the 1990s to 2009. The causes were

[72] Baizàn (2009).

the phenomenon of urban and rural unemployment and the consequent emigration of young age groups for employment. Nevertheless, the precarious health conditions also caused non-undervalued death rates among the reproductive population in the decades prior to the health reform. The new economic policies of the 2000s, aimed at increasing employment in Russia, together with the implementation of the health reform in response to the mortality rates. Not least the approval of the Federal Reform Act RF n. 256-FZ of 29/12/2006 "on additional measures of public support for families with children". This one in particular, had a positive impact on the total fertility rate, through an increase of the per capita income, which allowed a decline in youth emigration. Among these pro-natal measures promoted by the Russian political class, there have been incentives for families for second and subsequent births since 2007 and the doubling of family allowances for parents of children under one and a half years old, given to mothers also non-workers who have adopted/generated one or more children following the first. Following these policies to support the birth rate, "Russia had experienced a *true demographic explosion* with over two million children born between 1 January 2007 and 1 April 2008"[73] About the Russian case, some interesting data emerged from the Miljkovica and Glazyrina research on TFR in Russia. The study shows us the unemployment phenomenon as a negative determinant on the percentage of fertility. Infact, as the level of unemployment increases, there are a lowering of the family income that make

[73]Miljkovica and Glazyrina, (2008).

grown the perception of uncertainty that has been interpreted as a sequence of factors which can negatively influence the procreative choice. The migratory phenomenon too, for these study's results seems to influence the fertility rate. From these data emerged, immigration from other countries to Russia seems to be a countertrend flow that seems to have a positive influence on the growth of TFR, offsetting the still significant youth mortality rates and rates of juvenile migration of native people from Russia to other parts of the world, linked to a still high rate of unemployment. Ultimately, although the impact of pro-poor economic reform policy has had a positive impact on the Russian fertility rate. According to these research results, in favour of a decisive resumption of fertility the policies are oriented to implement services in support of youth employment in order to stop the outgoing migratory flows and creating the conditions of economic and housing stability such as to favour the increase of fertility.

At the contrary, France is an anomalous case given the apparent similarity of the French context to neighbouring nations with low TFR. In fact, France has recently exceeded the TFR rates historically typical of the Scandinavian countries. In 2015, with a TFR equal to 1.96 French has surpassed Sweden (1.85). France has implemented in the last twenty years a demographic policy, which has foreseen a constant increase of services in support of fertility rates. In France, policies in favour of the birth rate are not limited to classic monetary incentives such as the "baby bonus", but there are measures that counteract the progressive aging of the population through

concrete services and work facilities that support families who embrace the choice of procreation. First of these policies was to guaranty free kindergartens distributed throughout to all territory. Working mothers receive financial support and keep their career intact. Generating children in France is an event calculated in terms of merit for professional and pension purposes: for the compute of the retirement pension, the period of maternity and leave for breastfeeding or other early childhood-care are counted in favour of the female worker and contributions are paid by the state. These policies are the result of an ideological battle contaminated by pro-nativist values, among conservative supporters of family values and the promoters of individual and gender equality supported by the state and the feminist movement. It started precisely with the cultural ferment of the 70s, which generated in France an ever-increasing political attention. That caused the realization of a wide range of measures for gender equality, pro-autonomy. According to the study of Toulemon[74], the good rate of fertility in France can be explained by the policies supporting fertility expressly aimed at supporting, not the couple, but the *working mother and not working ones* and many other political initiatives to contrast youth unemployment and to favourite the working time flexibility. These policies can facilitate the reconciliation of family and working needs and should be replicable in other similar countries.

Another interesting purpose of this research was to consider other determinants too in my models, as female job insecurity, presence of part-

[74] Toulemon et al. (2008).

time opportunity, migrant fertility, female level of study, lagging economic growth analysing their joint influence on TFR. This intention derives from the suggestions of some recent contributions of the demographic literature[75], which have shown the incidence of these determinants on the postponement of fertility and the decrease in fertility.

Unfortunately, insert these too in my dataset was not possible for the lack of availability of temporal and territorial European data.

2.2 The Hypothesis of Research

Starting from the consideration of the literature examined on the topic, the aim of this analysis is to show the centrality of the presence of efficient early-childhood Childcare Services and Flexible women's employment policies on the decision-making to procreate, independently from the context.

For contemporary woman the occupational satisfaction expectations are a central theme to deepen from a social point of view, because from this depends the perception of self-realization. On this perception seems to depend the perception of security that pushes the woman to satisfy the desire to have children[76].

[75] Such as that of Gesano (2017), Wood and Neels (2020), Picchio (2018) for example.
[76] Bernardi, (2017).

At this moment becomes determinant the presence of family support for future working mothers. To reconcile the working-time with the family-care time woman has to rely on formal or informal CS and on flexible working time and family leave too.

Many studies have shown that if these policies are efficient, the TFR tends to grow up, how I will explain in the subsequent chapters.

For this reason, I decided to analyse the spatial variability of the influence of early-childhood CS and female employment policies on TFR in Europe territory, the latter context of particular lack of such policies, in order to validate the literature theses demonstrating their influence on fertility.

Confirm this hypothesis of research, should be interesting also to press the Italian politicians towards a new rescheduling of services policies for early childhood and for working women.

To verify this research hypothesis, the analysis questions it is firstly to understand if there is an influence of CS policies and female employment policies on TFR, then if it varies spatially in different European contexts and which regressor varies more than the others and at the end to check where this occurs.

CHAPTER 3

Research methodology applied

3.1 Some advantages of applying the spatial regression model GWR

Using a spatial analysis model gives demographic research several advantages. In fact, since demography is an object of study composed of systemic multifactorial phenomena, a global study that implements generalizations by combining different data is not useful. In this way, the study may lose its representativeness and would generate distorted analyses that are not very explanatory of the socio-cultural, economic and political peculiarities of specific contexts that are different from each other. Carrying out a spatial analysis, on the other hand, allows greater social comparability aimed at deepening the influence of the different determinants on TFR in the different contexts of the European territory.

In this methodological prospective, should became easier geo-localize and contextualize the multifactoriality, because a spatial regression model lets realize many “ad hoc” analysis of the determinants on the phenomenon of study in the specific spatial contexts.

In particular, analysing a demographic phenomenon using a spatial regression model, it is possible to denote any local significance even in case of a global not significance given by the OLS model's application.

Although it would have been useful to use different spatial models and compare their outcomes in order to understand the problem, the temporally and spatially data unavailability did not make it possible. It is useful in demographic analysis studying phenomena with weak time inertia using panel or cohort dataset among 10 or 20 years to find the variability of these phenomena. In this case, it was not possible to create a panel or cohort dataset as made by other researchers for example as Caltabiano and Rosina[77] in less recent years and with different determinants. According with my hypothesis of research, there was important to investigate on the use of childcare services and the conciliatory policies in European States and Regions (Nuts0 and Nuts2 geo-levels). Thus, to make this, to consider any variables chosen about these phenomena becomes essential. The availability of these informations at these specific spatial levels for recent years it is not complete yet. This was the reason why I chose to carry out a cross-sectional analysis rather than a longitudinal one, conditioning the time-selection on a small period of four years (2014 – 2017). However, it is my purpose to continue future researches as soon as new recent data on CS at Nuts2 level are available.

[77] Caltabiano et al. (2007).

Furthermore, the methodological choice of calculating the period average of the 2014-2017 data is motivated by the need to protect the dataset from abnormal annual fluctuations that could distort the research results.

Therefore, I decided to apply the Geographically Weighted Regression model (GWR)[78] and compare its spatial results with those resulting from the global OLS model as a comparison control model, capturing the local peculiarities on fertility deriving from this comparison.

However, applying a Geographic Weighted Regression model as spatial model of analysis I expected to improve the accuracy of analysis results.

Before to apply the GWR model it is convenient to check the spatial autocorrelation between the determinants considered. Spatial autocorrelation is the correlation between the values of a single variable strictly attributable to their relatively close localized positions on a two-dimensional surface; in other words, it represents the correlation between values of geographically close variables. It derives from Tobler's first law, according to which space units are related to their nearest geo-units more than to distant ones. Based on this assumption, the Moran index is one of the most commonly used measures of spatial autocorrelation[79] and I used it in these analyses before applying the GWR model.

[78] Fotheringham et al. (2002)

[79] It varies between -1 and +1, when it tends to -1 we are in the presence of negative autocorrelation and it means that there is dissimilarity between the values of the closest spatial units. If instead it tends to +1 we are in the presence of positive spatial autocorrelation or there is similarity of values in the neighbouring spatial units. If the Moran Index is equal

The Moran[80] Index is given by:

$$I = \frac{Z^T * W_{ij} * Z}{Z^T * Z} \qquad (8)$$

Where the numerator represents a covariance's measure of the matrix correlation of the spatial units and on the denominator, there is their mean square deviation.

In particular, W_{ij} is the spatial weight matrix, where w_{ij} are elements of the matrix considered as weighting function equal to 1 if *i* and *j* are close, or with value 0 if the locus is "close to itself"[81] or if *i* and *j* are not close. In other words, *wij* is the *ij-th* element of the row-standardized spatial weight matrix *W*, a row-standardized spatial weight matrix[82].

The Z^T is a transpose matrix of *Z*, the standardized vector of variance:

$$Z = \frac{I - E_n(I)}{\sqrt{Var_n(I)}} \qquad (10)$$

Where the Variance Test for the Moran Index $E_N(I)$, is given by:

$$E_N(I) = \frac{-1}{n-1} \qquad (11)$$

Another technique that I have used to verify the better significance of GWR model respect to the model of referent (OLS, in this case), is the Monte

to 0 it means that there is no spatial correlation between the values of the variables considered.

[80] Moran (1950). In particular, "Moran's I lies within the range [−1, 1].4 When values in the variable z are randomly distributed in space, the statistic asymptotically tends to zero. When a positive (negative) value of Moran's I is observed, this indicates that positive (negative) spatial autocorrelation exists across the regions; that is, the regions neighbouring a region with high (low) value also show high (low) value" (cit. Kondo K. 2021).

[81] Moran (1950).

[82] Kondo K. (2021).

Carlo Test. This test consists of a simulation using a series of repetitions[83], which allow you to test the model and produce reliable estimates of its coefficients. This technique is used to reproduce and numerically solve a problem in which random variables are also involved, and whose solution analytically is too complex or impossible[84]. The assumption is that the more said repetitions are numerous, the more the results of these experiments will constitute a "sufficiently faithful reproduction" of the type of relationship that is being studied with the model being tested. In simple words, to create each of the n combinations, the Monte Carlo test considers a value randomly for each explanatory variable included in the model, in accordance with the type of relationship specified and respecting the correlations imposed between the variables by the model itself. Repeating n times this simulation we will obtain output values referring to the explanatory variables that will represent the estimates of the coefficients of the model, which can analyse for the subsequent interpretation of the model created.

First, to check the hoped improvement of the model OLS through the use of the GWR model, it is necessary to compare the OLS R-Squared with the GWR R-squared: if this last one has a R-squared higher than the OLS's R-squared, it means that the GWR model has a better goodness of fit than that the OLS model. In other words, the GWR model shows a higher fitting of the observed data with the theoretical regression line, performing values nearer

[83] It is recommended to perform the test with at least 1000 repetitions for greater reliability reasons.
[84] Niederreiter (1992), James (1980), Halton (1970).

to 1 than OLS's R-squared. To check if the improvement of GWR model respect to the OLS's one, can be used the ANOVA test too. The ANOVA test is a statistical technique of analysis of variance and covariance. This test check if the averages of two or more matrix of data are significantly different from each other. Thus, ANOVA Test checks the impact of one or more factors by comparing the averages of different samples. In this case, having only one dependent variable I have used the one way ANOVA Test based on the Fisher distribution in which the variable F will be given by:

$$\left(\frac{SSB}{(n-1)}\right):\left(\frac{SSW}{(N-n)}\right) = \left(\frac{\sum m(\bar{y}_i-\bar{y})^2}{n-1}\right):\left(\frac{\sum_{i=1,k=1}^{m,n}(y_{i,k}-\bar{y})^2}{N-n}\right) \qquad (12)$$

With N = number of observations

And n = number of groups

However, from the AIC values too it is possible to check the *goodness of fit* of GWR model than the OLS one. In fact, it is true even if the GWR's AIC values are not directly comparable with the OLS's AIC values, because the AIC in the GWR model is a correct AIC, thus we speak about AICc. We can defines the AICc in GWR model as a function of sample size based on the number of parameters of the model and the maximized value of the likelihood function of the estimated model:

$$AIC_C = 2nlog_e(\hat{\sigma}) + nlog_e\,(2\pi) + n\left\{\frac{n+tr(S)}{n-2-tr(S)}\right\} \qquad (13)$$

"Where *n* is the sample size, $\hat{\sigma}$ is the estimated value of the error terms, the tr(S) is the trace of the hat matrix"[85].

Thus, in the comparison between OLS and GWR, to test if this last is more performing than the first model we have to look at the AICc values, to the ANOVA test and least but non last to the adjusted R-squared[86].

3.2 Methodological steps of analysis: different geo-levels of analysis

The methodology of analysis adopted in this demographic research, moves according to two steps: the first is the application of a global regression model "Ordinary Least Squares" (OLS linear regression model) with which we want to test the significance of the explanatory variables of the model. That model is useful in order to compare this global data with the spatial significance or non-significance of the same model applying in a second step of study a spatial model. This allows us to analyse the phenomenon of fertility and its possible socio-economic and political determinants from a *local* point of view, which is not global but contextualized. Individual level data are

[85] Fotheringham (1998) cit. page 61.
[86] Nakaya (2015), Fotheringham (2002).

needed to examine micro-level relationships between fertility and its determinants, also including spatial variation. I would like to deepen my object of research in future using also the micro-level analysis because the remaining time of this research period does not allow developing it.

Therefore, analysing on such a systemic and complex topic as that of low fertility, I considered essential developing the demographic analysis on different spatial geo-levels. I started the analysis of the influence of the determinants chosen on the TFR at the level of Nations of the European territory (Nuts0 euro-level) to then deepen and compare these research results with an analysis at the level of the Regions of the European territory (Nuts2 euro- level).

The expression “Nuts” was born in the early 1970s, when Eurostat established the NUTS classification as a single and coherent system of dividing the territory of the EU in order to produce regional statistics for the Community.

In particular, “the NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK for the purpose of:

1. The collection, development and harmonization of European regional statistics;
2. Socio-economic analyses of the territory: Nuts0: nations; Nuts1: major socio-economic regions; Nuts2: basic regions for the

application of regional policies; Nuts3: small regions for specific diagnoses;

3. Framing of EU regional policies defined at NUTS 2 level"[87].

For nearly 30 years, the implementation and updating of the Nuts classification has managed under a series of "gentlemen's agreements" between Member States and Eurostat.

The work on regulation (EC) no. 1059/2003 of the Commission to give NUTS a legal status started in spring 2000. Adopted in May 2003 and entered into force in July 2003. This regulation is important from a statistical point of view, as it also specifies the stability of the classification for at least three years. This ensures that the data refer to the same regional unit for a certain time-period and this is crucial for statistics, in particular for time series.

However, national interests sometimes require that a country's regional breakdown be changed. When this happens, the country concerned informs the European Commission of the changes. The Commission in turn changes the classification at the end of the stability period according to the rules of the NUTS regulation.

In these cases, the requesting State must update the data by replacing the previous data with time series according to the new regional breakdown within two years.

[87] Cit. Eurostat, NUTS - NOMENCLATURE OF TERRITORIAL UNITS FOR STATISTICS, History of Nuts classifications, in eurostat.eu

For this research work, the reference Nuts classification is the latest currently in force, the Nuts 2021 classification, valid from 1 January 2021.

To allow the comparison of the two models, I created the two databases by selecting the same determinants, methodologically constructed in the same way, but only in a deeper spatial scale. Going down a level on the geo-spatial scale, allows you to work with more disaggregated data. This gives more representativeness to the data and returns less discomforting indicators, capable of not concealing factors peculiar to the specific spatial units. Studying on a deeper geo-level of analysis, allows achieving greater spatial variability of the data, expanding the analysis on the local differences that did not emerge with the analysis at the Nuts0 geo-level.

The analysis continues on a further spatial geo-level, the Nuts3 level of the Italian provinces, in order to focus on the difficult Italian case in terms of low fertility within the different local conditions.

From a methodological point of view, the aim of applying these steps of geo-level analysis is to prove the usefulness of spatial models to analyse complex socio-demographic phenomena like this.

3.3 Brief notes on spatial analysis methods

Before going into the discussion of the spatial demographic analysis carried out by me, it seems only right to describe briefly the most commonly used models of spatial statistical analysis. Whichever spatial model you

decide to implement, it is always good practice to perform an ESDA (Exploratory Spatial Data Analysis)[88]. It consists of a series of preliminary tests on spatial autocorrelation, spatial heterogeneity, the construction of the weight matrix and the MUAP, the modifiable areal unit problem. In other words, it is necessary to consider whether the data used refer all to the same spatial scale or whether the aggregation of the spatial units was carried out according to the same criterion for all the variables considered.

After this initial verification stage, it is possible to choose which model to use.

The most common used Spatial Models are:

- Spatial Linear Regression;
- SAR (Simultaneous Autoregressive Model): Spatial Lag Regression, Spatial Error Regression, SARMA (Spatial Autoregressive Moving Average Model);
- CAR (Conditional Autoregressive Model)
- STRM (Spatial Temporal Regression Model).

"Spatial linear regression models may be viewed as generalization of standard linear regression models such that spatial autocorrelation is allowed and accounted for explicitly by spatial models"[89]. Among the Spatial Linear Regression Models, there is also the Geographically Weighted Regression

[88] Chi G., Jun Zhu E. (2008).
[89] Chi G., Jun Zhu E. (2008) cit. page 30.

Model (GWR), with the characteristic of the specification of spatial heterogeneity[90], which is the model chosen in my PhD research (see paragraph 3.4).

The SAR simultaneous autoregressive models include Spatial Error models and Spatial Lag models that are two common Spatial Regression Models. In the Spatial Lag model, the spatial autocorrelation is a linear relationship between the vector of the response variables and the weighted spatial lag matrix. Otherwise, in the Spatial Error model the spatial autocorrelation depends on the error term and on the matrix of the spatially lagged error terms. These two models have the defect of the possibility of not considering other causes of autocorrelation or other kind of lag or error autocorrelations due to their econometric simplicity[91].

The SARMA model tries to include both the lag model and the spatial error model combining a first-order spatial lag model with a first-order spatial error model.

The SAR models are usually present in demographic analysis than the CAR models. The CAR models, (Conditional Autoregressive models) have the peculiarity of "specify the distribution of a response variable at one location by conditioning on the values of its neighbours in the neighbourhood and the spatial effect of the neighbours is considered to be exogenous"[92].

[90] Fotheringham et al. (1998).
[91] This is an assumption described by Anselin et al. (2003).
[92] Anselin (2003).

Instead of taking into consideration the spatial autocorrelation in a single specific time-period, as all the spatial models described so far, the STRM, Spatial-temporal Regression Model, allows to consider the spatial autocorrelation between the variables of study in several time-periods. Thus, the STRM allows analysing the spatial and temporal autocorrelation in a single regressive model simultaneously, by adding in the model for each variable considered the respective timed variables[93].

Over the last few decades, demography has increasingly directed interest towards integrating the study of population data into the spatial context[94]. This is because the object of study of demography is characterized by complex and systemic phenomena which, to be fully understood, must consider a series of essential factors (social, political, geographical, climatic, economic, etc.). For this reason, demographics are increasingly using methods of spatial analysis.

Indeed, basing on this growing interest in spatial analysis in the demographic field, the term of Spatial Demography was coined as the spatial analysis of demographic processes[95].

In demography, the Spatial Analysis Methods most common used are: Spatial Econometrics, Geographically Weighted Regression, Multilevel Modelling, and Spatial Pattern Analysis.

[93] Chi G., Jun Zhu E. (2008).
[94] Matthews and Parker (2013).
[95] Matthews et al. (2013). Spatial Demography, was also the name of a new journal about these new spatial analysis on populations.

According to Matthews and Parker, spatial econometric methods can be grouped into three macro-categories: model specification (sometimes informed by specification test), model estimation, and spatial predictions.

The model specification usually uses spatial weight matrices to account for the influence of neighbouring regions on the variable of interest in the region of interest[96]. It is possible to assign spatial weights for neighbouring effects to dependent and independent variables or even to error terms. Some spatial contexts can often have non-homogeneous spatial dependencies and some methods such as Geographically Weighted Regression (GWR) are commonly used to analyse the varying strength of covariate effects on dependent variables[97].

The model estimation depends mainly on various methods of moments and Maximum Likelihood Estimation (MLE), with methods always characterized by more sophisticated and accurate calculations.

Finally, there are the Spatial Prediction methods, which use "*Spatial Lag models in which all observations are close to each other or in some case the model is an extension of the GMM to a spatial moving average process, including an endogenous spatial lag, for data spatially explicit panel data*"[98].

Generally, the empirical analyses of the past used global statistics such as OLS model in which all data were used to calculate a single statistic and in which the relationships between variables in the model are stationary in the

[96] Anselin (2003).
[97] Fotheringham (2009).
[98] This is a reporting cit. from Matthews and Parker (2013). For a complete description on the Spatial Prediction methods the authors recommend to refer to Kelejian and Prucha (2007).

study area. In this type of model, measured relationships that vary in space do not emerge. Geographically Weighted Regression (GWR) is a spatial method that allows measuring the variations of relationships in space through a single modelling framework[99]. The output of GWR is a set of surfaces where each surface represents the spatial variation of a relationship[100].

We use the Multilevel Modelling model when we want to analyse the effects of contextual factors on social behaviour performed at a lower level. In this way, we investigate the quantity of individual influences compared to the quantity of social or political influences (a broader spatial level). Multilevel models are characterized by a systematic collection of hierarchically nested data. The multilevel model is often estimated using maximum likelihood estimation (MLE) or limited maximum likelihood (RML), as well as Bayesian and bootstrap methods. *"MLE depends on algorithms designed to iteratively iterate through potential values, recording the value at which the probability has reached its maximum. Such algorithms include the Newton-Raphson algorithm, the Fisher scoring algorithm; the EM algorithm and the Iterative method of generalized least squares"*[101]. Instead, RML estimates the variance parameters using maximum likelihood and through these parameters estimates the covariates of the fixed effects. We use MLE and RML with large size samples, while Bayesian estimation is used in the presence of small samples, despite being characterized by complicated

[99] Fotheringham, Brunsdon and Charlton (2002).
[100] See the paragraph 3.4 for a complete description of GWR model.
[101] Matthews and Parker (2013).

computes. In alternative, to measure the estimation of variance and standard errors it is possible to use the Bootstrap model.

Since the variance of outcomes within a neighbourhood can be extremely high, it may be useful to include measures of variance in contextual effects using multilevel models[102]. Although multilevel modelling is a typical spatial statistic, many demographers[103] integrate spatial and multilevel models. Considering the spatial levels in a continuous way, multilevel models allow us to know spatial variations simultaneously on more or less aggregated geographical levels and are able to provide standard errors that are more accurate.

Another type of spatial analysis widely used in demography is that of Spatial Pattern Analysis with spatial clusters of point data methods. The aim of spatial clusters of point data methods is to investigate whether the phenomena of study occur according to a precise pattern rather than following a random distribution in a specific territorial area. Starting from this, Geostatistics is a new branch of statistics that studies continuous field variables. Citing Matthews and Parker, *"rather than focus on observations as the location of events, geostatistical methods aim to understand the spatial distribution of values of an attribute of interest over an entire study region, given values at fixed sampling points"*[104]. Geostatistics is based on the assumption that there are spatially autocorrelated random processes that are

[102] Merlo et al. (2006).
[103] Chaix et al. (2005).
[104] Matthews and Parker (2013).

able to model part of the spatial variation and this can provide accurate estimates even of missing spatial data.

3.4 The Spatial model GWR

The methodology chosen for the research to be carried out is that of spatial and space-time regression. It is intimately indicated for carrying out demographic studies with sociological investigation purposes, in which it becomes essential to integrate demographic transitions (of fertility, age structure, mortality, migrations, etc.) from a systemic perspective with the phenomena that characterize a specific spatial context at a precise moment in time. The aim is to investigate the timing and direction of the connections existing between various elements of the Italian local context, highlighting the possible causes and probable consequences. In this case, the spatial model GWR (Geographically Weighted Regression) is a model that uses the technique of statistical regression applied to a set of georeferenced data, allowing the coefficients to vary locally. The application of the GWR model extends the traditional regression model (OLS) allowing the estimation of local parameters, thus the model can be written as:

$$y_i = ß_0(u_i) + \Sigma\, ß_k(u_i)\, x_{ik} + \varepsilon_i \qquad \text{with } i = 1, \ldots n \qquad (14)$$

where u_i denotes the *i-th* point in space and $ß_k(u_i)$ is the realization of a continuous function $ß_k(u)$ at point *i* and ε_i is the Gaussian error at location *i*. As is evident, if the parameters do not vary spatially, equation (14) will be equivalent to that of the global OLS. The GWR offers us the possibility to explain the spatial variability of the phenomenon, when considering interactions between individual territorial units. The non-stationarity status of the parameter estimates can be assessed by comparing the standard errors of the OLS estimates with local estimates from the GWR (inter-quartile range), with larger values indicating significant spatial non-stationarity[105].

