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Abstract

In Tunisia as in some Arab countries like in Algeria and Egypt, fertility has known, after a deep decline, a steady increase from the mid of 2000s. This paper tries to apprehend this unexpected and current demographic issue. For that aim, we revisit the classical fertility decline factors (namely education, income, mortality and contraceptive prevalence) in order to inspect if they do no longer influence fertility downward. Furthermore, we explore three new socio-economic factors likely to favor fertility rise, such as divorce, unemployment and longevity. We apply the dynamic one-step generalized method of moments (GMM) method over the period 1999-2017 on eight Tunisian regions. Findings confirm our presumption. The three new variables estimated have a positive effect on fertility. Likewise, the education-fertility interaction is no longer obvious. Family planning program appears no longer playing its role. The income effect dominated the substitution effect in favor of fertility increase. The increasing fertility trend in Tunisia seems to be caused by the sociocultural factors.

Keywords: Fertility, education, divorce, unemployment, longevity, dynamic GMM.

JEL Classifications: J11, J13, C23.

1. Motivation

After the demographic transition fulfilment, at the early of 2000s and its engage in the aging process (the post-transition regime), Tunisia is experiencing a stable increasing fertility trend. Indeed, in contrast to Western countries demographic experience but like some Arab countries (like Algeria and Egypt), fertility from less than 2 children per woman in 2002 rose at to 2.46 in 2014 and thereafter to stabilize at 2.33 in 2017. Such a fertility evolution contradicts the demographic transition theory and the traditional cycle of demographic transition.² As well, it gives rise to many questions on whether fertility will keep its increasing trend and what are its main causes. Likewise, it creates concerns on the future population evolution and the economic and social consequences and leads to new challenges for policy-makers.

Even so, no clear and convincing explanation have been given. For example, Courbage (2015) believed that this fertility behavior change has been caused under the pressure of Arab spring revolution 2011. However, he overlooked that it has been observed long before the revolution for instance since 2006 in Tunisia. Henceforth, this fact deserves more attention and requires a deeper analysis of the causes of this fertility behavior change as to improve our understanding of the demographic of Arab countries when moving from demographic transition to ageing process.

Therefore, in this paper, we aim to give some light at this current demographic issue in Tunisia as in some Arab countries. This attempt is of particular interest to inform and guide Tunisian and Arab policy makers on the population challenge of the future. For this purpose, we revisit the familiar fertility decrease determinants during the post-transition period, in order to inspect if they do no longer influence fertility downward. More accurately, we re-examine the education-fertility interrelationship to check if education does no longer play its role in reducing fertility as strongly acclaimed by Becker (1960 and 1965), and as proved in the previous work on Tunisian case (e.g. Frini and Muller, 2012). Moreover, we explore new factors likely to favor fertility rise, however not considered in the previous works. More explicitly, we introduce, in line with Easterlin approach, new socio-economic factors such as divorce, unemployment and longevity³.

To assess empirically the long-run fertility behavior, we apply the generalized method of moments (GMM). We estimate a dynamic one-step GMM method applied to cylindrical data over the period 1999-2017 on eight Tunisian regions as defined by the Tunisian administrative distribution.

Hence, our paper presents two novel contributions to literature: (1) it is a first attempt to empirically assess the liable factors of the phenomenon of the fertility rise observed since a more than a decade. (2) It puts forward three new socio-economic factors the divorce, the unemployment and the longevity, which are likely to favor the fertility rise.

² Notestein, 1950 and Coale and Hoover, 1958.

³Easterlin, 1975, 1978 and Easterlin, Pollak et al. 1980.

In what follow, we present, in section 2, a brief overview of the literature on the demographic transition. In section 3, we give a sight on the demographic changes then we analyse the upward fertility trend to discuss its potential factors. In section 4, we specify the econometric model and in section 5 we interpret the results. In Section 6, we conclude with the main findings and policy recommendations.

2. Brief literature overview

Theoretically, the demographic transition describes the move in demographics, from high birth and death rates, what is called a “traditional demographic system”, at low rates (“modern” demographic regime)⁴. As a first step, health gains reduce mortality, especially for young children. The population is growing. In a second step, social progress, like schooling especially for young women, the age marriage increase. The birth rate in turn decreases. A new equilibrium is established: the population continues to grow very slowly; mortality and birth rates are low. These demographic changes are assumed to represent an irreversible process leading to the population aging.

The fertility transition is widely linked to social and economic development. According to demographers, fertility transition is mainly due to the mortality drops, following the health improvement and sanitary development. The mortality decline gives up the motivation to have extra children as an insurance device against child death and to replace dead children (Ben-Porath, 1976).