Although the form of the equation ßk (u) is unknown and therefore this could create some difficulties in the creation of the model (14), in the statistical literature the use of these models is becoming very popular, especially in the geological and recently economic fields. Precisely for the informative value that derives from it, as well as for its belonging to the class of coefficient models introduced by Hastie and Tibshirani[106].

A possible solution to the estimation problem due to the lack of knowledge of the equation ßk(u) is to calibrate n local models with non-parametric techniques, as suggested by Fotheringham[107], through the use of a *kernel* weighting function. The models can be estimated using a WLS (Weighted Least Square) approach, by applying a matrix of weights for each of the "n"

[105] Fotheringham (2015).
[106] Hastie and Tibshirani (1993).
[107] Fotheringham (2002).

reference points. The formula for estimating the parameter in a specific spatial position "i", therefore, will be given by:

$$ß\hat{}_k(u_i) = (X' W(u_i)X)^{-1} X' W(u_i)y \qquad with\ i=1.....n \qquad (15)$$

where $ß\hat{}(u_i)$ represents an estimate of $ß(u_i)$, while $W(u_i)$ is a matrix n by n of which the weights of each of the n data observed for the regression point i and all other off-diagonal elements are cross elements zero. The value $ß\hat{}(u_i)$ can be interpreted as a good estimate of $ß(u_i)$ in the measurement of the point u_i. Under this hypothesis, the weights are chosen in order to assign greater importance to the closest observations using a "distance-decay" function called *kernel*. Two of the most used weighting functions in the GWR technique are called “Gaussian” and “bi-quadratic” function. The kernel, in turn, can be fixed or adaptive.

In particular, the Gaussian kernel weighting function is given by:

$$w_{ij} = e^{-1/2(d_{ij}/b)2} \qquad (16)$$

where d_{ij} is a distance between the locate point u_i and the locate point u_j and b the bandwidth parameter. If i and j coincide then the weight associated with that point will be 1. As the distance of d_{ij} increases, the weighting of the data will decrease according to the Gaussian curve.

The bi-quadratic kernel is instead defined by:

$$w_{ij} = [\ 1 - (d_{ij} / b)^2\ ]^2 \qquad (17)$$

$$\text{if } d_{ij} < b \qquad w_{ij} = 0 \text{ otherwise}$$

Equation (17) provides an almost Gaussian weighting function for all points whose distance from *i* is lower than *b* and sets all other weights to 0. As can be seen from formula (15), if all the weights on the diagonal of $W(u_i)$ are 1, then the GWR estimator is equivalent to the OLS estimator. Even if a partial estimate of the local parameters is not possible, through the calibration process we can obtain estimates with a small chance of error. If the coefficients vary continuously spatially, a WLS regression is unlikely to offer an unbiased estimate of the beta parameter with respect to the given point u_i. This happens because for each spatial position there will be a different value of $ß(u_i)$, but the WLS regression produces a single theoretical value of beta which is the same for all points. In this way, a low value of the bandwidth parameter *b* can ensure a small error of $ß(u_i)$ because the points that fall in the circle with radius *b* centred at *u* are few compared to the whole sample, as well as their betas theoretical will make it be similar to the value $ß(u_i)$. With a small bandwidth, however, the standard error will be raised to the low number of observations that are included in the WLS (Biquadratic Kernel) regression. Indeed, as can be seen from the Gaussian kernel formula, the weights rapidly approach zero when the distance between observations is greater than *b*. On the contrary, a large bandwidth will produce an inverse

effect: distortion will increase but the standard-error will be lower. Therefore, it is necessary to be able to find a balance between bias and variance in order to balance the effects of excessive variability of estimates or severe bias of parameters. To overcome this problem, the bandwidth can be chosen through a cross-validation approach, suggested for local regression by Cleveland[108] and for kernel estimation by Bowman[109].

The function score below (18) is used in the calibration process to find the optimal bandwidth:

$$CV(b) = \sum_{i=1}^{n} [\, y_i - \hat{y}_{\neq i}\,(b)]^2 \qquad (18)$$

where $\hat{y}_{\neq i}$ is the adjusted value of y_i with the observation at point i omitted from the calculation. The choice of the optimal bandwidth will be made by minimizing (18) compared to b.

Another method suggested by Fotheringham for choosing b is the implementation of a "kernel adaptive band". Infact, if the points are not homogeneously distributed in space, as in the case in which they are concentrated only in some areas while in other areas the concentration appears very poor. The classic kernel method uses a fixed band distance, thus not making it possible to adequately acquire the possible spatial effects on the

[108] Cleveland (1979).
[109] Bowman (1984).

parameters. Instead, the adaptive band kernel determines the weights by adopting an algorithm of this type:

$$w_{ij} = [\,1 - (d_{ij}/b)^2]^2 \qquad (19)$$

if j is one of the nth closest neighbours of i

$w_{ij} = 0$ otherwise

This is a kernel (k-nn) method, that determines the optimal number of neighbours, where N represents the number of points to include in the local model calibration. The kernel used as in formula (19), is a bi-quadratic function, where b is the distance from the next nth near point i, and it changes along the reference point chosen for the local model.

There are many other techniques for selecting the GWR bandwidth, including for example the "generalized cross-validation" criterion[110] or the method based on the minimization of AICc (Akaike Information Criterion correct) proposed by Hurvich[111], which are the two methods that I have used in my PhD research.

However, for a more complete treatment of the methodology, I refer to the specialized texts present in the bibliography[112].

[110] Loader (1999).
[111] Hurvich (1998).
[112] Fotheringham, Charlton et al (2002); Coale (1996); etc., see the References at page 178.

CHAPTER 4

The European level of study

4.1 Analytical description of the research indicators

For the creation of the database, I decided to draw on the source of the Eurostat database. Although in the initial phase, I hoped for the use of data only at the Nuts2 territorial level, but due to the lack of data at the Euro-Nuts2 level concerning the research mandate I decided to consider the comparative approach suggested by the literature on the spatial analysis[113]. For this reason, I decided to carry out my analysis at both Nuts0 and Nuts2 levels.

The territorial level Nuts0 is inherent at the nations present on the European geographic territory. In this regard, it needs to specify that Eurostat includes among the units of analysis nations not necessarily belonging to the EU, as it does not follow a political but physical grouping criterion. The criterion for inclusion in the Eurostat databases of the individual regions

[113] Fotheringham A.S. (2002), in "Geographically Weighted Regression The Analysis of Spatially Varying Relationships", underlines the the usefulness of the comparability of the spatial results obtained at different geographical levels. It can denote local significance even in case of global non-significance, considering the same determinants (EuroNUTS0 and EuroNUTS2) to compare the geo-levels results having more disaggregated data and achieving greater spatial variability of the data. An analysis also at Nuts2 level allows deepening the local differences that did not emerge with the analysis at the Nuts0 geo-level and this can prove the usefulness of the spatial model for the analysis of complex socio-demographic phenomena like this where many political and cultural determinants affect differently on the regional and national TFR.

located in the European geographic territory takes place based on the availability of statistical surveys of those contexts.

Based on the analysis question of this research and on the literature on the topic, indicators are required, which could detect influences on the TFR, which is the dependent variable of this study. At the end of the construction of the database, in relation to the available data of the indicators considered, I decided to use the time-period from 2014 to 2017.

For greater understanding, you can look at the following table of indicators that make up the database of analysis created for this research:

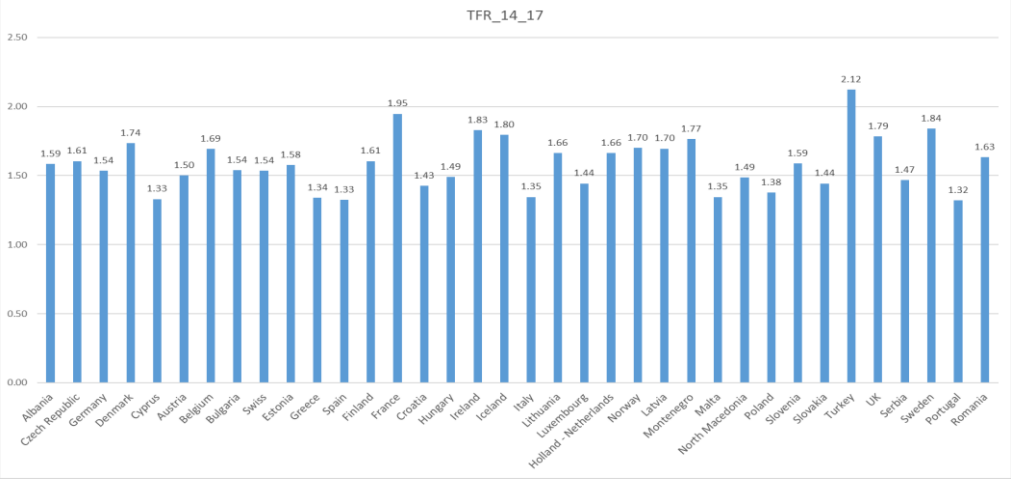
Table 1 – *Table of regressors considered and their expected result basing on the Literature*

Variables	***Description***	***Expected Result***	***Principal Reference Literature***
TFR_14_17	TFR average 2014-2017 of all the spatial units.	Dependent Variable	Sobotka 2013, Miettinen 2013, Rosina 2014, and all those below
W_AGE_M_14_17	Woman Average Age at First Childbirth, mean 2014-2017	Negative significance	Picchio 2018, Caltabiano 2016, De Rosa 2012, Kalwij A., 2016
W_EMP_14_17	Female Employment Rate, mean 2014-2017	Negative significance	Picchio 2018, Bernardi 2017, Bàizan 2013
W_E_FLT_14_17	Female Full Time Employment Rate, mean 2014-2017	Negative Significance	Bernardi 2017, Picchio 2018, Campisi 2020, Wood Neels 2020
W_E_PRT_14_17	Female Part-Time Employment Rate, mean 2014-2017	Positive Significance	Bernardi 2017, Blum 2012, Bàizan 2013, Mencarini, 2018
W_UNEMP_14_17	Female Unemployment Rate, mean 2014-2017	Positive Significance in Patriarchal Cultures; Negative significance in culture with gender equality	Gesano 2017, Sobotka 2013, Bernardi 2017, Miettinen 2013, Mencarini 2018
W_EMP_H_ED_14_17	Woman employed with high educational level	Negative significance	Gesano 2017, Gustafsson 2016
CHD_U_CHSRV_14_17	Children who use Childcare Services	Positive significance	Rindfuss 2017, Picchio 2018, Bernardi 2017, Mencarini 2018 Sobotka 2013, Wood and Neels 2020
CHD_NO_U_CS_14_17	Children who do not use CS	Negative significance	Rindfuss 2017, Picchio 2018, Bernardi 2017, Mencarini 2018, Sobotka 2013
CS_U_L_14_17	Children who use CS for Less than 29 hours a week	Positive significance	Rindfuss 2017, Picchio 2018, Bernardi 2017, Mencarini, 2018
CS_U_M_14_17	Children who use CS for More than 30 hours a week	Positive significance	Rindfuss 2017, Picchio 2018, Bernardi 2017, Mencarini 2018
PIL_PRC14_17	GDP pro-capita	Positive significance	Lutz 2017, Mencarini 2018, Wood and Neels 2020

The variable TFR_14_17 is the variable of the average values for the period (2014-2017) of the TFR of the spatial units considered acquired from the Eurostat database. Individual TFRs are calculated by summing the woman's age-specific fertility rates in a specific year.

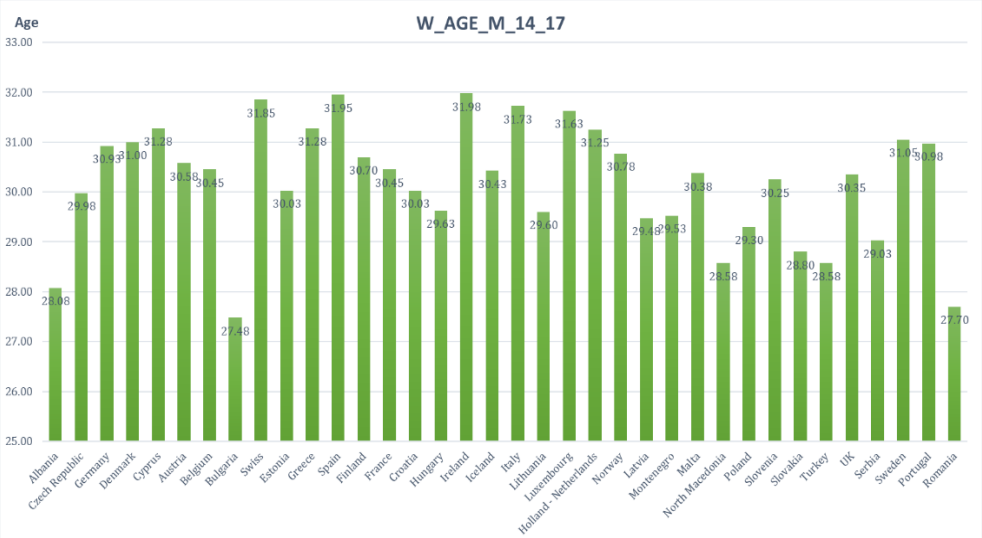
Through fig. 1, it is possible to view the distribution of the average value of the TFR in the period between 2014 and 2017 in the 36 countries considered in the European territory. The graph clearly shows the difference in the TFR value of the Mediterranean scrub states, in particular Portugal, Spain, Italy, Greece, Malta and Cyprus, whose values range from 1.32 to 1.35. They are almost similar nations in terms of social structure and cultural and family background and similar is the lack of measures adopted in terms of family and youth policies, which therefore hint at the reasons for these low TFRs. Not surprisingly, the high French TFR equal to 1.95, already declared in the literature, which confirms the expectations of positive influence of CS and youth work policies on fertility, like for the Scandinavian model (figure 1).

Figure 1 - *Frequency distribution of TFR average for the period 2014 – 2017. Elaborations based on Eurostat data Nuts0*



To analyse the influence of the phenomenon of elderly primiparas on fertility, was used the indicator of the average age of the woman at first childbirth (codebook: W_AGE_M_14_17). This is a Eurostat indicator, expressed by age, which represents the average age of women giving birth to their first child (live births). The W_AGE_M_14_17 indicator, for the individual countries, presents much diversified data (see Fig. 2).

Figure 2 - *Frequency distribution of Woman Average Age at First Childbirth (2014-2017). Elaborations based on Eurostat data Nuts0*

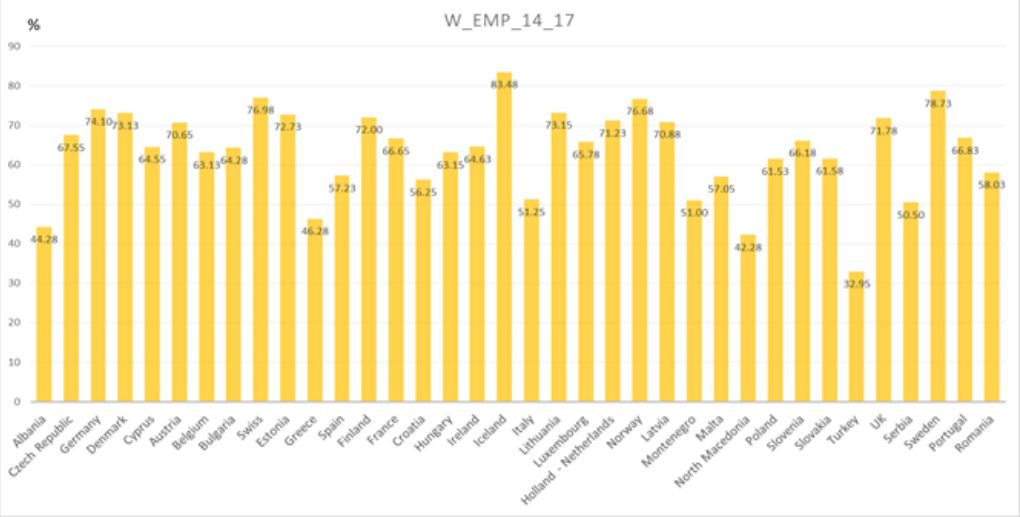


For the years 2014-2017, the highest value of the average age of women at first childbirth is in countries such as Switzerland, Ireland, Spain, Italy, Greece, Luxembourg and the Netherlands. While, there seems to have a low average age of women at first childbirth in Albania, Bulgaria and Romania, where the impact of patriarchal cultural heritage remains strong today and which envisage a clear division of gender roles within the couple. This phenomenon should induce the woman not to delay the moment of procreation and to devote herself exclusively to family care actions. Basing

on the different economic and productive structure of northern and southern European countries, it is expected a different impact within the two subgroups of countries on TFR. One would expect that this delay procreative affects TFR in a different way among these nations, in relation to the presence of conciliatory policies, such as CS and family and work policies of different depths according to the different local contexts.

The literature prompts to expect that a greater age of the woman at the first childbirth correspond to a lower TFR, because of the simultaneous orientation of procreative expectations that focus on the quality of children rather than quantity, trying to offer greater opportunities to a quantitatively reduced offspring[114]. In order to study the implications of female employment on TFR this study includes in the database a series of indicators on women's employment. The first of these is the variable of employed women aged between 20 and 64, or the active female share.

Figure 3 – *Total Female Employment Rate 2014-2017(%). Elaborations based on Eurostat data Nuts0*



[114] Rosina et al. (2014).

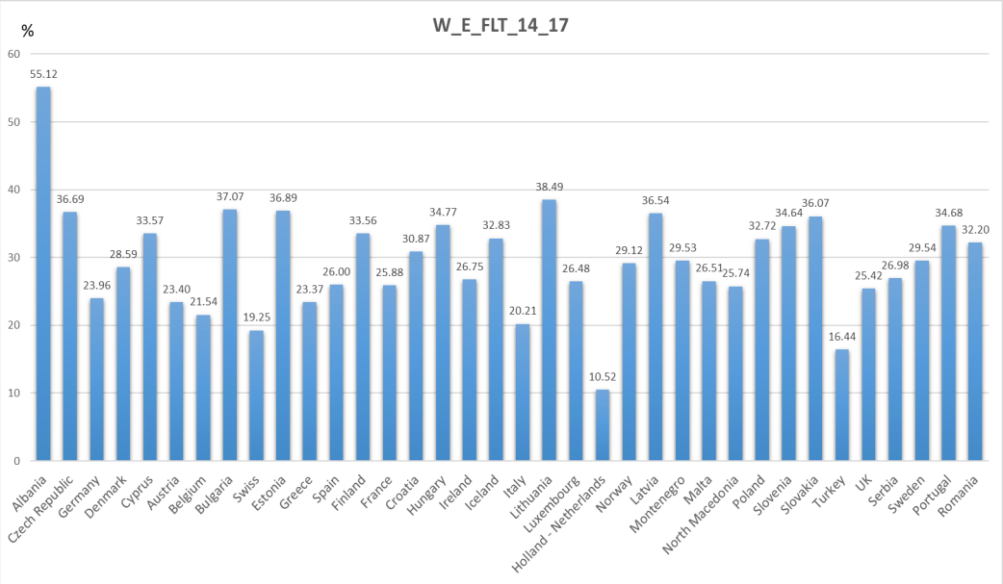
In the construction of this indicator, Eurostat considers “employed” all women who, during a reference week, have worked at least one paid hour or have been temporarily absent from work due to leave, leave or other justified absences. Observing the frequency distribution of these data, expressed as a percentage, we observe the greater presence of women employed in the reference period (2014-2017), in Iceland, Sweden, Norway, Switzerland and Germany. These data confirm the thesis of the literature on the subject, which describes the Scandinavian model of work flexibility as the best prototype of work-family reconciliation policies. The lowest number of employed women is in Turkey, Greece, Albania, North Macedonia, Montenegro, Serbia, as well as in Italy with an insufficient 51.25% of employed women.

In this study, the influence of female employment on TFR will be observed individually and jointly with the influence of the presence of CS. The aim is to affirm or refute the thesis supported by most of literature on the subject[115], which considers the presence of CS to be decisive on the woman's decision to procreate, without however having to give up the social expectation of self-fulfilment at work. Other indicators about this aspect are the female full-time and part-time employment rate and the female unemployment rate. The unemployment rate indicator is a rate expressed as a percentage (percentage of unemployed women, source Eurostat) which represents the number of women of working age (between 15 and 74 years of age) who did not carry out any day of paid work during the reference year of

[115] See Chapter 2 for a review of the literature examined on the topic.

the data. Other two Eurostat indicators used are two employment rates expressed in thousands calculated on the population of women of working age used for women full-time and part-time employed. For comparative purposes with the other indicators considered in the database created in this research work, these indicators refer to the annual total of the female population expressed as percentages.

Figure 4 – *Full-Time Female Employment Rate 2014-2017(%). Elaborations on Eurostat data Nuts0*

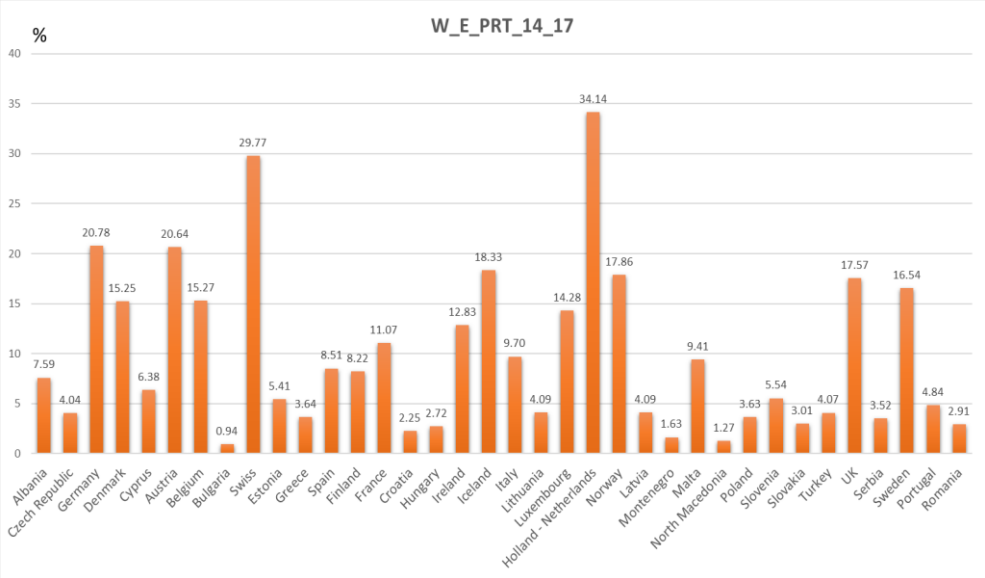


Therefore, the rate of women in full-time employment represents the percentage value of women in full-time employment refer to the total of women of active age (between 15 and 64 years of age). The figure n. 4 shows a rate of women employed full-time between 20% and 30% for most of the nations analysed and another large group of countries in the European territory presents rate higher than 30%. The exceptions are Albania, which reports the highest full-time female employment rate (55.12%) and the

Netherlands, which instead has the lowest full-time female employment rate of 10.52%.

Looking at the graph of the indicator of the female part-time employment rate, however, it is clear that this form of flexible work is once again higher in the Netherlands (34.14%) and Switzerland (29.77%).