However, the household economics’ theory, based on Becker (1960, 1965) work's claims that transition is related to the interaction between fertility and education. Education may take part in fertility declining rate as it vehicles values in favor of socioeconomic advances in contrast to traditional ones. The most known channel, however, is related to the child quantity-quality trade-off within household. Education increases the opportunity cost of time women spend in child care and favors a return to child quality (Becker and Lewis, 1973). As well, education may reduce fertility through changing motivation and attitude in favor of fertility regulation and of postponing women age marriage (as to prolong studies) which reduces the exposure to the risk of fertility. Furthermore, fertility decline could also be caused by preference change as argued Easterlin (1975, 1978). According to Leibenstein (1974) transition is due to the economic and social development on focusing on social influence groups. In contrast, the Caldwell (1982) interpretation is focused on wealth flow direction. Fertility transition is caused by the reversal of the wealth intergenerational flow: from children to parent shifts from parents to children. Such a reversal wealth flow is mainly explained by the education development.

These demographic transition features are empirically validated by the former works.⁵ However, this decreasing trend in fertility, which is assumed to be an irreversible process, has taken a reversal trend to register a steady increase in some Arab countries like Algeria, Egypt

⁴ Notestein, 1950 and Coale and Hoover, 1958.

⁵ E.g. Doepke, 2004; Dielbot and Doliger, 2005; Narayan and Peng, 2007; Fort et al, 2016....

and Tunisia. For better understanding of this unexpected fertility evolution, we assign our attention to the Tunisian case.

3. The fertility upward trend analysis

After has known a fast demographic transition and has launched an aging process, Tunisia is undergoing a change in its demographic indicators' evolution. The fertility rate has shown a steady increase since the mid of 2000s. After reaching a level below the replacement rate in 2000 (1.8 children per woman), it shifted to 2.15 in 2011, to 2.46 in 2014 and to stabilize at 2.33 in 2017. Likewise, the birth rate fluctuated upwards from 17.1 per thousand in 2000 to 20.5 in 2015 then to 18.2 in 2017. The mortality rate shown, after a stability at a low level (about 5.5 per thousand in 2000), a slight increase to reach 6 per thousand in 2017. Therefore, a slight change in the natural demographic growth rate is recorded during the same period. It moved from 1.15 percent to 1.48 in 2015 and to 1.22 in 2017. Hence, life expectancy at birth has progressed at a very slow pace by about three years during the period 2000-2017. From 72.6 years, the life expectancy reached 75.4 years in 2017 (78.1 years for woman and 74.5 years for man), which is a small increase in comparison to that occurred during the previous period⁶.

Then, how to explain this reversal in fertility trend? What are the liable factors for this fertility behavior change? To look for an explanation, we re-examine the trends of the main factors of the demographic transition picked out by the previous studies (such as the health conditions improvement, the family status development, the age of marriage delay, the education expansion, contraceptive availability and economic performance) to check whether they have changed behavior as well⁷. Moreover, we try to put forward others which likely to cause this increase, however, not revealed by the previous studies.

As a potential liable factors of fertility rise, we firstly quote *the decline in contraceptive prevalence and the looseness of fertility control by the national board for family and population (ONFP)*. We note that the contraceptive devices use has cut down. The number of contraception beneficiary had dropped by almost 40 percent during 2009-2011 to pass from 700000 to 440 000 and to 375653 in 2017. Accordingly, the contraceptive prevalence rate fluctuated downward from 63 percent in 2001 to 60.2 percent in 2006 and to 62.5 percent in 2012.⁸

The ONFP executives putted forward, in their statements in the workshops and in the mass media⁹ that this fertility regulation decrease is in part due to three main factors related to the office activities. (1) A change of the ONFP's population strategy: following the conference in Cairo in 1994, the board has sought more the reproductive health problems and the risks of diseases sexually transmitted. Later, during the period 2016-2020, it has sought to fight

⁶ The gain of life expectancy was about 22 years during 1960-1982 passing from 43 years to 65.3 years, for instance.

⁷ For the Tunisian case, we quote Cochrane and Guilkey, 1995 and Frini and Muller 2012 studies, for instance.

⁸ So far, these statistics have not been updated by the ONFP.