Figure 5 – *Part-Time Female Employment Rate 2014-2017(%). Elaborations on Eurostat data Nuts0*



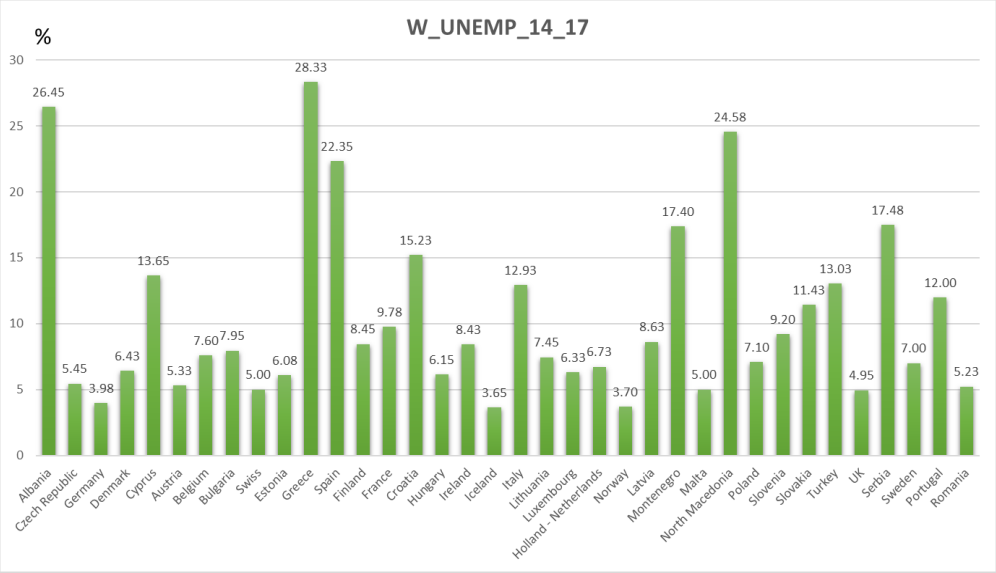
Followed by Germany (20.78%) and Austria (20.64%) with medium-high female part-time employment rates compared to the average. This data seems to confirm the literature, which describes a positive significance of the presence of parental leave, pension calculation systems that include parental leave and other measures that seem to have positively affected to the growth of TFR[116]. Nevertheless, in much of the European context the percentage of the female part-time employment rate appears below 20%. Thus, it is easy to see how there is still a low diffusion of flexible work as a conciliatory

[116] See for example the German case on paragraph 2.1.

employment policy, especially in countries with low TFR such as Italy and Spain. However, it can be supposed to detect a negative significance of the high female full-time employment on the TFR due to the work-family reconciliation difficulties and a correlated higher age of the woman at childbirth, testifying to the postponement of the procreative choice.

The female unemployment rate in the period 2014-2017 is an indicator expressed in percentage and calculated in relation to the active female population: unemployed women aged between 15 and 74 years. Looking at the figure n. 6, the distribution of frequency denotes that there are some high female unemployment rates that touch the 30% threshold in Greece, Albania, North Macedonia, Spain and other percentages are not very low also in Italy (12.93%), Croatia, Serbia, Montenegro, Portugal and Cyprus.

Figure 6 - *Female Unemployment Rate 2014-2017(%). Elaborations on Eurostat data Nuts0*

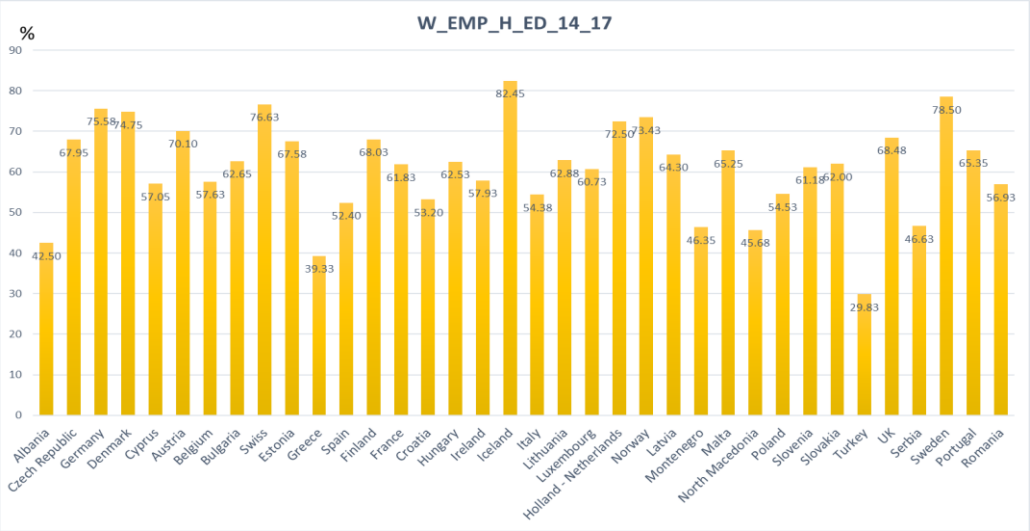


Instead, the literature on the subject (Bernardi et al.) confirms the low rates below 10% of female unemployment in Germany, Iceland, Norway, Sweden, Finland, Luxembourg, Ireland, United Kingdom, Switzerland, etc. Precisely,

in relation to the literature, can be expected that in countries where the unemployment rate is high, will check a positive significance on TFR, as it is expected that women free from work commitments are fully dedicated to family care actions, as in the old traditionalist patriarchal model.

According to the literature[117] occidental ideology, first, pushes women to emancipate themselves and to have massive expectations on their career in order to compete with men or overcome any form of economic and social dependence. To this purpose, women have begun to specialize more and more by extending the training period. This, in many contexts, has led to a postponement of the age of the first procreation[118]. To analyse the influence of these phenomena on TFR, I decided to include in database indicators such as female employment of women with a low or high educational level (according to the international classification of educational levels).

Figure 7 – *Frequency distribution of average of Woman Employed with High Educational Level. Period 2014 – 2017. Elaborations based on Eurostat data Nuts0*



[117] Bernardi (2007), Wood and Neels (2020), Blum (2012), Picchio (2018) et al., see the paragraph 2.1 .
[118] Idem to 117 note.

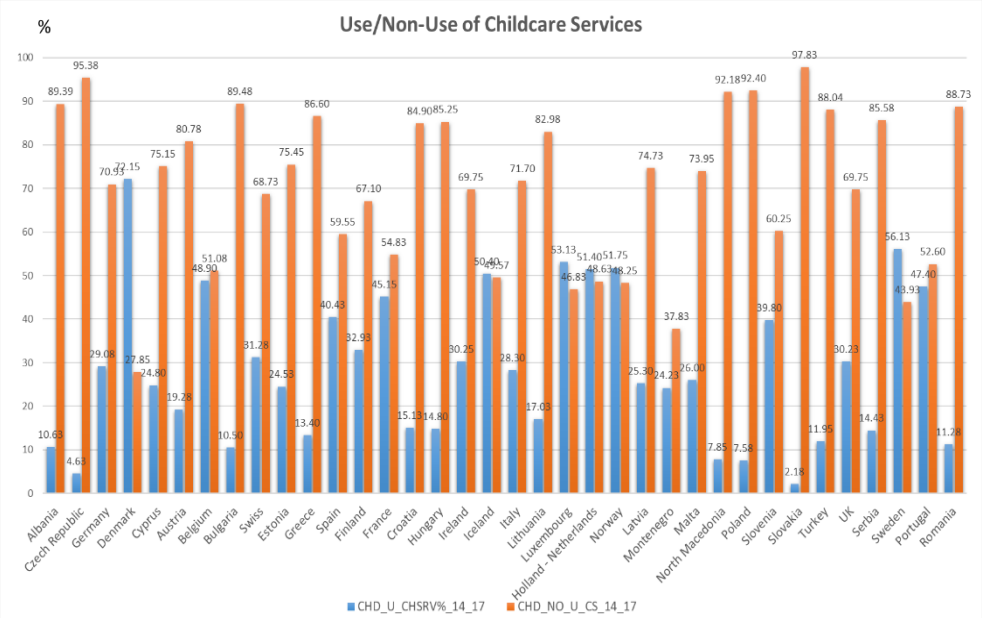
The indicator “employed women with a high level of education” (W_EMP_H_ED_14_17) is obtained from the Eurostat database and represents the rate expressed as a percentage of employed women aged between 15 and 74 with an education level between level 5 and level 8 of the international classification of educational levels. According to this classification, the levels range from level zero (unschooled) to level eight (above post-graduate tertiary education) are grouped in three categories: level 0-2, level 3-4 and level 5-8. As the graph shows, except the high Icelandic percentage, the states with the highest percentage of employed women with a high level of education in the period considered are Sweden, Switzerland, Germany, Denmark, Holland and Norway. These are nations where there are numerous conciliatory policies to facilitate women in their career advancement and in hyper-specialized training investment.

The nations with the lowest percentage of employed women with a high level of education are Turkey, Greece, Albania, Montenegro, North Macedonia and Serbia. This data also confirms the literature that attributes to these last nations traditionalist cultural models, in which women have not socially emancipation yet and therefore we does not expect that the level of their education will be high. In relation to the high level of education of the employed woman, should expect a greater postponement of procreative choice and a lower TFR too.

Crucial theme of this research work is the analysis of the influence of CS on TFR. For this purpose, various indicators have been included in the

database. These are indicators expressed as percentages of the population in the 0-3 age group.

Figure 8 – *Percentage of children 0-3 who use/not use Childcare services. Period 2014 – 2017. Elaborations based on Eurostat data Nuts0*

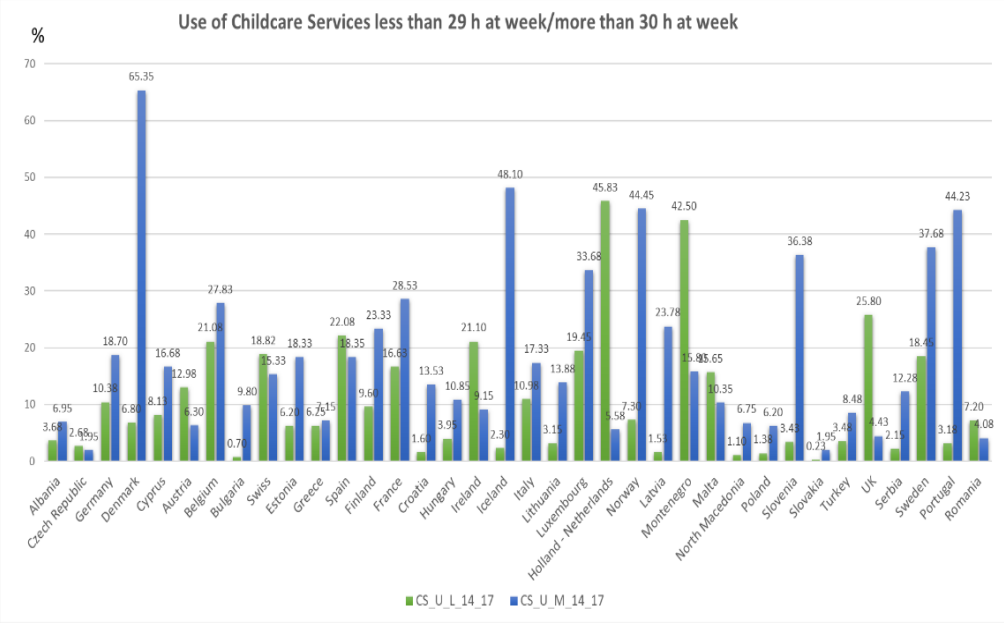


The graph in figure 8 shows a clear quantitative gap in the non-use of CS compared to the percentage of use of CS for preschool children (0-3 years), in the territory of the European continent. Denmark immediately stands out, where the use of formal 0-3 services is vastly greater (72.15%) than their non-use (27.85%), followed by Sweden, Norway, Holland, Luxembourg and Iceland, nations in which also the literature claims a good efficacy of childcare services for this age group. The data shows a very low use of childcare services in Slovakia and the Czech Republic below 5% and many other countries show a low use below 20% (Albania, Greece, Croatia, Hungary, Lithuania, Poland, Turkey, North Macedonia, Serbia and Romania). Thus, while in countries such as France, Belgium, Portugal, etc. the percentages of use and non-use are quite close, so it could interpret the

data as a symptom of cultural transition of pre-school care actions, in other countries it does not seem to be so. In Italy, for example, as well as in many other countries (see the graph), in the period 2014-2017 there is a large margin between the percentage of CS use of 0-3 (28.30%) and of non-use (71.70%). There, the low use of CS for pre-scholar children represents a disadvantage for working mothers, for whom this could still involve the obligation of a choice between a working career and parentage. Similar data can show the presence of scarce conciliatory policies, which should have negative analytical implications on TFR, confirming the literature on the subject.

To these indicators in terms of CS, I added other distinct variables for the duration of hours of use per week.

Figure 9 – *Comparison of use of Childcare Services less than 29h at week and more than 30 h at week (%). Period 2014-2017. Elaborations based on Eurostat data Nuts0*



Precisely, these two indicators specify the percentage of use of CS expressed in hours per week. The indicator CS_U_L_14_17 represents the percentage number of children in the age range 0-3 years old, who use the

childcare services for *less* than 29 hours per week and CS_U_M_14_17 the percentage number of children aged 0-3 who use childcare services for *more* than 30 hours per week.

The data for the period considered show a strong prevalence of childcare use for more than 30 h per week in Denmark (65.35% versus 6.8% of the low weekly use), Iceland and Norway, but also in Slovenia, Sweden and largely in Portugal (44.23% of "more use at week" against 3.18% of "low use at week").

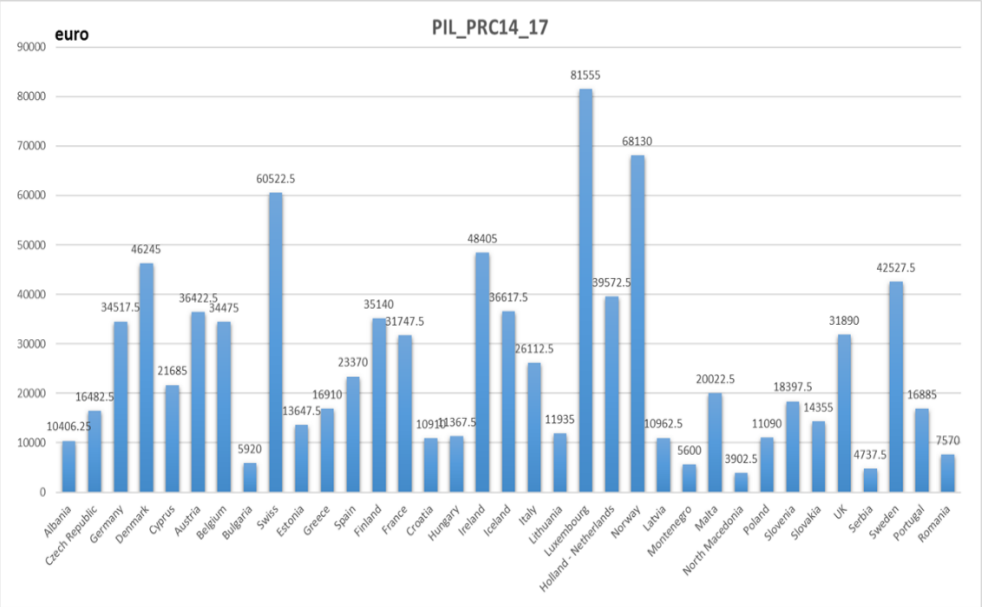
In this regard, it might be interesting to analyse jointly the implication of these regressors and female part-time and full-time work on TFR. For instance, I would expect a joint positive influence of the use of less than 29 hours per week and of the female part-time on the TFR. This because, the joint analysis of these regressors could prove the usefulness of conciliatory policies and other numerous socio-political and economic dynamics on TFR. For a thorough analysis of the demographic study, it is necessary to include indicators of the family *income* sphere too to check the incidence of income security on the procreative choice of women and families in general[119].

In this perspective, I consider the per capita GDP calculates by Eurostat as "the ratio of real GDP to the average population of a given year". The GDP "measures the value of the total final production of goods and services produced by an economy within a certain period of time". For the purposes of this research, the indicator in the database has the form of the

[119] Mencarini et al. (2012).

average value of the period of analysis (2014-2017). The per capita GDP data shows greater economic well-being especially in Luxembourg, Norway, Switzerland and Ireland, followed by Denmark, Holland, Belgium, Austria, Germany and the United Kingdom. At the contrary, it reveals a very low level of economic well-being in Bulgaria, Montenegro, North Macedonia, Serbia and Romania.

Figure 10 – *GDP per capita 2014-2017. Elaborations based on Eurostat data Nuts0*



The trends of the second demographic transition give attention to the quality of the offspring and not to the quantity[120]. These trends should give a lowering of the TFR in countries in which there are a higher GDP per capita. Nonetheless, we must also consider the greater purchasing power of private CS, a factor that could have a positive influence on the TFR.

[120] See at the paragraph 1.2

4.2 Descriptive analysis of fertility in Europe by territorial unit at Nuts0 level

Albania: The Albanian TFR for the period considered was equal to 1.59. Since 2014 to 2017, it recorded a significant decrease (from 1.73 to 1.48) with an average age of the woman at birth which increase from 27.7 to 28.4 among the three-year period considered. The data express female employment growth from 42.55% to 45.85%, although this rate remains below the 50% threshold. More specifically, in Albania only 55.12% of women of active age have a full-time employ, compared to 7.59% who work part-time. The female unemployment rate in the three-year period considered is high: 26.45%. These data take on particular relevance considering the use of childcare services for early childhood: only the 10.63% of children under the age of 3 use CS. Specifically, the 6.25% of children who use childcare services use them for more than 30 hours per week. However, this is a percentage still too low. In fact, it is clear that in Albania the emancipatory process of women leads to postpone the age of the first childbirth by virtue of the job realization that promote full-time as a type of female occupation. The scarce affirmation of the flexible form of work together with the limited use of early childhood services and the limited per capita GDP (€ 10.406,25) should causes the postponement of procreation and consequently the drop in TFR there.

Czech Republic: the TFR for the three-year period 2014-2017 is equal to 1.61 with an increasing trend from 1.53 to 1.69. In this three-year period, the woman gives birth to her first child at the average age of 29.98 years, an age that is slightly increasing in the period studied. The per capita GDP of this nation has an average three-year value of € 16.482,50 growing from €15.480,00 in 2014 to € 17.490,00 in 2017. Female employment is also growing from 64.7% to 74.5% of women of active age with a higher three-year percentage of women employed full-time equal to 36.69%, significantly higher than the small percentage of part-time employed women equal to 4.04%. The female employment rate, equal to 67.55% in the three-year period, seems to be relevant, which allows us to deduce the presence of many self-employed women practicing the profession, also in relation to the female unemployment rate equal to a modest 5.45%. In the period of study, there was a very low use of CS for early childhood 0-3, equal to 4.63%, of which 2.68% use these services for less than 30 hours per week. These data allow us to hypothesize a recovery in terms of fertility in the country, probably linked to a reconciliation of family care times and female employment, not very delegating towards CS, but which focus on the working flexibility of women for the choice of self-employed / freelance types of work.

Germany: the German TFR increase with an average value of 1.54 among the three-year period considered. Nevertheless, that fluctuates from 1.47 in 2014 to 1.57 in 2017, with a woman's average age at first birth almost constant at 30.93 years. Germany holds a good per capita GDP of € 34.517,50 as an

average for the three-year period considered, and the female employment rate seems to be increasing from 73.1% to 75.2%, one of the highest in Europe. For the three-year period 2014-2017 only 3.98% of German women are unemployed. The percentage of 23.96% is composed of women employed full time, higher than women employed part time (20.78%). Considering that only 3.98% of German women are unemployed, it becomes interesting to investigate the high percentage of non-use of early CS, equal to 70.93%. Of the remaining 29.07% who use childcare services for the 0-3 age group, 18.70% of children use these services for more than 30 hours per week. Studying the joint significance of similar regressors becomes of prime importance also in relation with literature[121], which expounds on the role of Germany, very attentive to family and work-family conciliatory policies.

Denmark: There is an increasing TFR equal to 1.74 for the three-year period of analysis (2014-2017), which expresses a total fertility rate increasing from 1.69 in 2014 to 1.75 in 2017. Observing the data recognised, it's note, over the three years, a slow growth both in the average age of women at first birth from 30.9 to 31.1 and in female employment (from 72.6% to 74.8%). The 28.59% of employed women work full-time, compared to 15.25% of women part-time employed. These data suggest a strong cultural affirmation of the women's social role, which pushes her to hyperspecialize in order to fulfil herself in the workplace, postponing the reproductive choice. The high use of CS for children under the age of 3, is equal to 72.15%, the highest in Europe

[121] Bauernschuster (2012).

in the 2014-2017 three-year period, probably affects this majority of full-time employed women. The indicators relating to early childhood services studied in this research report a wide use of these services for a duration of more than 30 hours per week (65.35%). This use could affects with the per capita GDP of € 46.245,00 that being among the highest in Europe in the period considered, could also allow for greater purchasing power of private CS.

Cyprus: There the TFR indicates a timid growth from 1.31 to 1.32 since 2014 to 2017 with an ascending peak in 2016 (1.37). Similarly, there is a slow postponement of the average age of women at first birth from 31 years to 31.4. For a valid decoding, this data must be read together with the female employment rate, equal to 64.55% which, as an average value for the three-year period, shows a considerable growth (from 64% of employed women in 2014 to 68.9% in 2017). Although the female unemployment rate of 13.65% is still high, in the three-year period there is an encouraging lowering of the rate from 15.10% to 11.30%. The affirmation of women in the job market in Cyprus therefore still seems to be in progress, it can also be deduced by observing the small presence of women employed part-time (three-year average value 6.38%, among other things with a downward trend from 6.67% to 6.39%) compared to 33.57% of women in full-time employment (constantly growing from 33.1% to 34.5%). The per capita GDP is equal to €21.685,00 a value that decreases within the European average, but which, based on the data of the study period, seems to be growing. However, in this context of socio-cultural growth, there are still too many children who do not

use CS: the 75.15% of children under the age of 3, compared to a shy 24.80% who instead uses it and of which 8.13% uses it for less than 30 hours a week. It would expect to find a positive significance between this low use of CS and the postponement of the woman's age at the first birth and consequently on the TFR.

Austria: there is an increasing TFR from 2014 with 1.46 to 2017 with 1.52, and an average age of women at first birth increasing from 30.4 to 30.7 years. Austria boasts a female employment rate of 70.65% with a growth of 1.30% in the three-year period 2014-2017. The 20.64% is employed part-time, while 23.40% full-time and there is a low female unemployment rate of 5.33% as a three-year average. These data represent a confirmation of the demographic transition theory, especially when considered together with the per capita GDP of € 36.422,50 and the data relating to the use of early childhood CS. In fact, the Austrian GDP per capita is in the medium-high range compared to the other European GDP per capita. If this data, together with the female employment rate, gives good expectations of the significance of these indicators on TFR, on the contrary the percentage of non-use of CS for the 0-3 age group equal to 80.78% suggests a role still primary of the woman in the actions of family care. This would also seems to be confirmed by the data on the weekly duration of use of CS: only the 19.28% of children 0-3 age use CS, of which 12.98% use them for less. 30 hours per week.

Belgium: Fertility recorded a decline over the three-year period of analysis, lowering the national TFR from 1.74 to 1.65, with a three-year average of

1.69. The average age of women at first birth suffers a slight increase over the three-year period from 30.30 to 30.60 years. The female employment rate in the period considered was 63.13%, and it is up from 62.90% recorded in 2014 to 63.60% in 2017. In Belgium, 15.27% of women of active age work part-time, while 21.54% work full-time, both values show a trend that is first increasing and then decreasing over the three-year period. The 48.90% of children between the ages of 0 and 3 use the CS, therefore the remaining percentage of infants who do not use them is still in the majority. However, it is interesting to note that of this percentage of 48.90%, the 27.83% use these services for a weekly duration of more than 30 hours per week. Thus, there is a sharply growing trend from 25.6% in 2014 to 30.4% in 2017. The constant growth of per capita GDP over the three-year period from € 33.870,00 in 2014 to € 35.050,00 in 2017 should represent a contributing cause of the growing trend in the use of CS. In these terms, should expect a joint correlation between the growth of female employment and the longer weekly duration of use of CS, as the conciliatory needs of the mother-working woman.

Bulgaria: there is an average TFR for the three-year period analysed equal to 1.54, a medium-low rate compared to the European median for the period (Me = 1.58). The average age of women at first birth is the lowest of the European countries analysed (27.48 years), although slightly increasing in the three-year period 2014-2017 (from 27.3 to 27.6). The female employment rate in the three-year period increased from 62.9% to 63.6% for an average period value of 64.28%. The percentage of full-time female employment increased

from 2014 (36.16%) to 2017 (38.35%) while, in the same period, female part-time employment showed a decrease from 1.04% to 0,93%. Therefore, Bulgarian women consolidate their presence in the labour market but with a greater tendency to work full time and this should be due to the tending growth in the average age of women at first birth. This is probably due to a very high unused of CS of children under 3 years of age (89.48%), against an insufficient 10.50% of children in the age group 0-3 who use CS, of which almost all (9.80%) use it for more than 30 hours a week. This high non-use of CS certainly does not facilitate the conciliation of family needs and work needs, which probably is the reason why Bulgarian women decide to postpone fertility choice.

Swiss: in Switzerland TFR is equal to a period average equal to 1.54, constant in the analysed period with the exception of 2017, in which it suffered a slight decrease (1.52). In this nation, the average age of women at childbirth was 31.85 for the three-year period of analysis with an almost constant trend. This is one of the highest average women age at first birth in Europe, which together with the high female employment rate suggests social priorities for Swiss women. As announced, the female employment rate in this country is growing from 76.2% in 2014 to 77.4% in 2017. It represents, after those of Iceland and Sweden, one of the highest female employment rates in Europe. Specifically, the 29.77% of employed Swiss women works part-time. The latter seems to be the clearly preferred type of job of full-time employment (19.25%). The female unemployment rate at 5% is almost constant in the

period considered and can be one of the lowest in Europe. This good socio-progressive framework is intriguing for the high percentage of non-use of childcare services, equal to 68.73%. Only 31.28% of children under 3 years use childcare services and mostly for a weekly duration of less than 30 hours per week (18.82%). A triennial average of per capita GDP of € 60.522,50 which may possible any private conciliatory solution.