⁹Conference held by the National Family Planning Program (ONFP) with the collaboration of GREQAM, Aix-Marseille University under the topic "The family network and the evolution of fertility in Tunisia. What can the past tell us to better manage the future?" 02 May 2016 Tunisia.

against cancer for women and to give instruction on sex education for children. (2) A behavioral change of the ONFP managers and of its medical staff; they display a contradictory personal motivation with that of the office. Instead of prompting women to resort to birth control devices, they discourage them by using moral and religious arguments. This statement is in line with that of Courbage (2015) that the Islamist movement and the return to religion after the Arab Spring could be a factor of cultural change in favor of fertility increase. However, it is worth noting that this fertility rise has begun well before the revolution of 14 January 2011. Nevertheless, the go back to the religious principles has disrupted the society perception. Thus, the society's values were no longer clear, particularly regard to the fertility regulation and the contraceptives use. (3) A decrease in the ONFP supply of contraceptives devices; there are a frequent shortage in pills, an order decline for IUD (the last order dates from 2016) and delays of the condom's delivery. Thus, this shortfall of fertility regulation awareness and the problem of birth control methods availability have allowed Tunisian woman to feel free to give up her fertility control, as she is no more strongly directed by the ONFP. Thereby, the family model with three children has appeared.

Further, the *increase of marriage* (for more than a decade) could somewhat explain this fertility rise. During 2004-2014, the marriage rate increased from 14.8 percent to 20.1 percent. Hence, a significant decrease has been noted on the celibacy rate, it passed from 42.2 percent to 36.9 percent (46.7 percent to 41.4 percent for man and from 37.9 percent to 32.5 percent for woman). Accordingly, the age at marriage, after a remarkable decline (mainly caused by the legislation and the obligation to attend school), it has recorded since 2005 a stability around 33 years-old for man and 27 years-old for woman.

Also, the *slow education development*, during the post-transition period, has maybe reduced or has made vanish the reducing education effect on fertility. For instance, during 2000-2017 the enrollment rate for female aged 6-11 years-old passed from 97.3 percent to 99.2 percent. However, during demographic transition a significant enrollment rate increase was recorded; it passed from 78.4 percent to 99.2 percent during 1983-2000. Furthermore, the school dropout rate increased to reach 10 percent for primary and by 11 percent for the secondary in 2019 and the illiteracy rate increased to shift from 18.2 percent in 2017 to 19.1 percent in 2019. Given such change, could education ensure its role in the reducing fertility as it is strongly argued by Becker, and as it is corroborated by the previous works, like Frini and Muller (2012) on the Tunisian case?

In addition, Tunisia has experienced an *economic recession*, which is likely to alter the individual behavior and motivation. The economic growth rate has at first weakly declined to shift from 4.7 percent to 3 percent over the 2000-2010 and then by a more pronounced decline to record an average growth rate of 1.7 percent over 2010-2018. According to Becker's theory, parents with high income may desire a greater expenditure per child to obtain better child quality and, therefore, have fewer children. Thus, reversely, the real income per capita decline may had stimulated an increase in children demand, and so explain the fertility rise.

Finally, the *socio-cultural and family changes* caused by the *increase in divorce*, the *family network strengthening*, the *longevity gain*, the *enduring unemployment* and by the go back to religious norms seem had contributed to this phenomenon of fertility rise.

Divorce is seen as one of the social change factors and family modernization (Antoine and Dial, 2003 and Ben Brahim, 2006). In Tunisia, divorce is no longer look down on; its rate has doubled from 0.6 percent to 1.3 percent in the last twenty years (from 1994 to 2014).

Divorce could affect the demographic path by two ways. On the one hand, it puts an end to additional births within the couple thus, the woman's fertility remains inactive. On the other hand, it promotes additional births by the establishment of a new family. Hence, did divorce has contributed to the fertility increase?

Besides, in Tunisia family network dynamic constitutes the base frame of the society. There is a strong importance attributed to family relationship in its traditional forms related to marriage, child care, child rearing, and parent assistance.¹⁰ According to Frini (2014 and 2016) finding's, the family network has favored a revising upward of fertility in Tunisia. Family attendance thanks to their child care and financial supports services may be an explanation of the fertility trend swing towards the rise. The chance of receiving family' child care and familial financial supports services reduces the incompatibility between work and a mother task and reduces the time devoted to childbearing and childrearing. Consequently, it increases the women desire for children and encourages them to intensively participate in the labor market. Besides, the financial family help leads to an income effect on fertility which it increases the children demand. Hence, both the availability and the low-cost of child care services affect women's time preferences and may explain this fertility upward trend.

These family interferences are reinforced by the population aging process. The longevity gain and so the aged (or retirement) period increase intensify the family network dynamic and could be a potential opportunity for childcare when health condition of parents' is good. Moreover, this longevity gain could modify the woman reproductive behavior. When woman having high life expectancy and a good health, she may desire to rejuvenate her couple life by having an additional child at a late age (between 40-49 years). In fact, the births at the age group [40-45] have increased, from 6000 births per year during 2000-2004 to 9196 in 2014.

Additionally, the significant rise of the unemployment rate could have changed the social and family behavior and as well has altered fertility behavior.¹¹ When suffering from enduring

¹⁰Basing on the ONFP's survey (2001) related to such issue, we remark that 90 percent of married couple keep up contacts with family, 26 percent cohabit with family, 48 percent profit form familial financial supports, 13 percent benefit from familial financial wedlock fee, 20 percent receive family childcare, 71 percent of husbands continue to support elderly members after their own family establishment. In addition, family is the essential meeting place of future spouse for 63.5 percent of couples and 42.3 percent marry with first cousins or other kinship. Upon to the ONFP's surveys (1988, 1995, 2001, 2006) data, the family endogamy persists substantial with the same percentage by about 46 % despite a trend toward exogamy in all regions.

¹¹The unemployment rate has switched from 12.5 percent in 2006 to 18.3 percent in 2011 to then stabilized around 15.3 percent during 2014-2018. It is more pronounced for women than man (22.7 percent and 12.5 percent in 2017, respectively). Also, the unemployment rate of higher education graduates' women is high, about 41 percent in 2017, while the women labor force participation is low, estimated to 28.9 percent in 2014 versus

unemployment women (notably the higher educated one) seek to marry and to have children, since their time cost opportunity is low. Furthermore, given the small proportion of the employed female workforce, the rise in income is then mostly explained by the rising in male's income which is positively related to fertility since the male's time is not important for child services production (Becker and Lewis, 1973 and Butz and Ward, 1979). Accordingly, the substitution effect is dominated by an income effect that stimulates demand for an additional child. In Tunisia, unoccupied married women don't have to balance her time value's cost with child opportunity cost, and are, therefore, able to achieve the husband desired number of children. Moreover, the highest unemployment rate by age group, which is recorded to 25-29 years-old, fits to the average age at marriage (27.7 years-old) as well as to the one where woman is biologically more fertile. Hence, the unemployment problem may had played a part of the fertility rise phenomenon.

This review of the factors that have assisted the demographic transition process demonstrates that they are no longer in position to keep fertility at low rate during the post-transition. In fact, we observe a health sector in struggling state, a decrease in contraceptive prevalence, a resumption upward of marriage, a lack of education system development and a slowdown in economic growth, which might have favored the fertility increase.

However, such a descriptive analysis remains simple and insufficient to assert the reliability of our reflections. Henceforth, an econometric analysis is very useful to answer at these questions. Is fertility decision no longer directed by the quantity-quality children trade-off? Is it shaped by the new social changes (as the divorce, the unemployment and the longevity)?

4. Data and method

4.1 Variable specification and data

Basing on the literature review and in light of the Tunisian context previously developed, we revisit the familiar fertility determinants. More accurately, we reexamine those usually introduced by the previous work, namely education, income, mortality and contraceptive prevalence in order to inspect if they do no longer influence fertility downward. Moreover, we look into new factors likely to favor fertility rise. In line with Easterlin approach (Easterlin 1975, 1978, Easterlin, Pollak et al. 1980), we introduce some socio-economic factors such as divorce, unemployment and longevity.

Fertility = f(education, mortality, contraception, income, unemployment, divorce, longevity).

More precisely, we use for our dependent variable the overall fertility rate by region (*fr*).

As a major explanatory variable, we introduce education to re-examine the education-fertility interaction. We check whether the fertility decision is still directed by the quantity-quality children trade-off and whether education still plays its role in reducing fertility, as Becker (1960, 1965) underlined and has been proven by the previous work on Tunisian case (e.g.

22.9 percent in 1994 (Data are quoted from NIS, annual statistics 2011-2016 and a general census of population and housing (RGPH) 1994, and 2014).

Frini and Muller, 2012). Education can also be seen as a proxy for children-devoted time cost to test the time cost hypothesis of Becker and Lewis (1973), which states that an increase in woman time cost increases the opportunity cost of having a child and thus, lowers its demand. As a measure we consider, by region, the woman education enrollment number at primary (*fpe*) and secondary level (*fse*)¹².

The income variable is introduced as an indicator of an individual living standard as well as of an investment capacity in human capital. It may also allow us to test the quantity/quality substitutions, as argued Becker (1960) and Becker and Lewis (1973). However, due to regional data unavailability of per capita gross domestic product, we have brought this indicator closer to the household electricity use at the regional level (*elec*) (defined as a percentage of households having an electrical current connection). Electricity consumption could somewhat reflect about the standard of living as it is an essential factor for improving living conditions.