Estonia: The average TFR for the period of analysis is equal to 1.58 and the woman has an average age at first birth of 30.03, increasing in the period considered from 29.60 of 2014 to 30.40 of 2017. Female employment in that period shows a good percentage equal to 72.3%, which appears to grow up from 70.06% in 2014 to 75.10% in 2017. There prevails the full-time female employment for the 36.89%, compared to the percentage of women employed part-time equal to 5.41% for the period of study. These average percentages for the period (from 2014 to 2017) have marked an increasing trend from 36.85% to 37.48%. The percentage of women employed part-time in the three-year period also increased from 4.63% to 5.75%. There the female unemployment rate is equal to the 6.08%. Estonian GDP per capita from 2014 to 2017 appears to grow from € 13.060,00 to € 14.480,00 for a time average of € 13.647,50 and places the socio-economic well-being of the country in the medium-low range compared to the rest of the context European (the average per capita GDP of Europe 2014-2017 is equal to € 25,575,17). Observing the data of the use of early childhood CS, it is still low (24.53%) and children aged 0-3 who do not use these services are still 75.45%, although fortunately

it is decreasing: in 2014 the percentage of not-use of CS was equal to 80.30%, down to 73% in 2017. The 18.33% of children uses CS for more than 30 hours a week. These data should represent the need for family care outside the nucleus due to the increasing female employment rate.

Greece: there is a fairly low TFR equal to 1.34, the lowest in Europe after Portugal, Spain and Cyprus, confirming the phenomenon of "zero fertility" typical of the Mediterranean area included in the demographic literature. The average age of women at childbirth in the years examined has grown from 31.28 to 31.4, on a par with the female employment rate, which shows an increasing trend from 44.3% in 2014 to 48% in 2017. The most present type of female employment in Greece is full-time for 23.37% of employed women of active age, which recorded a growth from 22.66% to 23.93% for the period considered. Only 3.64% of Greek women work part-time, but it is growing from 3.39% in 2014 to 3.91% in 2017. In this noteworthy descriptive framework is the very high female unemployment rate that, with 28.33% it is the highest in Europe. The low per capita GDP in Greece, equal to € 16.910,00 as an average value for the period, shows an increasing trend from € 16820.00 to € 17100.00 in the period analysed. This economic-employment and social prospect completes its profile with a still too low rate of use of CS for early childhood equal to 13.40% compared to 86.60% of not-use by the population 0- 3.

Spain: it is among the European nations that holds one of the lowest TFR in Europe equal to1.33 as an average value of the analysis period. At the same

time, the average age of women at birth increased from the age of 31.8 in 2014 to the age of 32.1 in 2017, with a three-year average of 31.95 years. In the workplace, there is an average female employment rate of the three-year period of 57.23 with an increasing trend from 54.8% in 2014 to 59.6% in 2017. The 26% of Spanish women of active age have full-time employment and only 8.51% a part-time one. In the three-year period, there is a growing trend in full-time female employment from 24.74% to 27.19%. A little more moderate was the growth in the percentage of women employed part-time from 2014 with 8.45% to 2017 with 8.63%. The trend for the period of the Spanish per capita GDP is also susceptible of interest, which grows from a value of € 22.210,00 recorded in 2014 to € 24.430,00 in 2017. The female unemployment rate in the three-year period of analysis is quite high with 22.35% of women of active age. From this perspective, the percentage of children under 3 years old who not-use CS, equal to 59.56%, which decreased by 8.8% in the three-year period analysed, from 63% in 2014 to the percentage of 54.2% in 2017, must also be interpreted. Consequently, there is an increasing percentage of use of the same CS equal to 40.44% as an average value for three years, the 22.08% of them use the CS for a weekly duration of less than 30 hours per week and the remaining 18.35% use them for more than 30 hours weekly.

Finland: The TFR for the three-year period 2014-2017 equal to 1.61, down from 2014 when the TFR was 1.71 to 1.49 in 2017. We observe an average age of the woman at the first birth that is constant in the three-year period of

analysis, which grows from 30.5 to 30.9. Observing the three-year data of the Finnish per capita GDP, we can observe a growth from € 34.390,00 to € 36.380,00. As regards the two rates of female employment and female unemployment, we note the three-year percentages of 72% and 8.45% respectively. The 33.56% of women of working age have full time employment and 8.32% are employed part-time. The percentage of full-time female employment appears to be decreasing from 2014 to 2017 from 34.09% to 33.16%, as opposed to that of female part-time, which grew up from 8.13% to 8.54%. Children 0-3 used early childhood CS for the 32.93%, while 67.10% do not use them. Both percentages are constant over the three-year analysis with a very low difference. In particular, the 32.93% above is composed of 23.33% of children who use CS for a weekly duration of more than 30 hours per week, while the remaining percentage of 9.60% uses those for less than 30 hours per week.

France: with 1.95 there is the highest European TFR for the three-year period analysed, although down from 2 (2014 value) to 1.9 (French TFR in 2017). In France, in the three-year analysis there is an average age of woman at first birth equal to 30.45, which tends to postpone. In fact, in 2014, there was an average age of the woman at childbirth of 30.3 years until 2017 with an average age of 30.6. Female employment in France is equal to 66.65% of women employed of active age, with a majority of 25.88% of women employed full-time and with only 11.07% of women employed part-time. The French female unemployment rate is 9.78%. The French per capita GDP is

equal to € 31.747,50 as an average value for the three-year reference period, which shows an upward trend. In this context, there is a good percentage of use of CS for early childhood, equal to 45.15% and among other things in rapid increase from 2014 to 2017, respectively with 39.5% and 50.5%. At the contrary, the data shows a decrease in the percentage of not-use of these services, leading to a percentage value of not-use equal to 49.5% in 2017. A percentage of 28.53% of children, who use early childhood care services, uses it for a weekly duration of more than 30 hours, while the remaining percentage of 16.63% uses it for 30 hours a week. Both weekly durations of use, show percentage values on the rise over the three-year period analysed, highlighting the stabilization of this conciliatory policy in favour of the working mother.

Croatia: The TFR for the period 2014-2017 is equal to an average of 1.43. This is a declining rate from 1.46 to 1.42. On the contrary, the average age of women at childbirth increased from 29.8 in 2014 to 30.3 in 2017. The female employment rate has a percentage of 56.25%, which expresses an average three-year value of a rate that increased since 54.2% in 2014 to 58.3% in 2017. The 2.25% of employed women work part-time, compared to 30.87% of women employed full-time. These rates, observing the three-year data, appear to be growing (full-time from 29.96% in 2014 to 32.12% in 2017 and the female part-time shows a bell-like trend that is first increasing and then decreasing at the end of the three-year period from 2.17% at 2.06%). Even the Croatian per capita GDP, although among the lowest in the European

territorial context, shows a positive trend among the years of study from €10.310,00 to €11.600,00. The use of CS for children under the age of 3 in Croatia is expressed by a period percentage of 15.13%, of which 13.53% use these services for more than 30 hours a week, compared to a substantial non-use of CS equal to the very high percentage of 84.90%.

Hungary: there is a medium-low TFR equal to 1.49 and an average age of the woman at childbirth of 29.63 years as the average values of the three-year analysis considered in this research. The Hungarian TFR from 2014 to 2017 shows a slight increase from 1.44 to 1.54, as the per capita GDP in the period of study, which also grew with a period average of € 11367.5, among the lowest in Europe. In 2014, the total female employment rate was 60.2% and in 2017, it reached the percentage of 65.7% for an average of 63.15% for the period. The full-time female employment rate for the three-year period 2014-2017 has a percentage of 34.77% (increasing over the three-year period from 32.95% to 36.29%) and it is higher than the female part-time employment rate in the same reference period equal to 2.6% with a decline from 2.98% to 2.43% from 2014 to 2017. The Hungarian woman is increasingly stabilizing in the labour market, mainly working full-time. Also considering the low per capita GDP, which becomes interesting if compared to the very high percentage of no-use of CS for 0-3 children (85.20%).

Ireland: this nation has one of the highest TFR in Europe with 1.84 in the three-year period 2014-2017, although with an annual decline from 1.93 to 1.77. While the average age of the woman at the first childbirth, in the three

years increases from 31.8 to 32.1 with a period average of 31.98. Ireland has a female employment rate referring to the three-year period of analysis equal to 64.63% and a percentage of full-time female employment of 26.75%, up from 2014 with 25.35% at 2017, with the percentage of 28.37%. There, the women employed part-time fluctuate in the period around the percentage of 12.83%. The data shown a net growth in per capita GDP from 2014 to 2017 from € 40.010,00 to € 53.930,00 with an average of € 48,405.00. About the impact of family reconciliation policies, in Ireland 30.25% of children under the age of 3 use CS, with an increasing percentage in the years of analysis from 27.4% to 34.4%. In the percentage of 30.25% of children who use CS, it is necessary to distinguish an increasing majority of 21.10% who use those for a weekly duration of less than 30 hours per week and a minority who instead uses those for a longer weekly duration, equal to 9.15%.

Iceland: The Icelandic TFR is among the highest in Europe of 1.80 for the three-year period 2014-2017, although down from 1.93 to 1.71. There is an average age of woman at first childbirth among the period of study equal to 30.43. Female employment has an average for the period considered equal to the percentage of 83.48%. The type of female employment most used in Iceland is the full-time (32.83%). Part-time in Iceland is a way of working used by 18.33% of women in working age. The capita GDP are noteworthy, not so much for the average value for the period of the period of study 2014-2017, with € 36.617,50 close to the European average, but for the annual growth from € 34.710,00 in 2014 to € 38.280,00 in 2017 observed in this

period. The 50.4% of children there use CS for early childhood, with a peak of growth in 2016 of 64.6%.

Italy: the TFR equal to 1.35 for the period 2014-2017, confirms the literature on the subject. In the same period, there is a postponement of the average age of women at first childbirth from the age of 31.5 to 31.9, with an average period of 31.7 age. The Italian female employment rate in the years period considered is equivalent to 51.25%, which is growing from 2014 with a percentage of 50.3% to 2017 with 52.5%, but it is still below the rate of average European female employment (63.58%). In Italy the full-time female employment prevails with 20.21% of employed women of active age. Part-time female employment in Italy records data on the growth from 2014 to 2017 from 9.46% to 9.93%, although with an average percentage of the analysed period of 9.70%. The Italian per capita GDP in the study time interval is equal to € 26.112,50 with a slightly growing annual trend (from € 25.620,00 in 2014 to € 26.730,00 in 2017), a value slightly exceed the European average of € 25.575,17. The medium-low GDP per capita and the insufficient female employment should be significant on the low Italian TFR. Equally, the low use of CS there (28.30%) confirms the Italian lowest-low fertility problem. It is an insufficient value but with an increasing trend from 22.9% to 28.6% over the three-year period of analysis. The 17.33% of these children use CS for a duration of 30 hours per week. Therefore, the not-use of these necessary CS showing a decreasing percentage from 77.1% in 2014 to 71.4% in 2017, remaining too high.

Lithuania: In the period 2014-2017, the TFR is equal to 1.66. This rate shows a bell-like trend over the three-year period with a peak of 1.69 in 2016 and then falling again. The average age of women at childbirth assumes an increasing trend from 29.4 years to 29.8, such as the female employment rate, which grows from 70.6% to 75.5%. The majority of Lithuanian women are employed full-time (38.49%) rather than part-time (4.09%). Lithuanian per capita GDP holds a period average of € 11.935,00, a value well below the European three-year average (€ 25.575,17). Despite this low index of economic well-being, the TFR is higher than many countries of the Mediterranean scrub, so a reason should be the use of CS. In fact, the data shown a high percentage of inactivity equal to 82.98% compared to the remaining 17.03% of children in the age group of 0-3 who use the CS. This is the result of a very inconsistent trend with high annual variance. The above-mentioned percentage of use is made up of a majority of children who use this kind of services for a weekly duration of more than 30 hours per week, equal to 13.88%. The trend of weekly duration of use shows an increasing trend during the period of analysis from 16.7% to 18.6% in 2017.

Luxembourg: the data show a TFR equal to 1.44 below the European average (1.58) for the analysis period 2014-2017. The trend of this rate during that period seems to decrease from 1.50 to 1.39. There, the female employment rate is equal to 65.78% with an average period of full-time female employment rate equal to 26.48%, which in the period of study shows a growing trend from 25.38% in 2014 to 27.41% in 2017. Only 14.28% of

employed women of active age, as the average value from 2014 to 2017, work part-time. In particular, the part-time employment rate over the three-year period is also growing, as it records a percentage of 13.99% in 2014 up to a percentage of 14.96% in 2017. The per capita GDP is € 81.555,00 and is by far the highest in Europe in the period considered in this analysis. In this excellent context of economic well-being, the use of CS has an increasing trend from 49% in 2014 to 60.8% in 2017. More specifically, the data relating to the use of CS for the 0-3 year-old expose a greater use for the duration of more than 30 hours per week of 33.68%, with a trend-increasing annual. There is still a large percentage (48.83%) of children under 3, who do not use CS, which should causes the negative significance on the TFR.

Holland – Netherlands: TFR is equal to 1.66 for the period-considered (2014-2017), a value of a few cents above the average European TFR. The average age of the woman at the first childbirth in the years studied corresponds to 31.25. The average percentage value of the Dutch female employment rate for that period is 71.23%, with an increasing trend from 69.7% in 2014 to 72.8% in 2017. The female Dutch employment is mainly part-time, as shown by the average part-time female employment rate of the three-year period considered equal to 34.14%, predominant compared to the average full-time female employment rate for the period of 10.52%. Holland has a per capita GDP of € 39.572,50, an average three-year value higher than the European average, with a growing trend from € 38580.00 to € 40730.00. It is peculiar that the rate of use of CS with the percentage of 51.40% is very

close to the rate of inactivity of the same, corresponding to 48.63%, as an average for the three-year period. The 45.83% of children use these services for less than 30 hours a week, with an increasing rate from 38.5% in 2014 to 56.10% in 2017.

Norway: for the period of analysis, TFR has an average of 1.70. This is a good date compared to the European average. In the period of analysis, the indicator of the average age of women at first birth shows an increasing trend from 30.6 in 2014 to 31 in 2017, with a period average of 30.78. The Norwegian female employment rate for the reference period corresponds to 76.68% and observing the annual data it appears to be slightly down (from 77.1% in 2014 to 76.2% in 2017). According to the data acquired, in Norway the full-time female employment prevails with an average of 29.12% among the years considered, with a constant annual trend. Women work part-time for the 17.86%. The national per capita GDP with an average three-year value of € 68.130,00 reveals a more than good average level of economic well-being, which over the period of study shows a growing trend from € 67.340,00 to € 69.130,00. The rate of use of CS express an average period percentage of 51.75%, of which 44.45% use these services for a weekly duration of more than 30 hours per week. This data increasing from 44.1% in 2014 to 47% in 2016 but with a negative peak in 2017 of 41%.

Latvia: there the TFR is 1.70 as an average among the annual TFR from 2014 to 2017, well above the European average. On the contrary, the rate of the average age of women at childbirth for the period analysed corresponds to

29.48 years and represents a lower value than other European countries (European average equal to 30.19). The female employment rate is equal to 70.88%, with an annual growing trend from 2014 to 2017, with the percentages of 68.5% and 72.7% respectively. The 36.54% of employed women of active age work full-time against a very low three-year percentage of 4.09%, which represents women employed part-time. Similarly to the full-time female employment rate, which during the analysis period shows increasing percentages from 36.23% in 2014 to 36.74% in 2017, part-time employment shows an equally increasing trend with a percentage increase of 0.82% from 3.52% in 2014 to 4.34% in 2017. For the period analysed, Latvia's per capita GDP is equivalent to a very low three-year average value of € 10.962,50 with a slightly increasing annual trend from 2014 to 2017. As regards CS in Latvia, the percentage of not-use CS is equal to 74.73%, probably linked to the low per capita GDP, against 25.27% of use as an average of period of study. Observing the annual data, the percentages of use, shows a slight increase from the percentage of 21.6% in 2014 to 28.4% in 2017. Of this 25.27% use of CS, the 23.78% of children use the service for more than 30 hours a week.

Montenegro: the TFR in Montenegro is equal to 1.77 with an average age of the woman at childbirth of 29.53 years as the average values of the years of analysis. The annual TFR has an increasing trend from 1.75 in 2014 to 1.78 in 2017. The same growing trend there is for the average age of women at childbirth. The female employment rate in Montenegro is equal to 51%,

which has a percentage of full-time female employment for the 29.53% calculated as average for the period. The annual data of this rate show an increasing trend from 2014 to 2017. The average 2014-2017 per capita GDP of Montenegro corresponds to € 5.600,00 and is among the lowest in Europe, although with an increasing trend from € 5320.00 in 2014 to € 5920.00 in 2017. In Montenegro, only 24.23% of children aged 0-3 use CS. Of the children who use it, the 42.50% use CS for a duration of less than 30 hours per week. There is an increasing annual trend from 2014 to 2016, with the exception of 2017, which recorded a negative peak.

Malta: data refer a TFR of average period (2014 - 2017) equal to 1.35. In the period of analysis, the average age of the woman at the first birth is equivalent to an increasing rate of 30.38, just above the European average. Female Maltese employment rate is equal to the percentage of 57.05% of women of active age in employment. There is a majority of full-time employed women with 26.51%, which according to annual data shows a positive trend from 54.3% in 2014 to 60.6% in 2017. The average per capita GDP over three years equal to € 20.022,50 expresses a lower value than the average European per capita GDP. From an observation of the annual data of this national per capita GDP, it seems to increase from 2014 with €18.610,00 to 2017 with €21.350,00. In Malta, 73.95% of children aged 0-3 do not use CS. The 26.05% uses them and the 15.65% of these, use these services for less than 30 hours a week compared to the remaining 10.35% of 0-3 users who instead use them for more than 30 hours per week. In the analysis of the annual trend,

both percentages of duration of use are increasing, probably due to the conciliatory needs of working mothers who are protagonists of the increase in full-time female employment, as explained above.

North Macedonia: TFR in North Macedonia is 1.49 and the average age of the woman at the first birth corresponds to 28.58 years as a average period 2014-2017. The annual TFR data suggest the presence of a bell-like trend, first increasing from 2014 to 2016 and then decreasing in 2017. The percentage of the female employment rate corresponds to 42.28% and has an increasing annual trend since 2014 with 40.8% in 2017 with 43.7%. Women employed full-time are equivalent to the period percentage of 25.74%, a majority compared to women employed part-time corresponding to 1.27%. The average of the annuals female unemployment rate is equivalent to the high percentage of 24.58%. The per capita GDP for the years 2014-2017 is equal to the very low value of € 3.902,50, which expresses a growth trend from € 3740.00 in 2014 to € 4020.00 in 2017. The use of CS for the 0-3 are equal to 7.85%, against a very high percentage of not-use of the same of 92.15%. The percentage of use of CS has a widely growing annual trend from 5.9% in 2014 to 10.3% in 2017 and 6.75% uses CS for a duration above 30 hours per week.

Poland: TFR in Poland among the period of analysis is equal to 1.38, with an annual growth from 1.32 in 2014 to 1.48 in 2017. The average age of woman at first childbirth there is equal to 29.30, an age lower than the European average age, but shows a slightly increasing trend from 29.1 to 29.5 during

the period of analysis. The average female employment rate in the period considered is 61.53% with a trend with full-time work (with percentage of 16.44%, up from 31.6% in 2014 to 34.5% in 2017). The per capita GDP indicator specifies a very low average period value equal to € 10.670,00 and which from 2014 to 2017 shows a slight increase. In Poland, there is a low use of CS expressed by the percentage of 11.95%. Only 8.48% of children use these services for more than 30 hours per week.

The United Kingdom : TFR for the period between 2014 and 2017 is equal to an average value of 1.79, showing a downward trend from 1.81 to 1.74. The average age of women at first birth, refers to an average period is equal to 30.35, slightly increasing from 2014 with 30.20 to 2017 with 30.50 of age. The average national per capita GDP of the period of study corresponds to €31.890,00 showing a growing trend from €31.290,00 in 2014 up to €32.430,00 in 2017. The United Kingdom has a female employment rate of 71.78% with an increasing trend in the period considered, registering a percentage of 70.60% in 2014 and one of 73.10% in 2017. The most popular type of female employment seems to be full-time with an average period of 25.42%, and a part-time female employment rate of 17.57% of women in age active. These are increasing percentages in both cases. The average period value of 30.23% shows the children 0-3 years old who use CS and 25.80% of these uses CS for less than 30 hours per week. By observing the annual trend of these rates from 2014 to 2017, both rates tend to increase like the female employment rates, so the joint effects of these indicators on TFR are expected.

Serbia: For the period, 2014-2017 TFR is equal to 1.47 with an increasing annual trend. In Serbia, the average age of women at first childbirth as average value of the analysis period coincides with 29.03 years and shows an increasing trend from 28.8 in 2014 at 29.2 years in 2017. The Serbian woman employed are among 50.50% and most of them work full-time with an average percentage of 29.54% since 2014 to 2017. Although with a growing annual trend, the Serbian per capita GDP is by far the lowest among the spatial units analysed and coincides with the value of € 4.737,50. This low per capita GDP, together with Serbian socio-cultural models, probably does not encourage the use of CS for preschool children, which in fact has a percentage of 14.43% of children who use CS for early childhood, of which only 12.28% use those for more than 30 hours a week.

Sweden: There the TFR is 1.84 for the period 2014-2017. It is one of the highest European TFR, which also shows an increasing annual trend from 1.23 to 1.38. With regard to the postponement of the procreative choice, the average age rate of the woman at the first birth is equal to 31.05, as an average value of the years of analysis, with a trend constant since 2014 to 2017 (from 31 to 31.1). The average per capita GDP equal to € 42.527,50 is also positive compared to the European average, which seems to assume increasing values over the period of analysis. The Swedish female employment rate is 78.73%. There is a predominance of full-time female employment in Sweden (29.54%) and only 16.54% of women who works part-time. These rates increase annually for full-time and decline for female part-time: it would

seem that the Swedish woman does not necessarily have to work part-time for conciliatory purposes work needs with family ones. In Sweden 56.13% of children aged 0 to 3 use CS. Of these, 37.68% uses them for a weekly duration of more than 30 hours and this duration of use is growing up from 2014 to 2017, which expect a positive significance link on the high TFR described.

Portugal: during the period considered in this study, Portugal has an average TFR of 1.32, a low fertility such in the other Mediterranean nations. The data confirm that in Portugal the average age of the woman at the first birth coincides with the average value of 30.98 years. This average hides an increasing annual trend from 2014 to 2017 with valuesfrom 30.7 to 31.2 respectively. In relation to female work, the Portuguese female employment rate for the period of analysis reports a percentage value of 66.83%, which, through annual data, expresses an increasing trend in the analysis period from 64.2% to 69.8. %. Looking at the rate of 34.68%, the majority of Portuguese women work full-time, compared to 4.84% of women of working age employed part-time. With regard to these employment indicators, commutated as averages for the period, there is an increasing trend from the annual analysis of the data from 2014 to 2017. The Portuguese per capita GDP has an average value of € 16.885,00 and is well below the European average. With this poor socio-economic well-being index, it is easy to expect low average percentages of use of CS for the 0-3 age children. In fact, the Portuguese rate of use of these services corresponds to 47.40% as average of period of study, of which 44.23% of users use CS for 30 hours per week.

Romania: The TFR is equal to 1.63 for the analysis period from 2014 to 2017 and expresses a rate slightly higher than the European average (1.58). The average age of women at first birth corresponds to 27.70 years for the period of analysis, with an increasing annual trend. As for the inclusion of women in the labour market, the Romanian female employment rate corresponds to 58.03% with an annual growing trend from 2014 (with 57.3%) to 2017 with 60.2%. The pre-eminent female employment type in Romania for the analysed period is full-time, with a percentage of 32.20% and with an average female unemployment rate of 5.23%. The annual trend of female employment in Romania has been growing since 2014 with 57.3% in 2017 with a percentage of 60.2%. The average Romanian per capita GDP for the years considered is very low (€ 7.570,00) with annual values increasing. The use of early childhood CS (0-3 years) is equal to only 11.28%, a low rate of use with an annual progression widely increasing from the percentage of 2014 equal to 2.6%, up to the percentage of 15.7% for 2017. Of these users of CS, only the 7.20% use CS for a duration of more than 30 hours a week probably due to the low purchasing power of families and traditionalist cultural legacies on family care roles.

4.3 Study of the European case on Nuts0 level: period 2014 – 2017

To test the influence of the phenomenon of postponement of the first pregnancy on TFR described by Miettinen's thesis[122], I used the indicator of the average age of the woman at childbirth. Instead, according with Bernardi's and Sabotka's thesis[123], who consider fundamental the influence of the presence of CS for children of pre-school age (0-3 years) and the FFE on the TFR, I included in this research model the determinants of use of services for early childhood (CS_U) and the female part-time employment rate (W_E_PRT). In particular, the first of these two is a rate of attendance of CS by children in the 0-3 age group[124], while the second is the classic part-time employment rate calculated on the active female population. To consider the influence of the income situation of the family on TFR, also for this geo-level of analysis I have considered the GDP per capita (PIL_PRC).

Thus, I proceeded to create the dataset, elaborating it from the European Eurostat database. Based on the availability of the data of the chosen determinants, I had to set the time of research in a four-year period from 2014 to 2017 inclusive. In order to protect the data from abnormal fluctuations between the years considered, I computed the time average thus

[122] Miettinen (2015).
[123] Bernardi (2007) and Sabotka (2013).
[124] Ii is expressed in percent and related to the young population of 0-3 years old.

obtaining greater data stability. The spatial units of this first analysis at Nuts0 geo-level coincide with the 35 European State (not just UE members) conventionally identified by the Nuts0 level and 55 variables differentiated by year and type of determinant. The determinants choice for my model starts from the Multicollinearity test, tested by the VIF test[125] for each predicting variable and excluding from the model all the determinants with a VIF greater than or equal to 10.

The literature of Gesano, Picchio, Gustaffson and Klawij, Mencarini et al.[126], explains the relevance of female educational level on the different choices of procreation. According to this thesis, in phase of creation of my dataset I had also decided to include variables relating to the female educational level classified by the European classification of educational levels (0-2 corresponding low educational level, 3-4 medium level, 5 -8 high level including women with post-degree educational level)[127]. These determinants gave Multicollinearity problem probably with the employment flexible female level, thus I decided to remove these from my models.

Starting a research is always important to consider the endogeneity problem, especially in demography. There are in the demographic literature

[125] The Variance Inflation Factor (VIF), which is a test to check the presence of Multicollinearity. This index assesses how much the variance of an estimated regression coefficient increases in case of correlation between the predictors. A VIF value greater than 10 indicates that that predictor is causing a Multicollinearity problem in the model. If no factors are correlated, the VIFs will all be 1.

[126] Gesano (2017), Picchio (2018), Gustaffson and Kalawij (2006), Mencarini (2018) etc. see the references. These authors in their papers in different kind of analysis on fertility show the influence of low or high female educational level which jointly other determinants as postponement of childbearing or work positions and use of childcare services can affect the fertility rate. See the References to find the complete denomination of the cited papers.

[127] European classification of educational levels by Eurostat.

two strands of approaches that treat endogeneity differently. One of these tests it through endogeneity tests such as the Hausman test and the application of the 2SLS model (Two Stage Least Square model) to correct the eventual endogeneity applying instrumental variables[128]. The second one strand, takes note of the possible endogeneity problem between systemic socio-economic factors, but prefers not to alter the spatial model with more complex methodologies, accepting the possible limits of the estimates produced as Campisi, Picchio, Blum, Woods[129], etc. In my research, the preliminary compute of the Hausman[130] test showed the absence of endogeneity between the determinants of my models, thus I decided to embrace the second strand described above. Applying the Hausman test to the model I get a p-value = 0.5656 so you cannot reject H_0. Accepting the null hypothesis of this test means that the variables of the model are exogenous and therefore it is not necessary to any apply instrumental variables. In other words, the test showed that the variables of my model do not have a causal correlation between them and therefore there is no need to correct the endogeneity.

This dataset contains less than 2% of reconstructed data, computed through a space-time neighbourhood averaging for missing data. The neighbourhood average is a space-time average of the values reported by the statistical units contiguous to the missing one and of the temporal values of the years preceding and following the missing one. In other words: 0.5 *

[128] Del Boca D. et al. (2007).
[129] Campisi (2020), Picchio (2018), Blum (2012), Woods(2019), etc. see paragraph 2.1
[130] Hausman (1978).

neighbourhood mean + 0.5 * temporal mean, where the "0.5" values depends on the number of neighbours spatial units (0.5 if they are two, 0.33 if they are three and so on). It is a percent of the neighbours[131].

Table 2 – *Comparison of datasets construction at European Nuts0 geo-level and at European Nuts2 geo-level.*

	DB at Nuts0 euro-level	***DB at Nuts2 euro-level***
Spatial Units	35	332
Annual Variables	55	55
Reconstructed Data	Less than 2%	About 5%
Source	Eurostat	Eurostat

The next phase to the construction of the dataset was the georeferencing of the data, preparatory to the application of spatial models. The first step for the computation of the spatial model is to geo-localize the data of the variables considered. To do this, it is firstly necessary to find the territorial centroids of the European regional space units at Nuts0 level and express them with latitude and longitude. In this way, "georeferencing" the data means attributing geographic coordinates (latitude and longitude) to the vectors points identified as the barycentres of the spatial units.

The research methodology used for the analysis in the two geo-level both, takes place in two steps: first considering the OLS model to evaluate the significance of global regression of the chosen determinants on the dependent variable as a comparison referemnet for GWR results and in a second stage considering the GWR spatial regression model to analyse if there is spatial

[131]Allison P.D. (2002)and Stef Van Buuren (2018).

variability of the regressors. Specifically, therefore, it is hoped to refute the null hypothesis H_0 of the absence of spatial variability:

$$H_0: \beta_k = 0 \quad \text{and} \quad H_1: \beta_k \neq 0 \qquad (20)$$

In case of spatial variability (when H_1 is true), it will be interesting to contextualize the data and interpret it in the light of the literature.

However, in order to identify the joint effect of public childcare and female flexibility employment on TFR, we use different variables[132]. In particular, the analysis started with the determinants choice according to the literature collected on the topic. The subsequent step, how I have said yet above, was the compute of OLS model with the regressors chosen, as a reference for the application of the GWR model (third analytic phase of study). Basing of these steps, the model of research includes the following variables, which I consider in this case at member states level (NUTS0):

a) mean age of women at childbirth (W_AGE_14_17) ;
b) female part time employment % (W_E_PRT_14_17) ;
c) Children who use the Childcare Services for early childhood % (0-3) (CS_U_14_17);
d) GDP per capita (PIL_PRC_14_17).

[132] All data are extracted from Eurostat dataset (2020)

The GWR model used for the European Nuts0 geo-level[133], therefore, is:

$$TFR = a + W\_AGE\_14\_17_{(LAT,LONG)} + W\_E\_PRT\_14\_17_{(LAT,LONG)} + CS\_U\_14\_17_{(LAT,LONG)} + PIL\_PRC\_14\_17_{(LAT,LONG)} + e \quad (21)$$

In the applied GWR model, I have chosen a Gaussian-type bandwidth, which is a distance decay function (Kernel) of unlimited and fixed type[134].

The application of GWR model gives some interesting results (see table 3 and 4):

Table 3 – *Monte Carlo Simulation with 1000 repetitions. Significance Test For Non-stationarity of GWR model at Nuts0 euro-level. Elaboration by Stata14.*

Variable	***P-Value***
Constant	0.000
W_AGE_14_17	0.000
W_E_PRT_14_17	0.002
CS_U_14_17	0.000
PIL_PRC_14_17	0.000

From table 3 you can see the p-values that express the outputs of the Significance test for Spatial Non-stationarity of my regressors, while from the following table 4 it is possible to read the GWR estimations in quartiles compared to the OLS estimates. In the last two rows of table 4, there are the comparison between the AIC of OLS model and AICc of GWR model. This

[133] That it is also the same applied on Nuts2 dataset.

[134] The weighting of the model depends on the bandwidth that is from the "Kernel" function: if the bandwidth is fixed, as in the Gaussian case used in this analysis, it means that the distance of the points from the spatial barycentre always has the same radius. Instead, as the bandwidth decreases, the distance decay becomes faster. For a more complete methodological description of the GWR model, see chapter 3.

comparison shows a better fitting of the GWR model than the OLS for this Nuts0 analysis. In the last row, there is the Moran Index, computed on the OLS residuals, equal to 0.73 that denotes the positive autocorrelation of my spatial units:

Table 4 – Nuts0 *GWR model. Elaboration by Stata14. (with * = p <0.05 and ** = p <0.01)*

Variable	***Global Model OLS***	***GWR Min***	***GWR 1 Q***	***GWR Median***	***GWR 3 Q***	***GWR Max***
W_AGE_14_17	-0.1042*	-0.1394	-0.1021	-0.0933	-0.0859	-0.0767
W_E_PRT_14_17	0.0053*	0.00003	0.0050	0.0057	0.0063	0.0071
CS_U_14_17	0.0048*	0.0024	0.0032	0.0038	0.0048	0.0112
PIL_PRC_14_17	1.34e-06*	-0.0000001	0.0000012	0.0000016	0.0000018	0.0000021
$Adj - R^2$	0.5663*	0.6724*				
AIC and AICc	74.8142*	11.9785*				
Moran's Index	0.7331*	0.6435*				

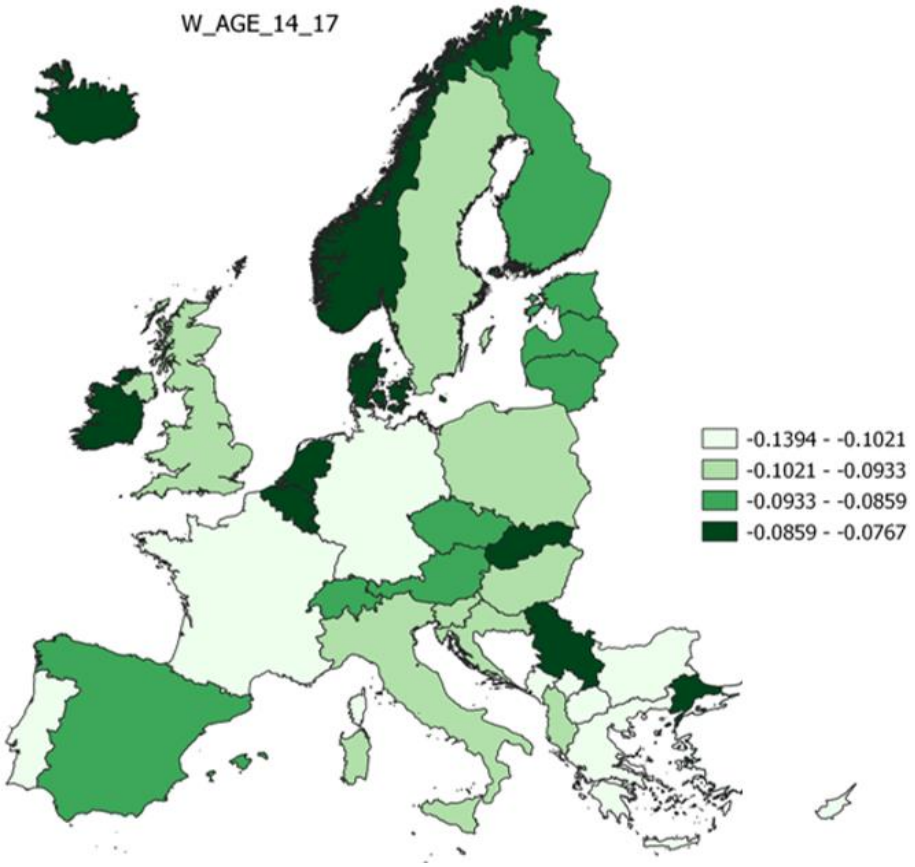
4.3.1 Results on Nuts0 European geo-level

As is easy to see from the results obtained, the variable "mean age of women at childbirth" (W_AGE_14_17) is negatively correlated with the TFR (see table 4). This correlation is probably due to the extension of the training education period and to the time taken to find employment, confirming the Picchio's thesis[135].

[135] Picchio et al. (2018).

The figure n. 11 shows the mapping of the estimates of GWR coefficients for the regressor W_AGE_14_17 at level Nuts0:

Figure 11 – *Estimates of the spatial coefficients of the average age of the woman at first birth obtained with the GWR model. Euro-level Nuts0. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis 3.16*



From the map on figure 11 representing the GWR estimates of W_AGE_14_17 regressor, it is evident that the postponement of pregnancy is negatively significant on TFR everywhere, but especially in Portugal, France, Germany and the southern part of the Balkan peninsula. This result

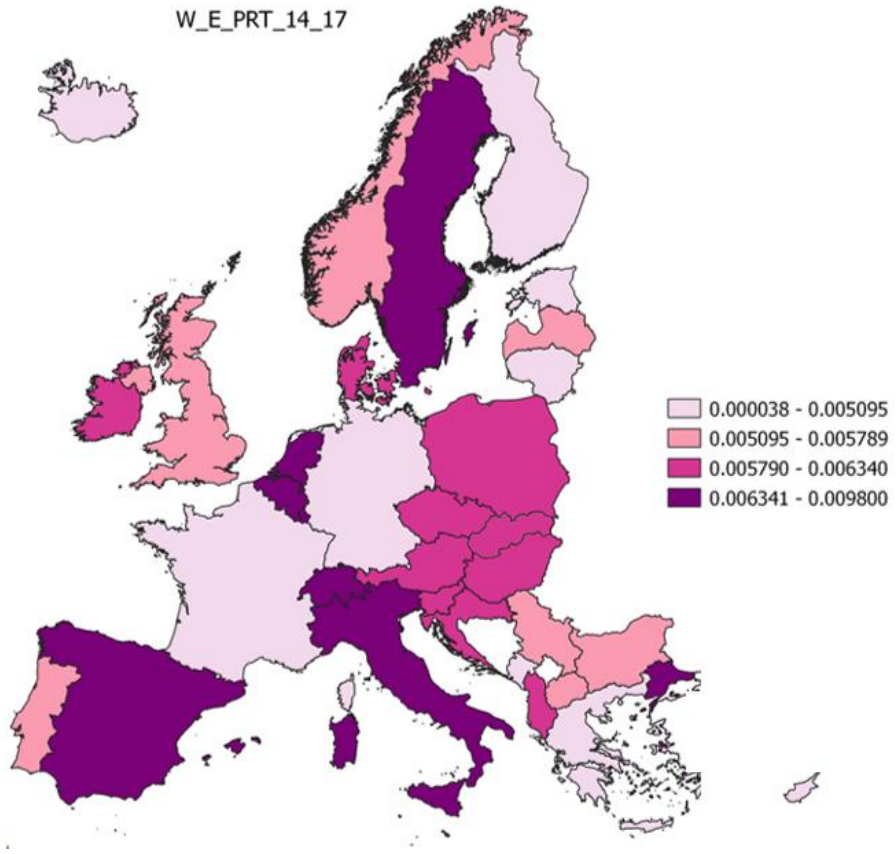
confirms the thesis of Mencarini[136] about the inhibiting effect of the postponement of childbirth on the fertility.

This result according also with the point of view of other authors[137] too about the influence of the extension of female training educational period and of the female expectation to find a prestigious job position on the postponement of childbirth's woman age and consequentially on the TFR.

Another classic thesis seems to be confirmed by our results. More pacifically, the variable "women employment part time" (W_E_PRT_14_17) is positively correlated with the fertility rate, thus the reproductive behaviour results to be conditioned by the part time women employment. This result can be interpreted concluding that women need to feel more economics and social secureness to make this decision, but they prefer to keep time for family care too[138] (see figure 12).

[136] Mencarini (2018).
[137] Miettinen (2015), Kalawij (2016), Picchio (2018) etc. See paragraph 2.1 .
[138] Blum (2012).

Figure 12 – *Estimates of the spatial coefficients of the female part-time employment obtained with the GWR model. Euro-level Nuts0. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis 3.16*



From the territorial point of view, the part time women employment is present mostly in Sweden, Netherlands, Spain and Italy, while this influence is less determinant in France, German and Finland, where the CS (see figure 13) are more efficient and used by working mothers.

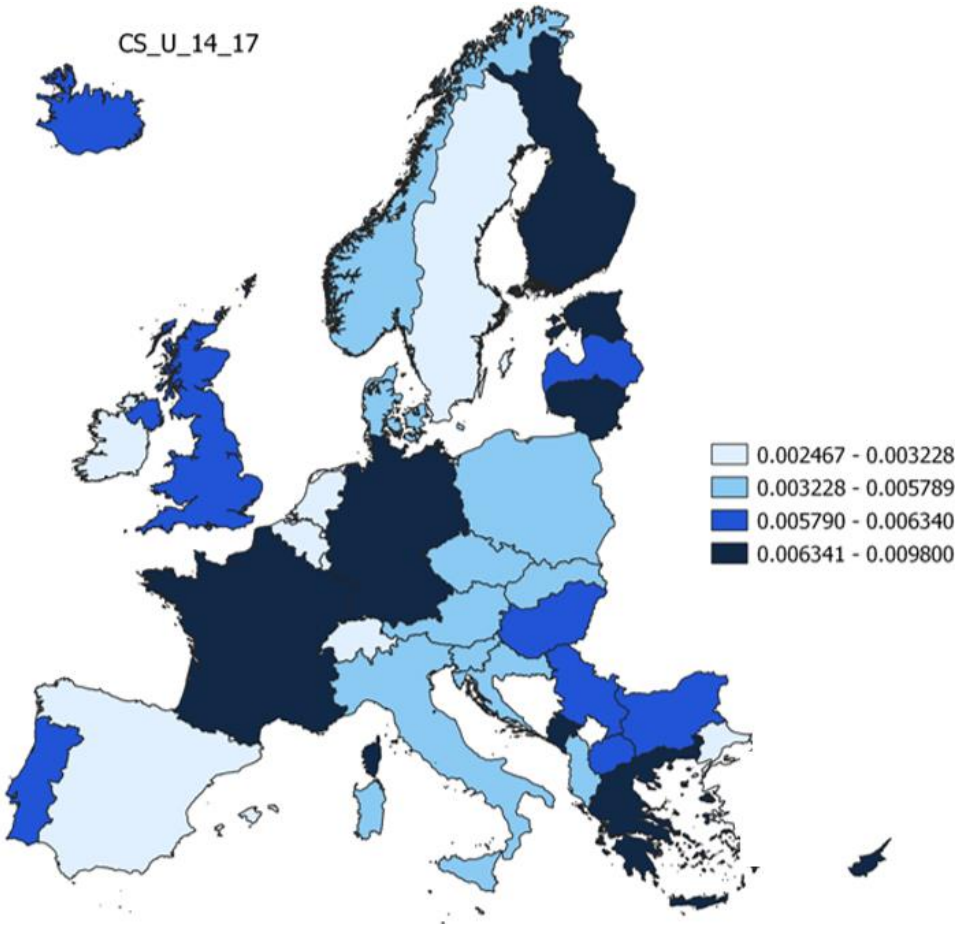
This result confirms the thesis of Bernardi, Blum et al.[139], who prove the impact of the female part-time employment on the fertility, as an efficient conciliatory policy for working mothers.

[139] Bernardi (2017), Picchio (2018), Blum (2012), Bàizan (2015) and Mencarini (2018).

Looking at the table 4, an interpretation of these results should be that the prospection to have children is more favourite by the woman part-time employed which is correlated with the use of CS too.

In fact, comparing the previous map with one on figure 13, it is visible that just in Germany, French and Finland, the CS are more influent on the TFR. Thus, probably this efficiency of CS compensate the less influence of part-time on TFR in these countries.

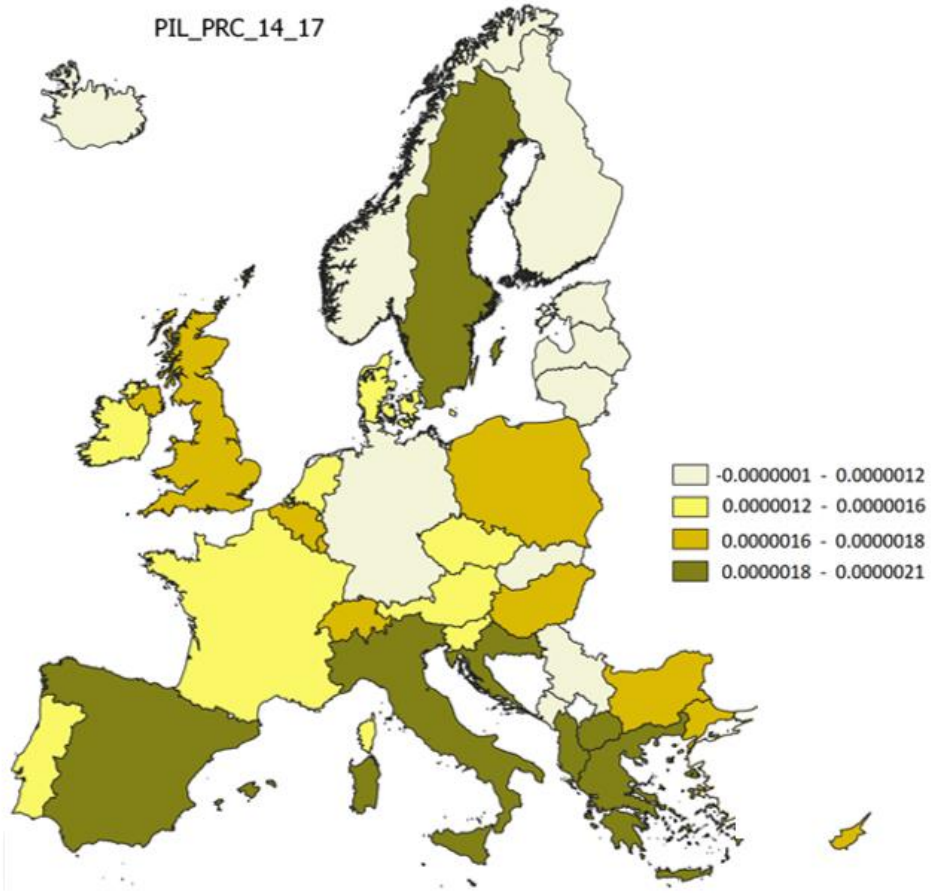
Figure 13 – *Estimates of the spatial coefficients of the Childcare Services obtained with the GWR model. Euro-level Nuts0. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis 3.16*



In each European country the CS have a positive significance on TFR. Mostly in France, German (confirming the Toulemon and Bauernschuster

thesis[140]), Finland, Greece and Baltic countries. This correlation is present a little less in UK, Iceland, Portugal and Balkan States too. The least positive significance of the CS occurs in Sweden and Spanish, where the flexible part-time employment probably allows conciliating yet the working needs with the childcare needs (see the previous map).

Figure 14 – *Estimates of the spatial coefficients of the GDP per capita, obtained with the GWR model. Euro-level Nuts0. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis 3.16*



The income situation too, looking the map on figure 14, have a positive significance on the TFR in great part of European States, except in Norway, Germany, Finland, Iceland and Baltic regions where the significance is very

[140] Toulemon (2008), Bauernschuster (2012).

near the negative threshold. However, looking at the values of the estimate coefficients, it is possible to consider positive the influence of GDP per capita on the TFR. This is stronger especially in Italy, Spain, Balkans and east-European countries and UK too, where the secureness perception seems to be determinant on the choice to procreate[141].

For the variables considered, the GWR model detects a spatial variability of the coefficients (see the range of the coefficients from the min to the max value in table 4).

The positive significance of the CS regressor, of the GDP per capita and of the female part-time employment and the negative ones of the woman average age at first childbirth, should mean that these variables are crucial elements (respectively with a positive correlation and with a negative correlation on TFR) for the reproductive choice.

Furthermore, looking the maps and the estimates it is clear that the application of GWR model allows denoting where this influence is stronger and where it is not.

It is possible to see from the CS estimates, how data confirms thesis of Sonja Blum's survey[142] that showed how the public childcare policies have almost everywhere an important role in family's decision-making on their demographic behaviour. In addition, other studies confirm our results: we

[141] This result confirms Sobotka's thesis (2013) and Mencarini (2018), De Rosa (2014), Lutz (2017), about the positive correlation of the perception of economic security, as a basic requirement of expectations to ensure qualitative care to the offspring
[142] Blum (2012).

refer, for example, at Baizàn's analyse[143], who underline the positive effect on fertility of formal childcare for children under 3 years old.

According to Gesano's study[144] in a socio-political context that pushes women to extend the period of training to hyperspecialize and compete for managerial work positions, it becomes natural to postpone the age of the first birth. To limit this, the presence of efficient early childhood care services becomes essential to allow women to reconcile the needs of the labour market with the needs of family care. In particular, Gesano's study, after a careful overview of the European reproductive differences of the last decades, shows how at Nut3 level (provinces) the average age of the woman at birth is young in the provinces of Eastern European countries, while it is particularly advanced in Sardinia and other regions of central and southern Italy and Spain.

The results of a research by Gustaffson and Kalwij[145] consolidate this vision, as it seems that the higher educational level of the woman, the lower chances of birth before the average age of the woman at birth and of births subsequent to the first, which translates into a negative relationship between fertility and school level of the woman. As a higher education level is associated with a higher wage rate and therefore with greater opportunities to give qualitative opportunities to the children. This dynamic reduces the demand for the quantity of children, which allows women to postpone

[143] Baizàn (2015).
[144] Gesano (2017).
[145] Gustaffson and Kalwij (2006).

childbirth and increase investment in human capital in a few children (i.e. higher quality demand).