The mortality rate is estimated in order to verify the demographic transition. However, as the regional child mortality rate is not available, we use the regional mortality rate (*mor*) (defined as the annual deaths per the total population by region).

Like in previous works contraceptive use is also considered to test the effect of birth control on fertility trends and as well to indirectly assess the ONFP functioning and its effort provided for fertility regulation¹³. This may reflect perceptions change, ideas and attitudes toward fertility as well as demographic policy efficiency. Given the lack of the regional rate of the contraceptive prevalence, we use the regional total number of contraception (all kinds) (*c*) used by eligible women (aged 15-49 years-old)¹⁴.

As socio-cultural variables we incorporate, referring to Easterlin's (1969, 1975, and 1978) model, three new variables that are assumed to affect fertility preference and motivation, such divorce, longevity and unemployment. These variables represent our empirical investigation novelty and contribution.

Divorce (*div*) is introduced to find out whether its influence is in favor of fertility rise like in Alesina and Giuliano (2006), Drewianka (2008) and Isen and Stevenson (2010) or in favor of its decline like in Stevenson (2007), Fahn and Rees (2014) and Jafari, Jaafaripooyan et al. (2016). This variable is defined as the number of divorces by region recorded by year.

Longevity measured by the life expectancy at birth (*leb*) is also regarded in our model to check our assumption that it is likely to positively affect fertility behavior and motivation

¹² Due to the lack of regional data, we do not consider the higher education level. We assume that this will not lead a significant problem since the negative interaction between education and fertility was only found as from the secondary level by the majority of the previous empirical work.

¹³ Masih and Masih, 1999, 2000; Narayan and Peng 2006, 2007 and Frini and Muller, 2012.

¹⁴ It is worth noting here that the endogeneity problem is not as much serious in the case of Muslim society study. In Muslim countries as Tunisia, childbearing is only tolerated within marriage. That is, the primary reason for getting married is to have children as argued Frini and Muller (2017). Accordingly, the contraceptive use decision mainly follows that of having child. In this case the contraceptive decision is significantly independent of that of fertility.

through two channels. (1) With high longevity, woman could exploit longer her fertility lifecycle even at its end, without fearing to die at early age, and to be unable to take care of her children. So, she may seek to have an additional child at the end of her fertility lifecycle for reviving her couple life (Bulley and Pepper, 2017). (2) Thanks to longevity gain, couples as well may be encouraged to have large family since they could benefit for their (aging) parents' attendance (if they are in good health) in particular from their childcare service for free (Del Boca 2002, Frini, 2014 and Garcia-Moran and Kuehn, 2017).

Likewise, we introduce the unemployment rate (u) as an explanatory factor of fertility change, like in Amara study's (2015). On the one hand, high and enduring female unemployment, like in Tunisia, may affect their time's value and the child opportunity cost. It is argued to reduce the women's time cost value and that of the child, to favoring an increase in fertility. On the other hand, household wealth is thus mainly formed by the husband's income to favoring the positive wealth effect on fertility.

We use the regional overall unemployment rate. However, we carry out a robust test by estimating a model using the aggregate female unemployment rate (uf) which yields to the same result.

The data used are gathered from the database of the National Institution of Statistics (NIS). The main statistical characteristics of these used variables are summarized in the table 1 below.

Table 1: Descriptive statistics of variables

<i>Variables</i>	<i>fr</i>	<i>c</i>	<i>mor</i>	<i>fpe</i>	<i>fse</i>	<i>elec</i>	<i>u</i>	<i>uf</i>	<i>div</i>	<i>leb</i>
Mean	65.87	57410.95	5.81	66951.86	65713.5	98.59	15.04	20.24	1525.83	74.03
Standard deviation	8.73	21646.3	0.67	22845.7	23463.03	2.69	3.42	3.29	1084.10	0.92
Minimum	46.44	17231.2	4.3	27771	29605	80.4	12.5	15.15	442	72.5
Maximum	83.89	111884	8.2	122269	122810	100	18.3	27.56	4760	75.6
Observation	152	152	152	152	152	152	152	152	152	152

4.2 Econometric methodology

To assess empirically the long-run fertility behavior, we use the panel econometric approach. The temporal dimension refers to the period of fertility increase clearly observed since 2006. However, to better judge this phenomenon, we have taken some hindsight by starting it at the end of demographic transition estimated at 1999. So, the period study is defined over 1999-2017. The individual dimension refers to eight Tunisian regions in reference to the administrative distribution (District of Tunis, North-east, North West, Midwest, Sahel, Sfax, South East and South West)¹⁵.