4.4 Study of the European case in NUTS2 Level: Results.

For the analysis at the European territorial level Nuts2, basing on the literature analysed on the topic and Multicollinearity test, I chose specific determinants with possible explanatory effects on the dependent variable TFR.

To allow the comparison of the results of this geo-level of research with these of the Nuts0 geo-level, the determinants chosen are the same elaborations of Eurostat database for Nuts0 and Nuts2 geo-levels.

Also in this geo-level of analysis, the data source is Eurostat and the determinant chosen basing on the literature were 55, differentiated by years and type of determinant. The time-period is equal to this of Nuts0 ever for comparison reason (since 2014 to 2017).

Being at a different geo-level, the spatial units are different: dataset of analysis there are 332 European sub-national regions, conventionally identified with the Nuts2 level. This dataset contains about 5% of data reconstructed using space-time neighbourhood averaging for missing data.

Therefore, in this second analysis of research at European Nuts2 level, the first phase was applying the OLS model to check the global significance of regressosrs as a referment for the effective model.

From the OLS results emerges a negative correlation between the postponement of pregnancy (W_AGE_14_17) and the total fertility rate (TFR_14_17) (table 5). The female part-time employment rate appears to have a positive significance on the TFR, so women who work part-time are able to reconcile work needs with the needs of family care actions. Furthermore, the OLS model shows a positive correlation between the income situation and the TFR[146]. If we had stopped at the analysis using the OLS global regression model we would have concluded that CS have no significance on the TFR. For this purpose, the local analysis was done using the GWR spatial regression model, which looking at the AIC and AICc comparison, the GWR model seems to have a better fitting than the OLS model for this Nuts2 level too.

Table 5 – Nuts2 *GWR model. Elaboration by Stata14. (with * = p <0.05 and ** = p <0.01)*

Variable	***Global Model OLS***	***GWR Min***	***GWR 1 Q***	***GWR Median***	***GWR 3 Q***	***GWR Max***
W_AGE_14_17	-0.7967*	-0.6451	-0.0997	-0.0704	-0.0380	0.2680
W_E_PRT_14_17	0.0004*	-0.0029	-0.0001	0.0001	0.0003	0.0112
CS_U_14_17	0.1134*	-3.2918	-0.1527	0.0259	0.1501	2.4551
PIL_PRC_14_17	0.0059*	-0.0738	-0.0047	0.0016	0.0061	0.0650
$Adj - R^2$	0.5823*	0.6941				
AIC and AICc	77.3121*	13.1692*				
Moran's Index	0.7106*	0.5981*				

[146] For the OLS results look at the table n. 4 below.

The estimation with GWR model allows to check the local significance of the regressors chosen on the TFR, applying the cross validation approach with Monte Carlo Simulation test. In this european geo-level Nuts2, the GWR test gives non stationarity for all the regressors considered (see table 6).

Table 6 – *Significance Test For Non-stationarity of GWR model. Elaboration by Stata14.*

Variable	***P-Value***
Constant	0.000
W_AGE_14_17	0.000
W_E_PRT_14_17	0.003
PIL_PRC_14_17	0.001
CS_U_14_17	0.000

This result tell us that the regressors considered have spatial variability among the European regions.

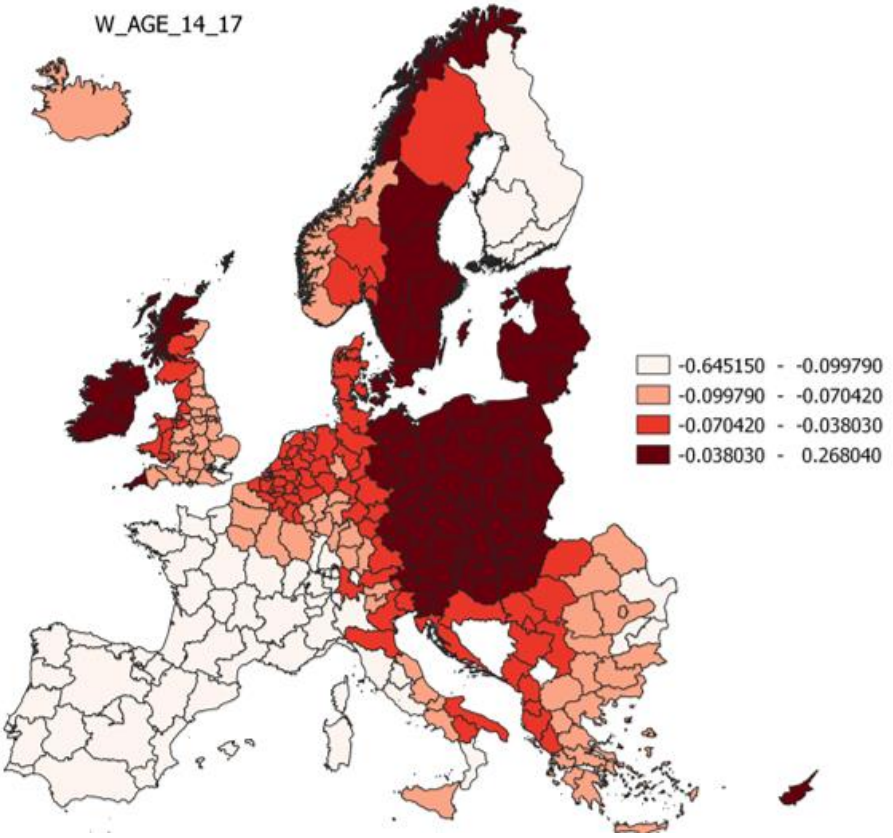
In particular, looking at the table 5, we can realise the comparison of the GWR model compared with the control OLS results, gives a better fitting of the GWR model (looking at the highest Adj-R squared of the GWR model equal to 0.69 respect to the 0.58 of the OLS model). Moreover, the Moran's Index espresses also for this analysis at Nuts2 european level the presence of positive autocorrelation between the spatial units.

Even if it is yet evident from the table 5, the following maps summerize well the GWR results.

4.4.1 Results on Nuts2 European geo-level

The GWR model highlights that the Woman Age at first childbirth influences negatively the TFR everywhere, except in polish regions, Baltic too and Sweden regions. Instead, it is stronger negative in Spanish, France Finland and western Italian regions mostly (figure 15). This negative correlation shows that where there is a higher age at first childbirth there corresponds a lower TFR, confirming the literature examined[147].

Table 15 – *Estimates of the spatial coefficients of the woman average age at first childbirth obtained with the GWR model. Euro-level Nuts2. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis 3.16*



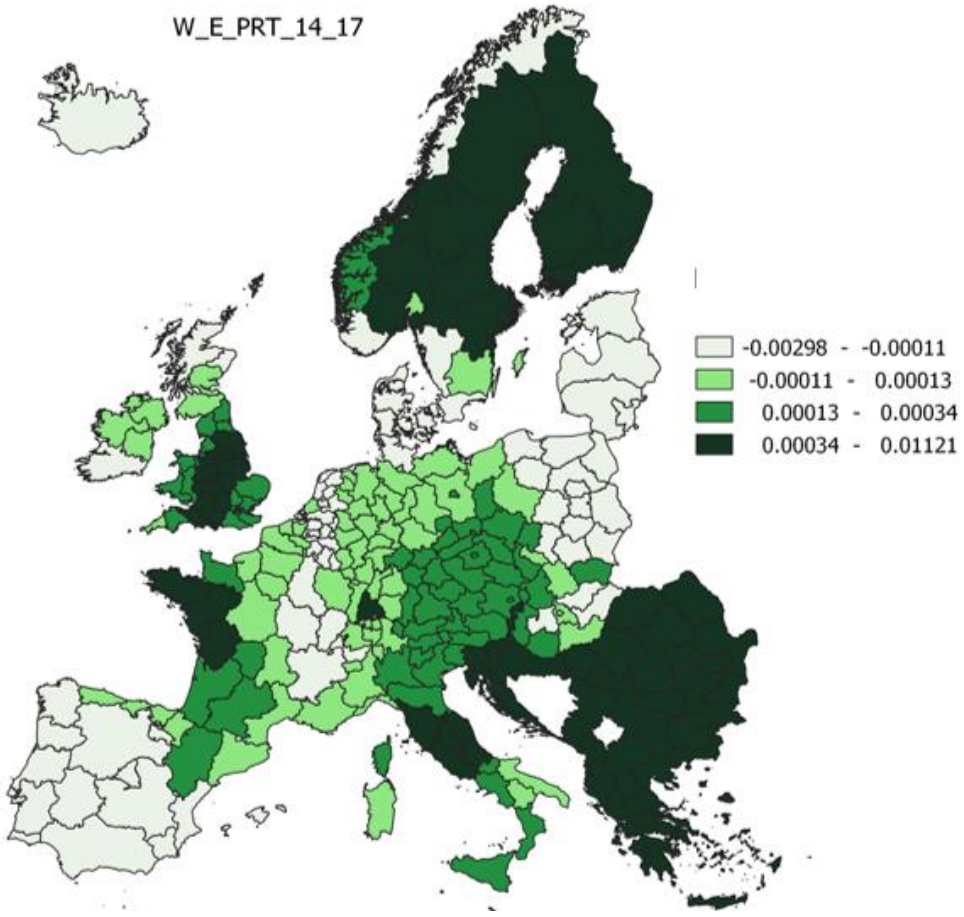
[147] Picchio (2018), Gustaffson and Kalwij (2006), De Rosa and Rosina (2014).

In this analysis at a deeper geo-level, the GWR estimates for the W_E_PRT regressor, show somewhere a positive influence on the TFR and somwhere a negative ones.

In fact, the female flexible employment represented by the female part-time employment rate, seems to have a negative significance on TFR in Spanish regions, Eastern Polish regions and some French regions, while it denotes a positive significance in in the Greek and Hungarian, Austrian, Czech and Slovak and Scandianvian regions too[148]. A positive significance of the part-time regressor, according to the literature, means that in these regions it allows women to take care of children in the rest part of the day and for this reason this influence incentives the reproductive choice. On the contrary, where there is a negative correlation with the TFR, it can be linked to the income situation, probably associated with poor part-time remuneration in these regions.

[148] Look at figure 16 in the next page.

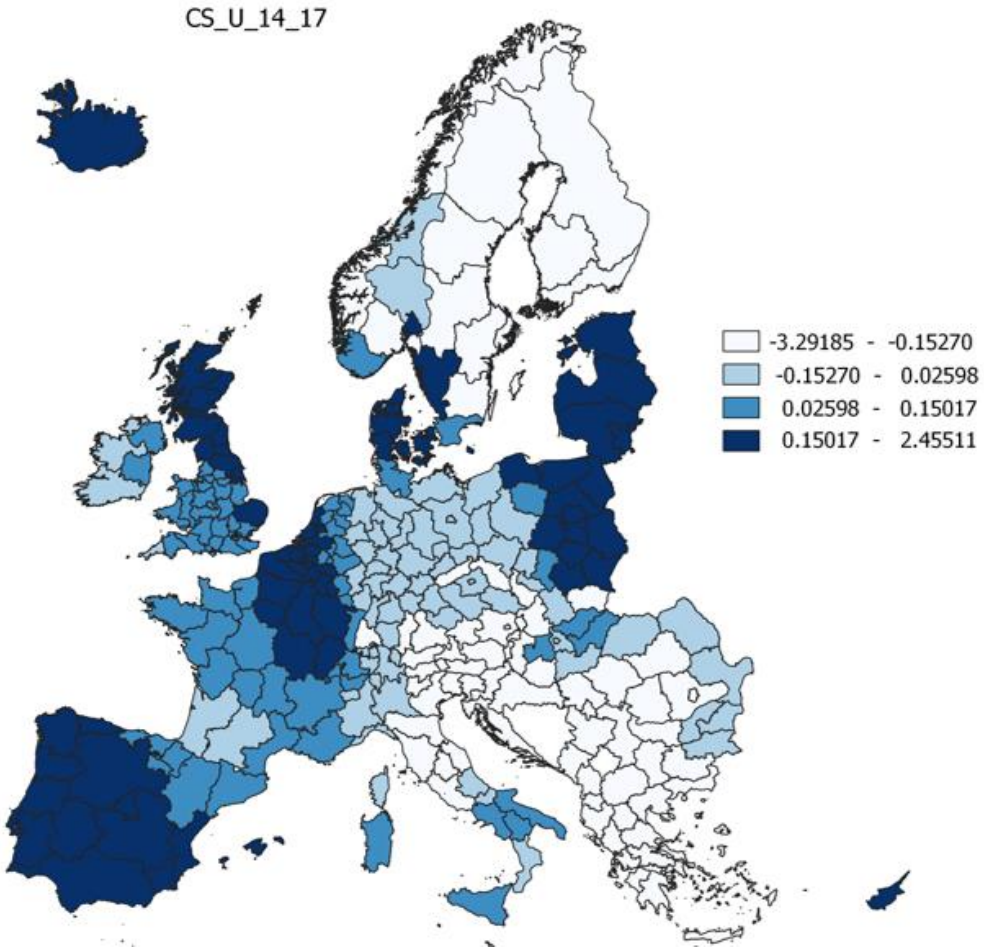
Figure 16 – *Estimates of the spatial coefficients of the Part-Time Female Employment Rate obtained with the GWR model. Nuts2 Euro-level. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis*



Thus, we can say that where the part-time is positively significant on the TFR, it seems to suggest that the negatively significance of a higher age on the TFR can be joint to the use of part time which, at the contrary, has a positive influence on the TFR.

However, the GWR estimates about the influence of Childcare Services somewhere show negative significance (in centre-east European regions and Balkan area and Scandinavian regions too) and somewhere positive significance as in Spanish regions, Baltic regions and northern French and Belgium too (see the figure 17).

Figure 17 – *Estimates of the spatial coefficients of the Childcare Services obtained with the GWR model. Nuts2 Euro-level. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis*

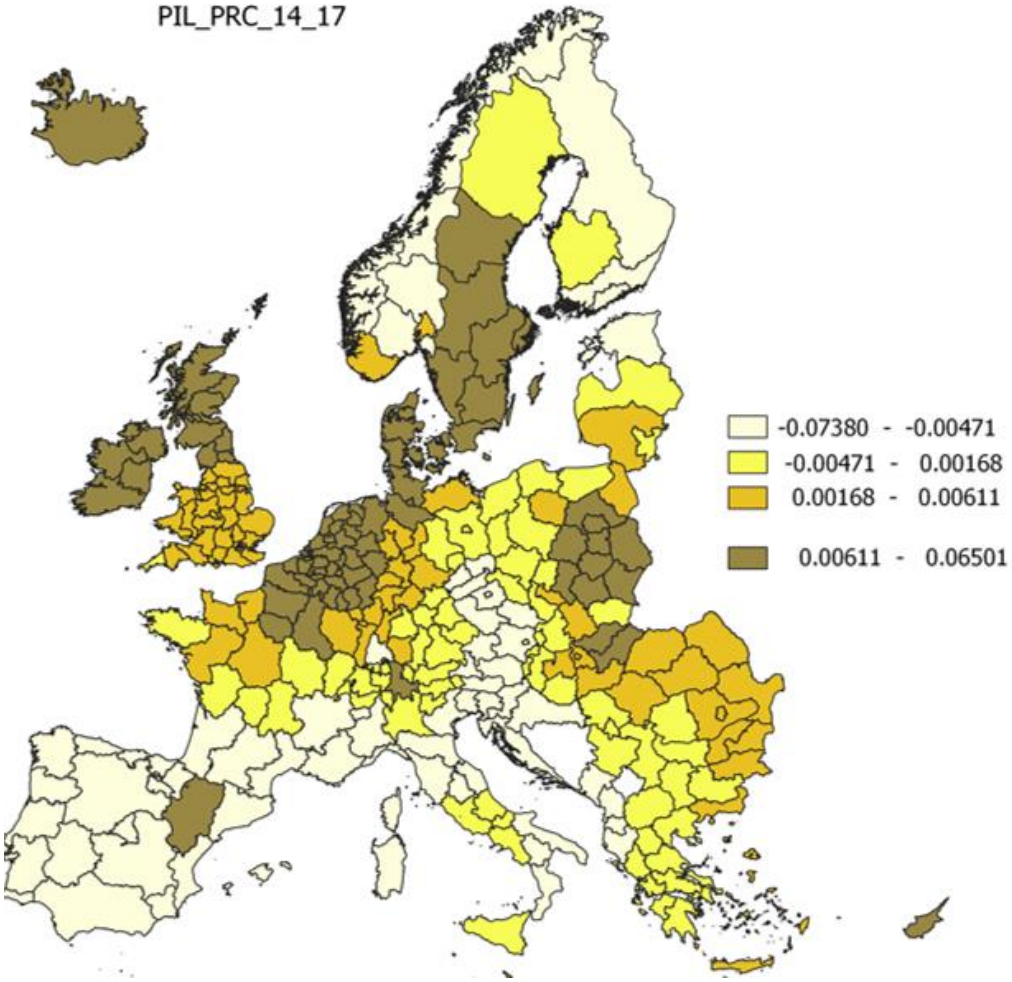


The positive significance of this determinant can be due to the income situation and to the employment: where there is a better GDP or a higher Female Flexible Employment, there you have more possibilities purchasing for CS[149]. In particular, this Nuts2 analysis gives another surprising result on the influence of CS on the TFR in Scandinavian regions: at this deeper level of study, the negative correlation showed disconfirm Rindfuss's thesis about the historical correlation of CS on TFR in the period examined[150]. It is

[149] This conclusions confirm the Miettinen thesis (2015) and Sobotka (2013)
[150] Rindfuss R. R. et al. (1996).

possible that the factors influencing the TFR in these regions are involving into new socio-cultural factors which regarding to the new familiar gender roles between the couple, interpretation that find reference on the thesis of Sobotka and Blum[151]. Even at this European level, it is primary to deep the spatial differences on the influence of the income situation on TFR (look at figure 18, in the next page).

Figure 18 – *Estimates of the spatial coefficients of GDP per capita, obtained with the GWR model. Nuts2 Euro-level. Period 2014-2017. Elaboration software: Stata14. Mapping software: Qgis*



[151] Sobotka (2013), Blum (2012).

The estimated coefficients on the previous table 5 yet express the spatial trend of the GDP per capita influence on TFR. In Southern part of Sweden, North Germany, Netherlands and Northern UK and Some French regions there is a better influence of income situation on TFR. While it has a negative significance on TFR in Spanish, southern French, central Italy and Poland and Balkan regions too. Where it has a negative significance on TFR for instance, how it happens in some Spanish and Italian regions, probably there are still other predominant cultural values at the basis of this choice some cultural values regarding the traditional Mediterranean societies[152]. Instead, according to Lutz and Mencarini[153] point of view, where the GDP per capita presents positive significance on the fertility rate, this should be due to the perception of secureness as a requirement for choosing of procreation.

[152] Baizàn (2013).
[153] Lutz (2017) and Mencarini (2018).

Conclusions

All the researches made, have a common basic results: European results at Nuts0 and Nuts2 level[154] express a similar semantic deduction about the influence of CS on TFR. In fact, in both geo-level, the analysis confirm the homogeneous influence of childcare services[155] on woman reproductive decision making, regardless of the reference context. These results, confirm the theories showed by Rindfuss, Mencarini, Bernardi and Sobotka on this positive significance of CS on the fertility choices[156].

It is not the same for woman age at first childbirth and flexible female employment that depend on other political and social factors, which are different among the local contexts as shown by the literature examined[157] and by the descriptive statistics indicated on the fourth chapter.

In particular, comparing the European results of analysis at Nuts0 and at Nuts2 level, there are a negative significance of woman age at first childbirth both and for each spatial units. That means that, with more disaggregated data too, the analyses confirm the negative correlation of the

[154] The determinants used in Nuts0 and in Nuts2 euro-levels are the same for construction and sources but only with spatial units more disaggregated, thus their results are comparable.
[155] At Nuts0 European geo-level the variable CS there has a positive significance on the TFR, even in Nuts2 geo-level analysis (except for few regions. See the results paragraphs in chapters 4).
[156] Rindfuss et al. (1996), Mencarini et al. (2018), Bernardi (2017), Sobotka (2013).
[157] See the local differences of Welfare regime described by Esping-Andersen for example in paragraph 2.1. Esping-Andersen (1990).

childbirth's postponement on fertility choice showed by the literature[158]: at higher age correspond a lower TFR.

My analyses show for W_E_PRT regressor a positive correlation with the TFR in Nuts0 and in Nuts2 geo-level too (with some little exception, see the maps). It means that the reproductive behavior should be encouraged by the part-time female employment for two reasons: probably the flexible female employment, as the part-time working time, is a conciliation policy that allows women to caregiving the familiar needs without scarifying the career expectances[159]. This should means that women need to feel more economic and social secureness to procreate, but this is conditioned yet to the possibility to take care of children personally or using CS[160].

The analysis at Nuts2 European level has given a peculiar result on the CS determinacy. If it is true that at both European levels, state and regional, CS have an influence on the TFR, the analysis show also an important evidence at Nuts2 level. In fact, in this deeper level of analysis, looking at the *min* and *max* values of the estimates of coefficients GWR for the CS_U variable (use of childcare services) it is clear that CS regressor has a great spatial variability. It has a positive significance and a negative one on the TFR among the European regions, with positive correlation in the first case and negative correlation in the second one. However, this means that the

[158] First of all by Mencarini (2018) Campisi (2020), Wood et al. (2019, 2020) and Blums (2012).
[159] Bernardi (2017), Mencarini (2018), Wood and Neels (2020), Salvati (2020).
[160] Sobotka (2013), Campisi (2020), Mencarini () etc. (see the paragraph 2.1 on the theory references discussion).

use of CS has a central position on the fertility choice jointly to the other factors analyzed: female flexible employment, income situation and woman age at first childbirth, confirming the different theories enunciated in the second chapter[161].

Another improvement given to this research by the study carried out at Nuts2 level concerns the analysis of the influence of the income situation on the TFR. It is obviously that the power of economic sustenance of the families is determinant for the choice to procreate as many researchers indicated in their works[162]. To check this influence on the TFR, I considered in my models the "GDP per capita" (PIL_PRC), as income indicator. At Nuts0 level, this regressor denotes a positive significance on TFR, while at Nuts2 level it gives somewhere a positive significance and a negative ones, above all in the Mediterranean area, where the individualistic values seem to push women to seek personal satisfaction towards individual professional and economic fulfillment and less towards family fulfillment[163]. According with this literature, my results on Nuts2 level show that in presence of a high female part-time and the postponement of childbearing, the presence of early-childhood services and facilities are determinant on the fertility choice (look at the local joint positive significance of these two regressors on the TFR – figures and 16, 17 and 18 on chapter 4).

[161] Bernardi (2017), Campisi (2020), Wood and Neels (2019, 2020) Gesano (2017), Rindfuss (1990), Blum (2012), Mencarini (2018), Picchio (2018), Pezzulo (2017), Salvati (2020), etc.
[162] For exapmle, Wood et al. (2020), Salvati et al. (2020).
[163] Mencarini (2018) , Rosina and De Rosa, (2014).

This jointly significance on TFR of these two determinants is another innovative contribute of my research respect to the previous others. In fact, Wood, Neels and the other researchers mentioned before, analyzed local significance of these demographic and economic factors separately. This my job shows the jointly significance of use of CS and female part-time employment on the TFR at a European regional level Nuts2. This is an original contribute allowed by this analysis. Overall, this jointly results are there showed at a deeper level of each study on CS and Female Employment.

The results there described, suggest the necessity for the politician forces of the areas with lower-low fertility to draw guidelines and governance programs on the empowerment of CS and female flexible employment too, following the Scandinavian model and trying to recover the demographic gap on TFR.

APPENDIX

The Italian case

In addition to what I have done yet in this research previously, The "Italian Case" is a supplementary analysis on the Italian Nuts3 geo-level, which has the aim to focalize the fertility situation in Italy, deepen the spatial variability of the influence of some determinants individuates from the literature on the fertility.

This Italian study on the fertility is only a focus on the Italian situation on the fertility at provincial geo-level (Nuts3 level) and not a comparative application of my analysis, for that reason you can find it only included in the appendix of this thesis as a supplementary study. At support of this choice, there is a methodologic reason too: only the determinants used in this adjunctive focus of research on Nuts3 Italian geo-level are different from these of the previous level of research analysed, due to the unavailability to have the same Eurostat indicators in DemoIstat. This is the reason because the Italian study on the fertility is an analytical focus as a supplementary part of my PhD research. I presented this supplementary part of my research and its results at Bocconi University in Milan on the occasion of the AISP Pop Days 2019 organized by SIS (Società Italiana di Statistica) in January 2019.

This analysis uses the methodology of the GWR spatial model too. This job is a provincial study among the influence of local expenditure for conciliatory services and local services for early-childhood and the spatial

variability of the influence of employment rate jointly to the influence of cultural provincial level[164] and to the provincial location monthly rent[165] on TFR at Italian provincial Nuts3 geo-level[166].