We apply the econometric method of dynamic GMM. The determination of the GMM estimator depends on the validity of the assumption that the autocorrelated and the validity of

¹⁵ For the Central West region, we have divided it in two regions: the Sahel and Sfax.

the instrumental variables used. To verify the absence of autocorrelation of the error and the validity of the instruments used, Blundell and Bond (1998) propose two essential tests, namely: the Sargan tests. (1) The first concerns the overidentification of the model which tests the validity of the instruments used for the lagged variables. (2) The second is the usual test of absence of autocorrelation of the error, ε_{it} ; where the null hypothesis is the absence of second-order autocorrelation of errors (AR test).

We estimate the equations system with the dynamic one-step GMM method applied to cylindrical data panel.

The model specification is derived mainly from the hypothesis of fertility dynamic behavior ($fr_{i,t}$). Hence, we introduce, like in Yurtseven (2015)'s study, its delayed value by one period as an explanatory variable ($fr_{i,t-1}$). We specify a reference model (model 1) based only on the traditional variables, such as primary and secondary female education ($fpe_{i,t}; fse_{i,t}$), mortality ($mor_{i,t}$), contraceptive prevalence ($c_{i,t}$), and income proxied by electricity consumption ($elec_{i,t}$).

Besides, we estimate another model where we include in addition the unemployment ($u_{i,t}$), the divorce ($div_{i,t}$), and the expectancy of life at birth ($le_{i,t}$). As regional data of life expectancy is not available, we estimate its aggregate form. We assume that there is not a significant gap between regions. However, by statistically caution we alternatively introduce it. Thus, we estimate two other models as formulated below. All variables to estimate are transformed under the logarithm form and preceded by the letter L.

$$Lfr_{i,t} = \alpha_i + \beta_1 Lfr_{i,t-1} + \beta_2 Lmor_{i,t} + \beta_3 Lc_{i,t} + \beta_4 Lfpe_{i,t} + \beta_5 Lfse_{i,t} + \beta_6 Lelec_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$Lfr_{i,t} = \alpha_i + \beta_1 Lfr_{i,t-1} + \beta_2 Lmor_{i,t} + \beta_3 Lc_{i,t} + \beta_4 Lfpe_{i,t} + \beta_5 Lfse_{i,t} + \beta_6 Lelec_{i,t} + \beta_7 Ldiv_{i,t} + \beta_8 Lu_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$Lfr_{i,t} = \alpha_i + \beta_1 Lfr_{i,t-1} + \beta_2 Lmor_{i,t} + \beta_3 Lc_{i,t} + \beta_4 Lfpe_{i,t} + \beta_5 Lfse_{i,t} + \beta_6 Lelec_{i,t} + \beta_7 Ldiv_{i,t} + \beta_8 Lu_{i,t} + \beta_9 Lle_{i,t} + \varepsilon_{i,t} \quad (3)$$

With $i=1,..,N$ and $t=1999,..,T_i$

Where ε_{it} is the error term., i for the region and t for the time.

Before undertaking the estimation, it is necessary to check the absence of multicollinearity problem between explanatory variables. The matrix (Table 2 below) shows that, in general, variables are not correlated.

Table 2: Correlation matrix

	<i>Lfr</i>	<i>Lc</i>	<i>Lmor</i>	<i>Lfpe</i>	<i>Lfse</i>	<i>Lelec</i>	<i>Lu</i>	<i>Lle</i>	<i>Ldiv</i>
<i>Lfr</i>	1								
<i>Lc</i>	-0.408	1							
<i>Lmor</i>	-0.064	0.044	1						
<i>Lfpe</i>	-0.191	0.592	0.024	1					
<i>Lfse</i>	-0.315	0.640	0.000	0.616	1				
<i>Lelec</i>	0.035	-0.158	-0.149	-0.233	0.027	1			
<i>Lu</i>	0.345	-0.350	0.020	0.006	-0.153	-0.077	1		
<i>Lle</i>	0.524	-0.270	-0.032	-0.226	-0.002	0.490	0.191	1	
<i>Ldiv</i>	-0.067	0.363	-0.226	0.615	0.682	0.200	0.061	0.291	1

5. Results and discussion

Results of the GMM estimator system are given in table 3 below. The p-values of the over-identifying restrictions test are rather high to validate our instruments choice. The serial correlation test points out the presence of a one order effect (AR1) and an absence of second order autocorrelation (AR 2).