In other words, this adjunctive study analyse the influence of monthly rent, total employment rate, a proxy of level of study and the public expenditure for CS on the TFR.

In the specific Italian case, according to data published by the United Nations in the period 2005-2010, Italy ranks 174th in the world list of fertility rates with a value equal to 1.36. This alarming fact underlines the importance of demographic analysis on this issue, which have copiously followed one another in the last decades.

Following the rapid and intense decrease that occurred after the baby boom, Italy is today one of the countries with the lowest fertility, both at European and world level among the countries considered to be advanced. In 2014, the Italian TFR amounted to 1.37, therefore very close to the threshold called "lowest low fertility". The situation was quite fluctuating: there was, in fact, an initial increase in the fertility rate at national level around the mid-90s followed by a phase of stability and subsequently of slight decline. For some researchers this swinging rate was due to the postponement of maternity

[164] Analysed through the indicator of presence of libraries per 1000 inhabitants, (LIB_16) as a proxy.
[165] I considered this kind of influence using the determinant of provincial position in 2016 for the "Monthly rent".
[166] This Italian analysis is a publication discussed on the SIS PopDays 2019.

for women in the centre-north Italy and to the greater fertility of immigrant foreign women.

a. Some scientific literature on TFR in Italy

The need to study the phenomenon of the drop in fertility rates in some geographical areas are connected to the processes of production, economic, political, commercial and development globalization, as well as to the perception of social and health well-being felt by the population. Many statisticians have observed that varying one or more factors connected to even one of these areas there corresponds a different total fertility rate.

In the Italian case, as mentioned in the previous paragraph, we have faced a now well-known case of demographic drop in TFR compared to the rest of the world and Europe, to the point of letting the scientific literature on this matter trigger.

The phenomenon has distant roots, since the end of the 19th century where the phenomena of urbanization and industrialization in the industrialized countries, which changed the uses, customs and cultural and family models, connected to the reproductive, individualistic, and occupational expectations of female emancipation, giving life to a real "demographic transition".

In the first phase of the demographic transition, there is generally a decrease in mortality (as an effect of an increase in the quality of life, in terms

of lifestyles, hygiene and health care), while fertility levels remain high. In this phase, more or less extensive, population growth occurs rapidly and consistently. In the following phase, fertility also begins to decrease, and population growth slows down, tending again to remain stationary. We are in the presence of the so-called stationary mature populations, characterized by a low flow of generational turnover and by an almost elderly population. These changes were experienced by European populations, (including by Italian regions with different rhythms and intensities), in the period from 1870 to 1930, with the exception of France, characterized by an early decline in fertility which began in the early decades of the nineteenth century.

In most western societies, since the mid-sixties of the 20th century, after the baby boom years that culminated in 1964-65, there has been a phase characterized by a drastic decline in fertility, which has fallen well below the generational replacement level (two children per couple). It follows that without the contributions of migration, the population would have tended to decrease. This phase, for its peculiarity of breaking with the past, is the "second demographic transition". Its characteristics are clear changes in wedding and family behaviours, with the growth of phenomena such as separations and divorces, lowering of marriages and corresponding increase in cohabitations and new types of families and births outside of marriage.

In order to understand the processes underlying the occurrence and evolution of the two transitions, there are different theoretical paradigms, which we can mainly enclose in three theoretical strands:

1. The vein of classical literature, which attributes a fundamental role in the evolution of the demographic transition to the phenomena connected to socio-economic modernization[167];

2. The cultural approach, which interprets the transition through changes in dominant ideologies, such as individualism and consumerism, which induce new needs and expectations in the collective imagination of globalized societies[168];

3. The fundamental explanatory approach which considers both the two previous approaches in a systemic and non-generalized way decisive: the demographic change of only specific local context appears due to the ideological influences dictated by socio-economic changes and intra-family and class culture[169].

Depending on the economic or sociological approach used and the countries examined, the researchers underlined different determinants and formulated different theories.

In the case of the "*new household economics"* approach, which spread in the 1960s in the United States with Becker, the drop in fertility depends from the economic changes of the last century. According to Becker[170], it is linked to the rise in incomes and the entry of women into the labour market. According to this micro-economic approach, children become durable goods

[167] Notestein (1953).
[168] Lesthaeghe et al. (2002).
[169] Caldwell (1982).
[170] Becker (1960).

and parents choose their number and quality, that is, they choose how much to invest in them in terms of money and time.

According to this conception, the quantity of children is directly proportional to the level of income, even if there are also countertrends according to which quality prevails. In this case, the demand for children in the presence of high income would tend to decrease[171].

Some scholars, starting from Becker's theory, have emphasized the influence that other socio-political factors have on women's decisions regarding fertility: not only income but also the presence and cost of childcare services. Therefore, if these costs are high, then women with a higher income will be led to decide to increase the quantity of children, as they have the possibility of having access to care services[172].

Hence, the main limitation of the economic approach of new household economics scholars: it tends to neglect the institutional, cultural and social factors of the reference context, which largely influence the choices regarding the fertility of women and couples[173].

In the 1980s, the two scholars Van De Kaa and Laestaghe inserted the new social and demographic trends including low fertility, in a scheme they called “second demographic transition”. We cannot consider it ended yet, considering its persistence and spatial heterogeneity[174]. This second transition

[171] Becker (1993), Freguja (2002), Kreynefeld et al. (2012).
[172] Ermisch (1989).
[173] Schleukter (2013).
[174] Giacomello et al. (2002).

differs from the first due to the different determinant of activation: the drop in mortality for the first, the drop in fertility for the second[175].

Among the numerous positions of academic scholars who have tried to hypothesize with their analyses how and for what reasons such a low fertility rate persists in the Italian territory, for example, Marcantonio Caltabiano stands out. The author, in several of his papers on this subject[176], affirms a very interesting position of which I would highlight two aspects relevant for the purposes of this my research work. The first is the research approach he has chosen which underlines that in Italy there are important regional differences in terms of fertility, information that pushes me to adopt a methodological choice of spatial demographic analysis. The second interesting aspect of the Caltabiano studies is the evidence of a slowdown in the drop in TFR or even in some cases his stopping in some northern regions of Italy as opposed to a continuous decline in the same in the southern regions. He hypothesizes an increasingly less positive course for the Italian TFR in the coming years. It, he says, will can be compensated for the south with the substantial flow of immigration in the absence of a new active population in the south linked to the low birth rate and the high emigration of autochthonous to the foreign countries or to the northern regions more developed and with more employment opportunities.

[175] Van De Kaa (2002).
[176] Caltabiano (2006).

In particular, Caltabiano conducts an analysis in 2006 using a methodology of demographic cohorts on the levels of Italian fertility highlighting two different models of reproductive behaviour between northern and southern Italy. In northern Italy, the decline in fertility, as mentioned, seems to slow down or stop in the 70s with cases of even growth of this indicator, as in Emilia Romagna in the early 80s. This figure, in case of constant growth, leaves the researcher to hypothesize a stabilization of the cohort fertility rate of northern Italy equal to 1.6-1.7 children per woman which, associated with a sustainable flow of immigrants, would lead to the real growth of the active population. On the contrary, Caltabiano's analysis shows that fertility in the south continued to decrease in the 1970s. Of great significance in this regard are the differences that seems to be between the various southern regions. There are regions where the TFR is much more similar to the northern regions (as in the case of Molise and Abruzzo), others whose TFR continues to decrease slowly (Sicily and Campania) and others where the decline of this rate is much faster and more substantial (Puglia, Basilicata and Calabria).

On the prospects of timid growth of TFR in northern Italy, some authors identify the role of immigration as a determining factor in an ongoing debate. Others do not consider it a significant variable on TFR due to the irregularity of these fluctuations, but believe that the decision to postpone the age of motherhood, on average after 30 years, was decisive in the north.

Caltabiano's position is therefore fundamental for understanding the need to carry out analysis that take into account the spatial differences of the socio-economic factors connected to the study phenomenon.

Another interesting reading of the phenomenon of low fertility in Italy can be found in the work of Laura Bernardi[177], which denotes the high influence of women's employment on regional rates fertility and age at first maternity. Data that, once again, underline the need for the realization of spatial analysis such as to grasp the different local dynamics of the phenomenon. What is surprising is that no national or European demographic forecast had foreseen a fertility rate as low as in the last decades in the Mediterranean regions, historically and traditionally centred on family care: culturally traditional and Catholic contexts such as Southern Italy, Greece and Spain Mediterranean, recorded the lowest fertility data in the rest of Europe[178]. For Bernardi, the presence of lower female participation rates in the workforce in Europe causes this figure here descripted.

A correlated factor to this determinant is inherent to family policies: in fact, as Bernhardt states, where these responds to the needs of family and parental care as happened in most of Europe, the rate fertility rate remained low or tended to stop in the following decades. On the contrary, in contexts in which these types of policies have been lacking, the drop in TFT has been unstoppable (in Italy it was the case of Campania, Basilicata and Calabria).

[177] Bernardi (2007).
[178] Chesnais (1996).

Therefore, according to the thesis carried out by Bernardi, the different spatial fertility rates are affected by individual (micro) components, inherent choices and life plans that concern a different way of understanding the couple (religious marriage or coexistence, etc.) and different expectations of personal fulfilment; as well as socio-political and economic (macro) components such as employment and welfare. In fact, the results of this research show that 64% of women between the ages of 20 and 49 in the north-west have a greater chance of joining the paid workforce, compared to the small 36% of women in the South. Even more significant than this spatial comparison is 41% of women from Southern Italy who never took part in the world of work compared to 7% of women from the north-west[179]. Ultimately, in addition to the different employment opportunities between north and south and the consequent family welfare responses, also other elements can be determinant. For example the different individual habits, such as spousal, cohabitation/cohabitation before marriage and divorce, typical of more modern and less traditionalist contexts (centre-north) seems to have had an impact on postponing the age of first maternity in the North compared to what happens in the South and in the islands. These determinants would also push to delay or evade second motherhood, probably also due to a training course with different duration and levels of education in the centre-north.

[179] Bernardi (2007).

The position of Carolici and Cuffaro is also interesting[180]. In a spatial analysis on unemployment in Italy, they highlight the persistence of the unemployment condition in some underdeveloped areas of the national territory, which offer the possibility of drawing a "heterogeneous map of the distribution of unemployment". It is an analysis of historical and spatial data cohorts, which outlines the diversified effects of intra and extra-national emigration, which, in the light of our study on spatial employment and childcare related fertility rates, shows the relevant data. To support this position is Marston[181] says there exist three forces that guide the labour market towards stability: the emigration of workers due to high unemployment rates; the investment of companies towards places with high unemployment rates, attracted by the third factor consisting in the possibility of decreasing wages due to the excess of labour supply.

According to this study, there are positive factors that prevent the rebalancing of the distribution of unemployment rates. These are values and affective factors that go beyond the quality of life and that often create reticence for the unemployed to emigrate, crystallizing the condition of high unemployment in that area.

A further confirmation of the usefulness of the spatial analysis comes from Giovanni Pezzulo's study analysis[182], aimed at monitoring and improving maternal and reproductive health levels and identifying the groups

[180] Casrolici and Cuffaro (2006).
[181] Marston (1985).
[182] Pezzulo et al. (2017).

most at risk at preventive purpose. Indeed, in this work, the usefulness of examining the phenomenon of fertility transnationally through spatial analysis is evident, demonstrating once again the insufficiency of studies that are based only on a-spatial OLS models for understanding heterogeneity of fertility rates and adolescent fertility.

b. Focus on TFR in Italy: Nuts3 Level

As explained in the specific paragraph on the research hypothesis, the decision to deepen the geospatial level of analysis from the European NUTS0 level to the Italian NUTS3 level is based on socio-political investigation reasons (see chapter 1, research hypothesis) , as well as on methodological reasons. From a methodological point of view, moreover, this allows to have a more disaggregated dataset, where it is possible to analyse a greater number of smaller and closer spatial units. This should inevitably ensure greater reliability of the study. In this case, however, it is not possible to compare the results of the Nuts0 and Nuts 2 European geo-level with the results of this additional analysis at Italian Nuts3 geo-level, because the DemoIstat Childcare variables are not the same as the Eurostat ones. Furthermore, the comparison between European and Italian results it is impossible at this state of research because, the dataset uses also data by the

"IlSole24Ore" source, that produces provincial rankings based on indicators determining the quality level of life of the resident population. Therefore, for each province, there are no values available but they are scores. Thus, at European levels we have values, but at Italian level we have scores and these are not about the same determinants yet, but different each other. In future researches, it is my intention to verify the availability of new data sources at Italian Nuts3 level, in order to apply any imputation method to analyse deeper spatial comparison between the Italian and European results.

Therefore, hoping to deepen the possibilities of imputation between the data in future analysis, in this research we will limit ourselves to carrying out this supplementary analysis with the purpose of interpreting the situation of Italian fertility and not for comparative intentions with the European macro-level.

The first operation of this step of study concerned the acquisition of data from statistically reliable national sources such as "DemoIstat" and "Il sole 24 Ore online".

Starting from the data collection of these sources, I built a dataset by placing all the data acquired on a provincial basis (110 provinces, Nuts 3 level) of the determinants deemed relevant on basing of the existing literature on the subject of study.

In this way, a three-year database (2014-2016) of the provincial TFRs and the provincial data of the determining variables was created, according to the exemplary prototype shown below in table 7:

Table 7 - *Prototype of the Italian Nuts3 dataset built*

COD_REG	COD_PRO	PROVINCES	TFR _16_I	Cons_14_S	…	Lib_16_S
1	1	Torino	736,53	840,00		500,00
1	2	Vercelli	706,59	863,00		517,00
…	…	…	…	…	…	…
16	110	Barletta - Andria - Trani	748,50	569,50		345,00

Microsoft Office Excel software is the software used to the construction of the dataset. There, the creation of codebooks is fundamental: it means a complete caption of the codes with which the chosen variables are named, which, as in the example above, express the reference year, the source and its description. For example, "Cons_14_S" stands for consumption per household - in euros - of 2014, source "Il Sole 24 Ore".

c. Explanation of the determinants used in Italian NUTS3 Level

Starting from a study of the aforementioned literature on fertility in Italy, the writer has deduced that it could be relevant to analyze both income and consumption factors as well as occupational and educational-cultural factors. Investigating household consumption is useful for analyzing the real level of economic wealth of households. To do this, it was used indicators such as: "consumption per household - in euros"; "GDP per capita" and "spending on durable goods" which, together with indicators such as "average

family assets - in euros" and "per capita bank deposits", help to know the income level and, therefore, the condition of greater or lesser economic comfort in which these households find themselves. The family economic conditions influence, as the literature shows in one direction or another, the procreative choices of the Italian couple. In this sense, it also seemed relevant to analyze the living conditions, which we tried to study through the variables "house cost per m²" and "monthly rent - average".

Furthermore, it would not have been logical to omit the variables inherent in the occupational condition, which is often decisive for women[183]. Both because of the working hours that are often incompatible with the actions of care for children, and for contractual reasons of precariousness that often do not guarantee maternity support measures (parental leave, reduction in breastfeeding hours, family allowances, etc.). These are decisive assumptions in such a delicate and complex evolutionary phase of the family both from a psychological and economic point of view. For these analytical purposes, therefore, I considered the variable "Total employment rate - 15/64 years". Other factors deemed to be influential were those relating to family fertility support policies useful for women to reconcile care activities with employment, for which the following choices were made: the "availability of kindergartens with respect to potential users" and the variable "total index of taking charge of potential users for early childhood nurseries".

[183] Bernardi (2007)

In my opinion, in addition to the literature examined, the migration factor is not to be underestimated as a consequential factor of other determinants (here we analyzed the "total migration rate"), as the TFR can vary spatially also due to displacements of the population in childbearing age, therefore analyzing this variable as a possible determinant seems to be essential.

Finally, in order to assess the possible influence of educational and cultural interests on fertility choices, it should be relevant to cross-reference the data on the provincial presence of libraries per 100 inhabitants with the TFR data.

d. Principal results of Italian Analysis

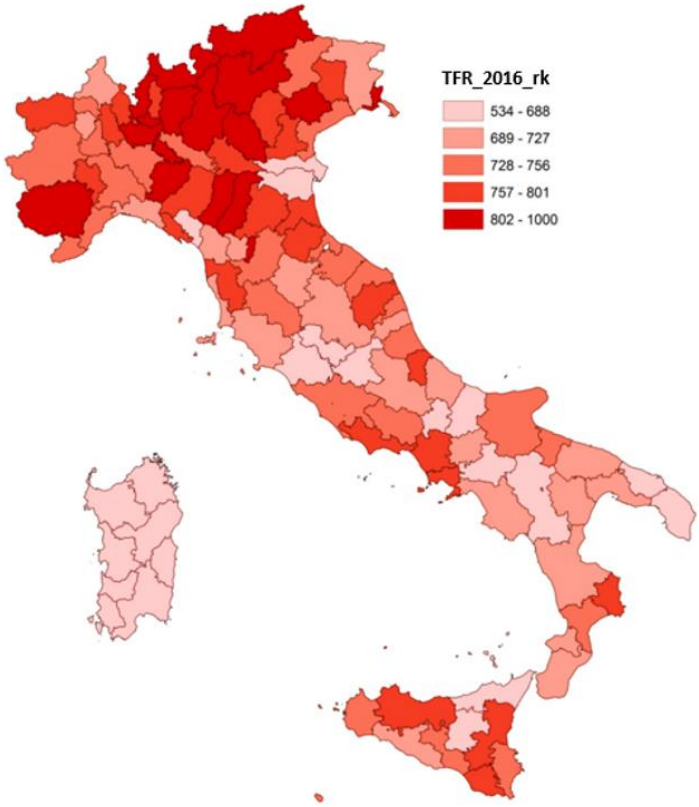
In a very early phase, we concentrated on the observation of the TFR data, highlighting in which provinces it appears higher and in which lower, in order to hypothesize which determinants among those choices, could be of greater analytical interest for the construction of the OLS model.

Thus, in order to understand the usefulness of the geo-spatial regression model (GWR), also in this geo-level of analysis, it was decided to examine the classical regression technique (OLS), set as a basis for comparison (benchmark), which applies the parameters of the model globally,

and which represents the generally most widespread statistical model in the socio-demographic context.

The latter assumes that the territory in its entirety presents that parameter that emerges from its application, not considering the actual territorial differences that instead emerge through of the spatial regression model, as described above. To understand the provincial TFR[184] data, view the following map attached (Figure I):

Figure I – *TFR score among the Italian provinces in 2016. Mapping software: Qgis*



[184] The TFR variable used in the analysis of the Italian case is an indicator constructed from the source "annual provincial rankings on the quality of life" of "Il sole 24 ore online" which produce provincial rankings based on indicators determining the quality level of life of the resident population. Therefore, for each province, there are no values available but they are scores. For this reason I constructed a "TFR_rk" equal to a TFR ranking expressed, a variable that relates the TFR DemoIstat value on a scale from 0 to 1000, in order to ranging this variable in terms of score. Because that, the map "figure I" shows TFR_rk, as a variable with values between 0 and 1000. For the score the formula is the TFR value of the single province divided by the highest TFR provincial value.

Specifically, among the different models produced, the most significant and relevant according to the literature examined is the following:

$$TFR\_16 = f(CLM\_16; TOCT\_16; Lib\_16)^{185} \quad (22)$$

with:

TFR_16 = score[186] of the province in 2016 regarding the "TFR";

CLM_16 = score of the province in 2016 regarding the "Monthly rent";

TOCT_16 = score of the province in 2016 regarding the "Total employment rate";

Lib_16 = score of the province in 2016 regarding the "Presence of libraries for 100k inhabitants";

Applying OLS and GWR methods on this model, the obtained results are in the following table:

Table a.1 – *Main values of the OLS and GWR parameters. (with * = p <0.05 and ** = p <0.01). F-Anova GWR Vs OLS (p <0.05). Test on the variability of the coefficients (p <0.05). Processing with STATA ver. 13.*

Variable	Global Model (OLS)	Min (GWR)	1Q (GWR)	Median (GWR)	3Q (GWR)	Max (GWR)
Intercept	826.34**	312.77	707.06	805.67	828.32	1206.63
CLM_16	-0.1588*	-0.40553	-0.13241	-0.11703	-0.10253	-0.02400
TOCT_16	0.08464*	-0.17029	-0.04020	0.10047	0.20024	0.63292
LIB_16	-0.13786**	-0.25299	-0.14691	-0.13750	-0.09194	0.02694
Adj-R^2 OLS	0.35143	/	/	/	/	/
Adj-R^2 GWR	0.46127	/	/	/	/	/
	* = p< 0.05	**=p<0.01				

[185] For the complete name of the variables used, see the codebook in the section "Codebook" after the References.

[186] Look at note 183. All the variables of this model follow this computing.

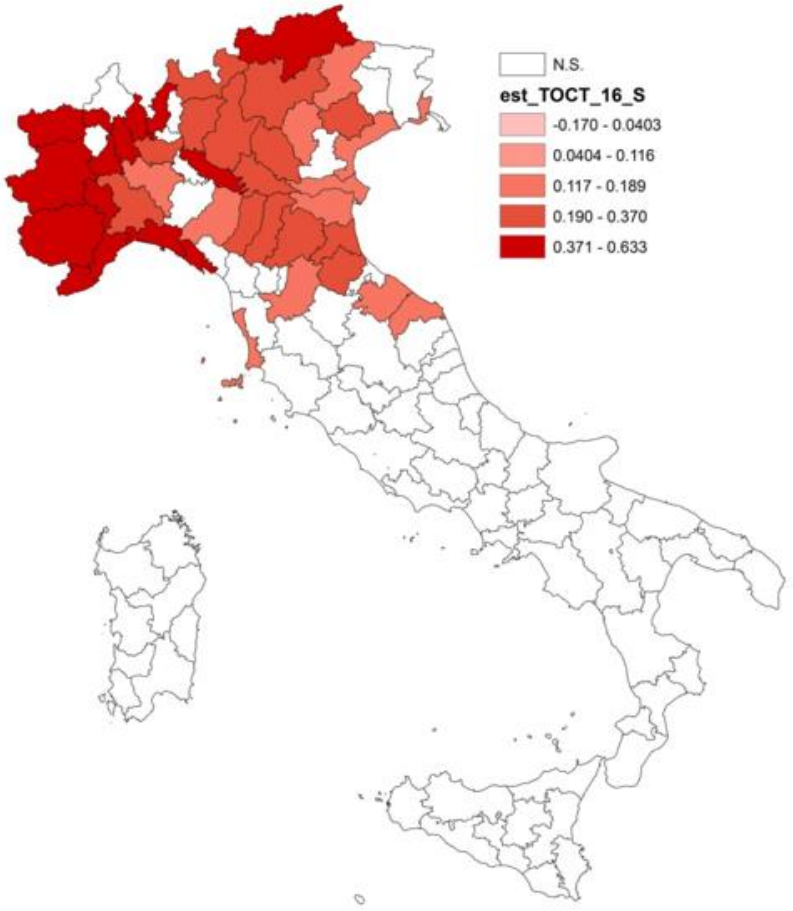
If we look at the data in the first column of the table above, it is possible to see how from the analysis of the global OLS model, the positivity, albeit at the limit of significance, of the total employment rate (TOCT_16) on the TFR at national level is evident. At the same, it is clear the negative significance for the determinants Monthly rent (CLM_16) and Presence of libraries per 100 inhabitants (LIB_16).

Instead, the results of the analysis carried out by applying the spatial regression model (GWR), show a non-homogeneity of the "fertility" phenomenon in the various provincial territories. Precisely, this inhomogeneity confirms the initial expectations of this work, which had prompted the writer to use a methodological technique capable of grasping the different contextual factors of a socio-demographic, economic and political nature that it was felt could affect the fertility rate.

Therefore, it can be said that the spatial model significantly improved the results obtained by the global model.