Table 3: GMM estimates results

Variables	Model 1	Model 2		Model 3
		With regional unemployment rate ($u_{i,t}$)	With aggregate female unemployment rate ($uf_{i,t}$) (Robust test)	
$Lfr_{i,t-1}$	0,945*** (0.247)	0,929*** (0.232)	0.785 (0.285)	0,873*** (0.228)
$Lmor_{i,t}$	0,032 (0.044)	0,041 (0.056)	0.052 (0.031)	0,023 (0.053)
$Lc_{i,t}$	-0,021 (0.015)	-0,013 (0.010)	-0.021 (0.018)	-0,020 (0.017)
$Lfpe_{i,t}$	-0,010 (0.007)	-0,012 (0.011)	0.024 (0.013)	0,014 (0.013)
$Lfse_{i,t}$	-0,014 (0.011)	-0,033 (0.034)	-0.076 (0.035)	-0,057** (0.023)
$Lelec_{i,t}$	0,236** (0.096)	0,195* (0.091)	0.291* (0.137)	0,156* (0.073)
$Ldiv_{i,t}$		0,027** (0.012)	0.023* (0.011)	0,018* (0.009)
$Lu_{i,t}$		0,035** (0.012)		0.56** (0.214)
$Luf_{i,t}$			0.432* (0.212)	
$Lle_{i,t}$			1.364* (0.536)	1,443** (0.418)
Constant	-0,725 (0.529)	-0,365 (0.540)	-0.665** (0.216)	-4,885** (1.612)
Test of Arellano-Bond AR(1) (first order negative correlation)	-2,37**	-2,43**	-2.65**	-2,39**
P-value AR1	0.075	0.062	0.052	0.051
Test of Arellano-Bond AR(2) (Second order correlation)	-0,770	-0,710	0.834	-0,850
P-value AR2	0.701	0.392	0.124	0.491
Statistic of Sargan of overid.restrictions	0,221	0,383	0.323	0,308
P-value of Sargan statistic	0.503	0.309	0.390	0.221
Observations	144	144	144	144

Note: Robust standard errors are in parentheses and *, **, *** denote significant at 10%, 5% and 1% respectively.

Findings, generally, confirm our presumptions since all variables present the expected signs. In line with Yurtseven (2015)'s study (on Muslim countries during the period 2000-2013), a dynamic fertility behavior is highlighted by a positive impact of it delayed value with 1 percent significant level. The past fertility increases the current one. The fertility behavior is affected by the norms and tradition of society as argued Easterlin (1975, 1978). The couple's

preferences or their material aspiration is affected by that of parents (by the previous generation).

Contrary to the theory of the demographic transition but in coherence with Akin results' (2005) on Middle East countries, mortality did not have a significant positive influence. The mortality trend decrease seems no longer alter fertility to be a determinant of children stock. It seems that the mortality stability at low rate secures the couple about their children stock, so they do not longer take account about it in their fertility decision. This fact maybe also related to the use of the overall rate instead of the child one as a mortality indicator.

Similar to OlaOlorun et al. result's (2016) (in Sub-Saharan Africa countries), the contraceptive use does not present a significant impact on fertility. The contraception devices are likely used for birth spacing motive not for reducing fertility. Hence, couple's motivation and fertility preferences have changed. This result highlights the role of aspiration. As Becker (1981) pointed out, the decline of birth does not occur when there is no free desire of fertility regulation, even in presence of family planning program and modern contraceptive methods. Such a result credits our predictions aforementioned that family planning no longer plays its role assigned at its creation (which was namely the awareness and motivation to birth control). Thus, to regain the birth control aspiration, the ONFP should take back its family planning activities.

Against the previous results on Tunisian case found by Frini and Muller (2012) (during the period 1963-2007) and unlike the huge literature on other countries, there is no relation between education and fertility. All the coefficients are insignificant except for the secondary level in model 3. The opportunity cost assumption is not verified. Thus, compared with previous work, education's impact seems has weakened after the demographic transition so that it is unable to reduce fertility. The negative interaction between education and fertility becomes less obvious over the post-transition period. Hence, we could advance that the fertility evolution shift toward the rise is partly due to the lacking of reducing effect of education.

The economic factor reflected by the income variable (proxied by electricity consumption) has, according to the reference model (model 1), a positive effect on fertility. Such result reveals the dominance of the income effect in Tunisia during the period 1999-2017, joining the results found in Tunisia over 1963-2007 by Frini and Muller (2012), in Greece over the period 1960-1996 by Hondroyiannis and Papapetrou (2002), in France after the Second World War by Doliger (2008) in Post-war France and in Japan over 1950-2000 by Narayan and Peng (2007). Given the small proportion of the employed female workforce, as described above, the general rise in income in Tunisia is much explained by a rising in male's income, which positively relates to fertility. This is consistent with the argument of Butz and ward (1979) according to which increases in female wage has a negative effect on births, while male wage is positively related to fertility. Explicitly, the rising of the potential wages is likely to raise the value of time of unemployed females and child cost opportunity, favoring, therefore, substitution of child quality for child quantity in demand. In addition, as male's time is not

important for child services production, this substitution effect is accompanied by an income effect that stimulates demand for an additional child.

However, in Tunisia, unoccupied married women don't have to balance their time value cost and child opportunity cost, and are, therefore, able to achieve the husband desired number of children. Hence, a large unemployed female proportion may lead to higher fertility rate. Indeed, the unemployment rate coefficient is significant and positive in models 2 and 3, which is opposed to the result of the Amara (2015)'s regional study on Tunisia.¹⁶ In addition, for female the highest unemployment rate coincides with her average age of marriage, which corresponds to the most fertile biological age. This unemployment increase seems have not keep the low birth rate, but in contrary encourage the birth increase. Hence, a society characterized with a large unemployed female proportion is likely to present higher fertility rate than other typical western societies (Frini and Muller, 2012).

As well divorce and life expectancy at birth intervene in favour of fertility increase. The positive association of fertility with divorce may be explained by that divorced man or woman seek to remarry and to set a new family by having other children. Thus, when divorce is a rather widespread social act it may lead to the births increase. Such result is in coherence with Alesina and Giuliano (2006), Drewianka (2008) and Isen and Stevenson (2010).

Likewise, with an increasing longevity, women are encouraged to have children. In fact, when living longer, women could take care of their children although they have them at the end of their fertility lifecycle. So, they are motivated by having an additional child at their advanced age for instance to rejuvenating her couple life. Further, the couples are motivated to have more children when parents live more longer with good health. As they can benefit for free of their childcare service and parent's financial assistance, they revise upward their children number desire. Such finding is in coherence with that of Frini (2014 and 2016) that, in Tunisia, fertility is determined not only by women's time cost opportunity but also by the family network, particularly the odds of receiving and/or offering family assistance. More clearly, the odds of benefiting parents' child care and financial support reduce woman time devoted to children and the cost of child care services. Subsequently, it intensifies the desire to have more children or/and to participate intensively in the labour market.

6. Conclusion

After a rapid fertility decline an increasing trend is observed since the mid of 2000s in some Arab countries, like Algeria, Egypt and Tunisia, instead of a downward stability like in the developed countries and in accordance to the demographic transition theory. This paper gives some light at this current demographic issue. Using a dynamic GMM approach, over the post-transition period during 1999-2017 on eight Tunisian regions, it attests that the determinants of fertility decline which are largely accredits by the previous empirical works do not longer play efficiency their role. Interestingly, the negative interaction between education-fertility is no longer obvious. The contraceptive use does not alter children

¹⁶The Amara (2015)'s regional study is based on the fourth round of multiple indicator cluster survey Mics 4 conducted in 2011-2012.

number. The family planning program appears no longer playing its role, assigned at its creation namely the birth control. Moreover, the income effect dominates the substitution one in Tunisia to favoring fertility increase.

However, the most appealing result is that fertility increase is mainly explained by the new socioeconomics variables estimated, the divorce, the unemployment and the longevity. The social and cultural context and familial environment positively affects fertility preferences and the children number desire. The fertility decision seems to be more directed by the family and sociocultural factors than by the classical factors. Fertility behavior seems reply more to Easterlin's approach than to the Becker's approach in Tunisia.

Henceforth, authorities should be more aware of such population evolution. They should revise their population strategy and orientation given this fertility behavior change. They should not only emphasize on economic development as reflected by the education to bring about a change in fertility behavior; a strategy long advocated in the history of Tunisia's demographic policy. Further, to recover the control fertility motivation, the ONFP executives should review the office political orientations and taking back its active role on family planning and fertility control by awareness activities in favor of birth control. Also, they must seek to better disseminated the contraceptive methods device. Likewise, they should better focus on the family institution behavior in order to sustain fertility decline and improve the efficiency of its family planning program. Policy-makers should account more for the extended family when designing family planning programs. For that, fertility surveys should be conducted not only directed toward women, but also towards the husbands and their families. Moreover, media and advertising campaigns for fertility control should be relaunched and should be directed not only to women but as well to men and the family.

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