There are significant differences in the significance of the determinants examined between the application of the global OLS model and that of the GWR spatial model. In particular, if the employment rate (TOCT_16) in the global model is not significant, instead by applying the GWR model it is noted that it is positively significant even if only in the area of northern Italy and especially in the North West (see Figure II):

Figure II – *Estimates of the spatial coefficients of Employment Rate, obtained with the GWR model. Period 2016. Elaboration software: Stata14. Mapping software: Qgis (NS = not significant).*



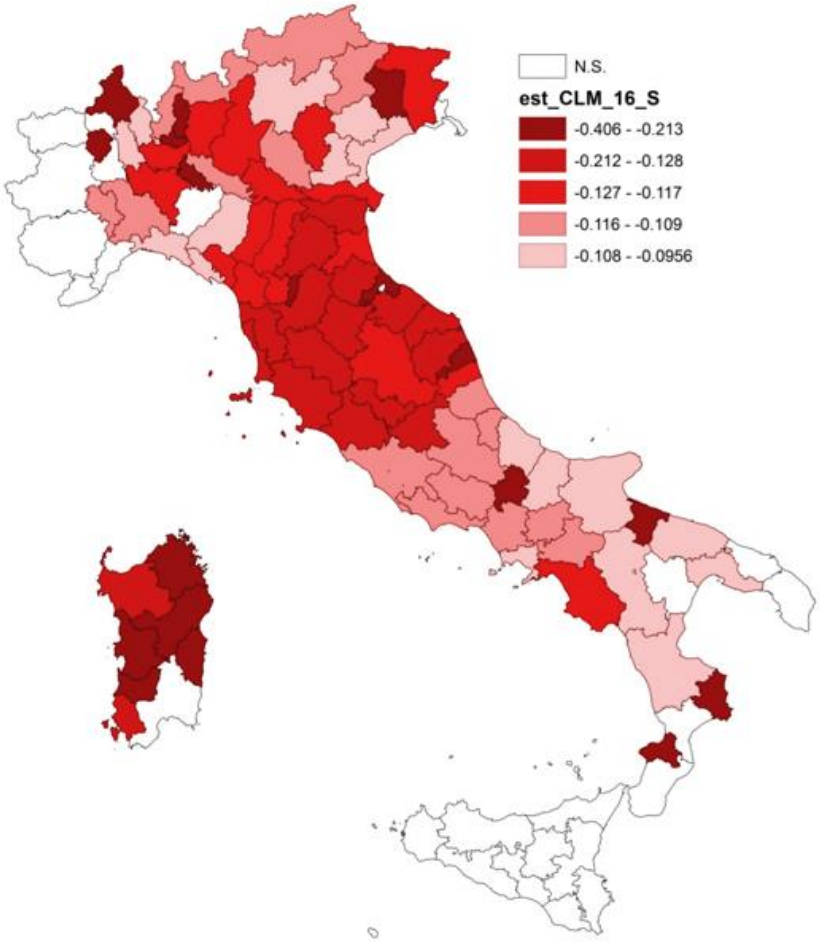
From the data, it can be deduced that the total employment rate is a determining variable with respect to the fertility rate in the regions of northern Italy, an area in which the employment rate appears to be higher than in the Southern area. It, therefore, represents its positive significance. That means that it is a variable which affects the growth of the fertility rate in northern Italy directly.

The influence of the employment rate on the TFR in Northern Italy can be explained by a condition of greater economic comfort deriving from the employment condition, such as to induce the family unit to perceive a low

sense of precariousness that would push it more easily to undertake a life plan including procreative choice.

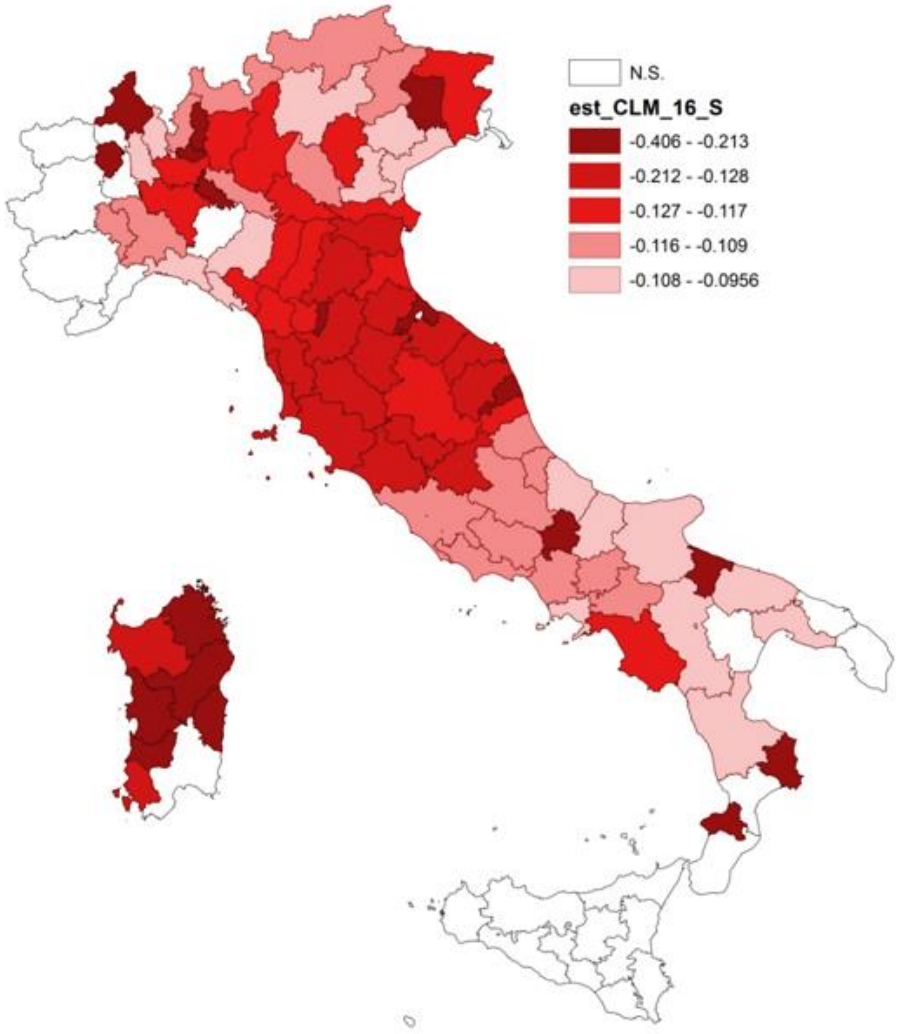
As for the monthly rent (CLM_16), the results of the analysis confirm the literature examined on the subject: there it seems to be a negative significance both globally and locally which highlights the existence of an inverse correlation between the TFR and the CLM. According to this analysis, the increase in the local monthly fee would tend to slow down the procreative choice of Italians, and this occurs strongly in the regions of Sardinia, Central Italy and Italy North-East (see figure III):

Figure III – *Estimates of the spatial coefficients of Monthly Rent, obtained with the GWR model. Period 2016. Elaboration software: Stata14. Mapping software: Qgis (NS = not significant).*



Then, interesting for sociological purposes is the result of the analysis concerning the presence of libraries per 1000 inhabitants, (LIB_16), used here as a proxy of the cultural level of the province (Figure IV):

Figure IV - *Estimates of the spatial coefficients of Presence of Libraries per 1000 inhabitants, obtained with the GWR model. Period 2016. Elaboration software: Stata14. Mapping software: Qgis (NS = not significant).*



The determinant in question appears to be negative and significant on a global level (LIB_16 OLS = -1.1378, see table no.2 above) as well as on a spatial level. This result has interesting facets at geographical level: how it simplifies the map (figure n IV), the variable “bookshops per 1000

inhabitants" has a strong negative significance but only limited to some provinces of North-West Italy and the Emilia area. These results underline, the aforementioned analytical value of spatial analysis: despite the fact that the determinant at a global level is significant, thanks to the GWR model it is noted how this significance is actually so strong in some provinces that win in the global data also the non-significance of the same determinant in the other provincial areas. If we had stopped at the OLS model, I would have assumed that the cultural level negatively influenced fertility in all Italian provinces, when instead it strongly affects the TFR but only limited to some provinces.

Thus, the sociological relevance of this data, has to be interpreted as a proxy of the provincial cultural level It allows to hypothesize that, since there is an association between the presence of bookshops and the percentage of graduates present in the province, its negative significance on TFR. That probably imply the choice to delay the marriage or any other form of conviviality of the couple and the consequential procreative choice justified by the continuation of the pursuit of high-level training courses that would take priority in terms of personal fulfillment of the components of the couple in the areas of north-west Italy. According to which historically, the advent of consumerist and individualistic ideologies have led to a gradual but clear orientation of youth expectations towards the preparatory training higher employment achievement[187]. Infact, globalizing logics have imported the

[187] De Rose et al. (2008).

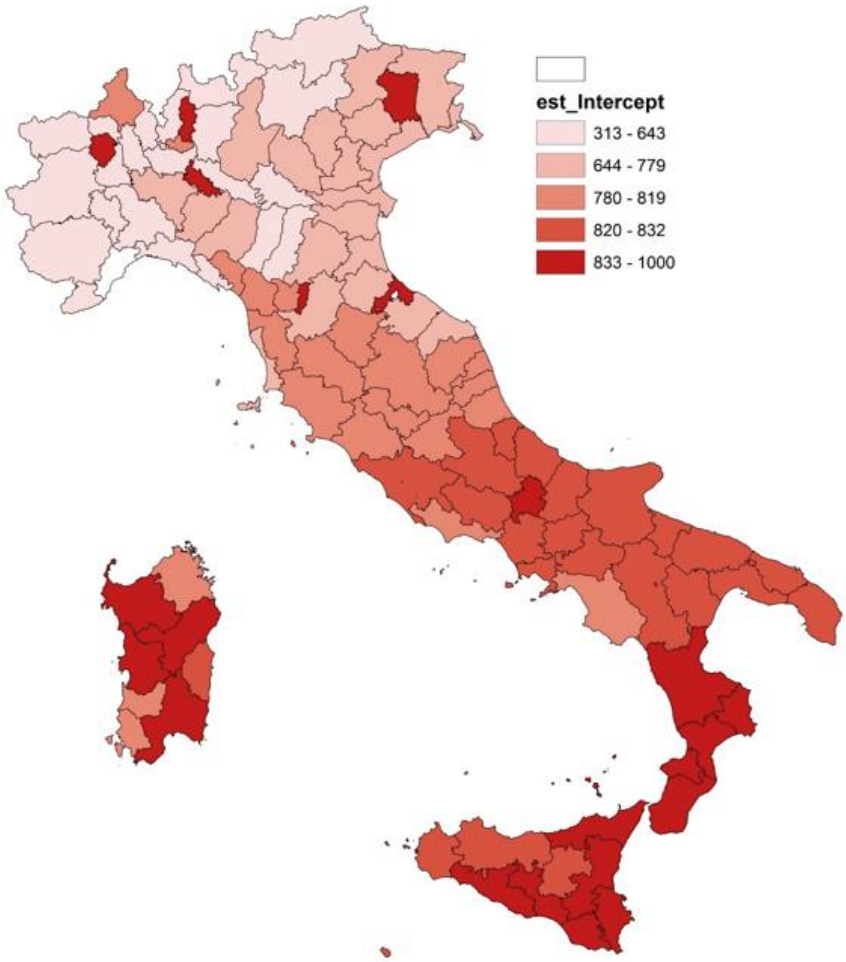
ideology of the "made-self man" from the American Far West, now strongly introjected in this century man. This is a sociological mechanism which influences the collective imagination of current generations, impacting on the personal ambitions and the individual needs, as exhaustively explained by a great contemporary sociologist and philosopher, Zygmunt Bauman in numerous of his essays on the current post-contemporary society, precisely defined as a "liquid society"[188].

Further confirmation of the influence of the determinants examined with respect to the TFR is given by the intercept values (see Figure V in the follow page), which represent proof of relevance. Infact, the intercept indicates the value of the "theoretical position" of each individual province if the factors represented by the certain monthly rent, occupancy rate and libraries per 1000 inhabitants did not intervene.

Because of these results, it was decided to investigate in this level of Italian Nuts3 analysis, on further multifactorial incidences of the determinants examined at European Nuts0 and Nuts2 level. I refer, for example, to the deepening of the female employment rate through spatial regression, understood as a possible determinant of TFR in association with the average age of the woman at childbirth.

[188] Bauman (2011).

Figure V – Intercept according to GWR. (NS = not significant).



The analytical results that would derive from such in-depth studies would represent a useful knowledge background for forecasting the future developments of the Italian socio-demographic condition, fundamental in terms of local and global governance in terms of family and employment policies.

There is no doubt, about the importance of social reprogramming policies. It is urgent, as it is necessary in a country that is emblematic of the phenomenon of population aging such as Italy. This reprogramming should

be based on a careful, detailed and localized analysis of the needs of the resident population, in order to pursue the much-acclaimed standards of effectiveness, compliance, efficiency and economy of social policies, for a truly advanced and qualitative society in terms of GDP and social well-being. This research was born yet to emphasize the inseparable systemicity existing between statistics, sociology and social policy: an important but still underestimated link, despite the numerous European and Italian regulations and guidelines in force for decades (think for example of law framework 328/2000 et seq.).

In order to identify the effect of public childcare on fertility, I used socio-educational services for infancy day-care data set (ISTAT, 2015). I recalled that public care for children, from ages three months to three years, is mainly provided by “asili nido” (day care centers).

In particular, we considered these variables at the Italian provincial level:

a) percentage of municipalities offering day nursery services (NURSERY_MU)
b) percentage of municipalities offering innovative infancy day-care services (SS_MU)
c) expenditure of municipalities for 100 children, aged 0-2 years, (euro) for day nursery (NURSERY_EX)
d) expenditure of municipalities for 100 children, aged 0-2 years, (euro) for innovative services for infancy day-care (SS_EX).

Being in this case DemoIstat data, the dependent variable considered in the model is the TFR expressed in values and no longer in score as in the previously analysed model.

The OLS regressions model confirm that the percentage of municipalities that have a daily nursery service and the municipality expenditure for 100 children, aged 0-2 years, are positively correlated with the TFR (see table a.2).

Table a.2 – *Estimates OLS and GWR for the NURSURY_MU variable*

Variable	OLS	Min	Lower quartile	Median	Upper quartile	Max
Intercept	1.2228**	1.1111	1.2177	1.2625	1.2930	1.6168
NURSERY_MU	0.0016**	-0.0044	-0.0003	0.0007	0.0018	0.0027
Global regression results (OLS): AICc=-165; Adj-R-square=0.13; *=p<0.05; **p<0.01						
GWR results: AICc=-222; Adj-R-square=0.66; GWR ANOVA Test: F=5.66						

Table a.3 – *Estimates OLS and GWR for the NURSURY_EX variable*

Variable	OLS	Min	Lower quartile	Median	Upper quartile	Max
Intercept	1.2766**	0.9730	1.2608	1.3121	1.3878	1.4065
NURSERY_EX	0.0001*	-0.0003	0.0000	0.0000	0.0000	0.0002
Global regression results (OLS): AICc=-154; Adj-R-square=0.05; *=p<0.05; **p<0.01						
GWR results: AICc=-217; Adj-R-square=0.48; GWR ANOVA Test: F=12.29						

Table a.4 – *Estimates OLS and GWR for the SS_MU variable*

Variable	OLS	Min	Lower quartile	Median	Upper quartile	Max
Intercept	1.2889**	1.0912	1.2807	1.3151	1.3430	1.3656
SS_MU	0.0015*	-0.0059	-0.0006	0.0012	0.0017	0.0064
Global regression results (OLS): AICc=-155; Adj-R-square=0.05; *=p<0.05; **p<0.01						
GWR results: AICc=-221; Adj-R-square=0.49; GWR ANOVA Test: F=12.88						

Table a.5 – *Estimates OLS and GWR for the SS_EX variable*

Variable	OLS	Min	Lower quartile	Median	Upper quartile	Max
Intercept	1.2940**	1.0505	1.2866	1.3263	1.3705	1.4096
SS_EX	0.0008**	-0.0030	-0.0010	-0.0002	0.0002	0.0057
Global regression results (OLS): AICc=-155; Adj-R-square=0.06; *=p<0.05; **p<0.01						
GWR results: AICc=-224; Adj-R-square=0.66; GWR ANOVA Test: F=6.99						

The research results confirm Sonja Gesano's survey thesis[189] that showed how public childcare policies have an important role in family decision-making on their demographic behaviour. In addition, other studies confirm our results.

We refer, for example, to Baizàn's analysis[190], who underlined the positive effect on fertility of formal childcare for children under 3 and the importance of differences among the contexts. In fact, even in our study, there are some territorial differences (see figure VI in the following page, where the coefficients of the GWR model are mapped for each variable). With some territorial exceptions, from this analysis West-Northern Italy seems more influenced by the percentage of services offered (nursery and supplementary services). While the expenditure situation seems more difficult to identify with positive values in central Italy, only for the expenditure of municipalities (NURSERY_EX).

[189] Gesano (2017).
[190] Baizàn (2009).

Figure VI – *Local coefficient estimates for "NURSERY_MU" in Italian Provinces (Nuts3 Level). Elaboration software: Stata14. Mapping software by Qgis.*

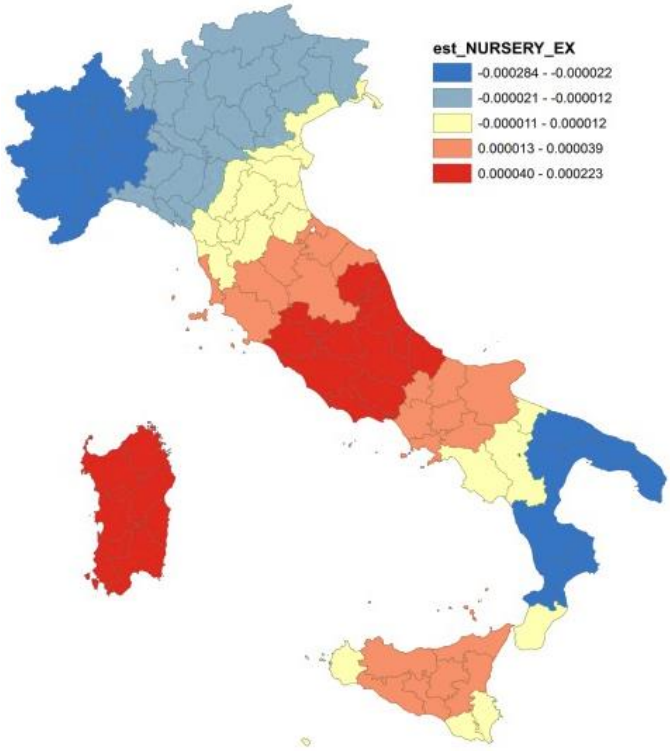


Figure VII – *Local coefficient estimates for "NURSERY_EX" in Italian Provinces (Nuts3 Level). Elaboration software: Stata14. Mapping software by Qgis.*

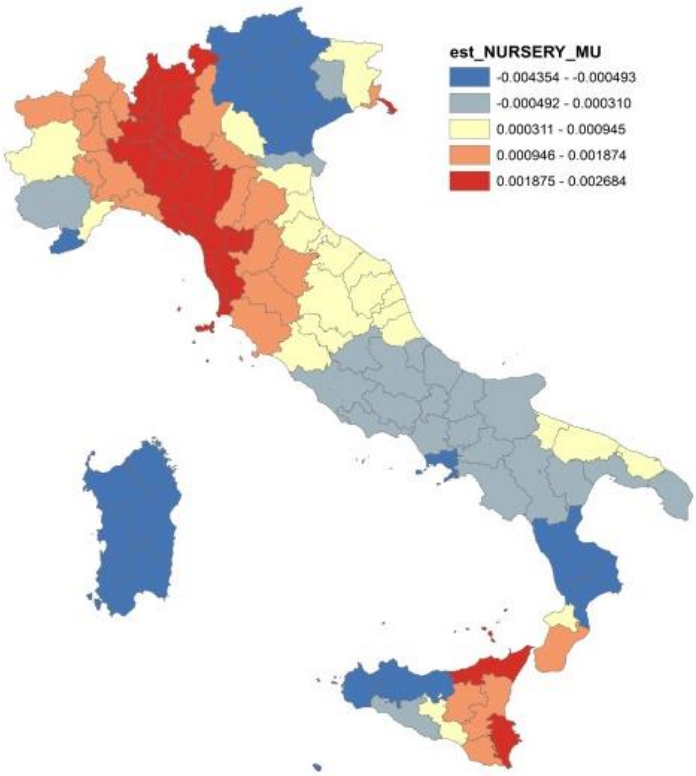


Figure VIII – *Local coefficient estimates for "SS_MU" in Italian Provinces (Nuts3 Level). Elaboration software: Stata14. Mapping software by Qgis.*

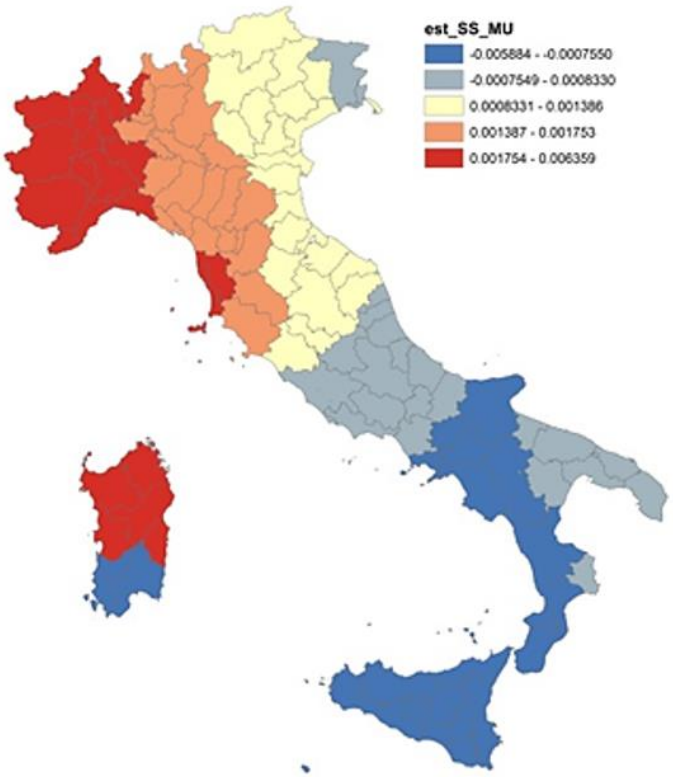
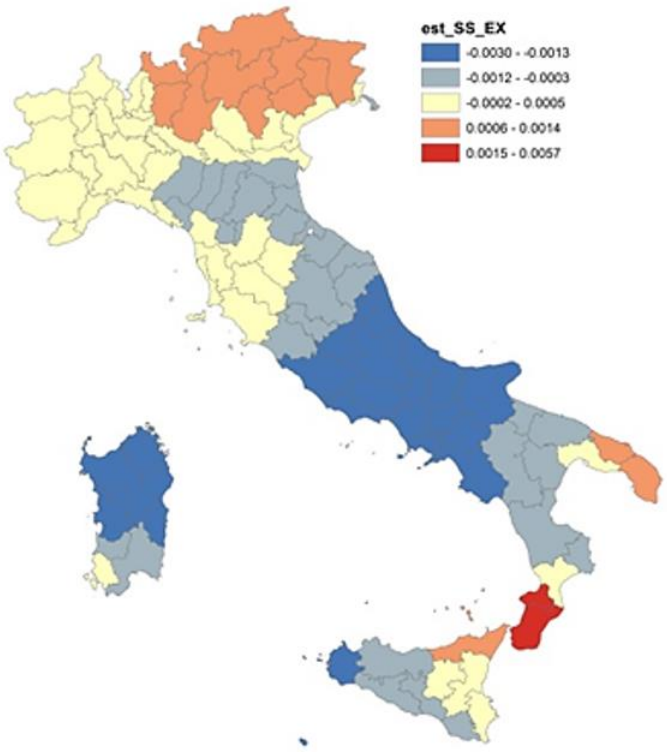


Figure IX – *Local coefficient estimates for "SS_EX" in Italian Provinces (Nuts3 Level). Elaboration software: Stata14. Mapping software by Qgis.*



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Codebook

CLM_16 = Score of the province in 2016 regarding the “Monthly rent”;

CHD_NO_U_CS_14_17 = Children who do not use CS % (0-3) (average among 2014-2017);

CS_U_L_14_17 = Children who use the CS for less than 29 hours per week % (0-3) (average among 2014-2017);

CS_U_M_14_17 = Children who use CS for more than 30 hours per week % (0-3) (average among 2014-2017);

CS_U_14_17 = Children who use CS for early childhood % (0-3) (average among 2014-2017);

Lib_16 = Score of the province in 2016 regarding the “Presence of libraries per 100k inhabitants”;

NURSERY_EX = expenditure of municipalities for 100 children, aged 0-2 years, (euro) for day nursery;

NURSERY_MU = percentage of municipalities offering day nursery service;

PIL_PRC_14_17 = GDP per capita (average among 2014-2017);

SS_EX = expenditure of municipalities for 100 children, aged 0-2 years, (euro) for innovative services for infancy day-care;

SS_MU = percentage of municipalities offering innovative infancy day-care services;

TFR_14_17 = Total fertility rate (average among 2014-2017);

TFR_16_rk = Score of the province in 2016 regarding the “TFR”;

TOCT_16 = Score of the province in 2016 regarding the “Total employment rate”;

W_AGE_14_17 = Mean age of women at childbirth (average among 2014-2017);

W_E_PRT_14_17 = Female part time employment % (average among 2014-2017);

W_EMP_14_17 = Female Employment Rate % (average among 2014-2017);

W_EMP_H_ED_14_17 = Employed women with a high level of education % (average among 2014-2017)

W_EMP_L_ED_14_17 = Employed women with a low level of education % (average among 2014-2017);

W_E_FLT_14_17 = Female Full Time Employment Rate % (average among 2014-2017);

W_UNEMP_14_17 = Female Unemployment Rate % (average among 2014-2017);