Article title: Determinants of Fertility Rate: a regression analysis case of Tunisia

Authors: Sassi Mohamed Taher[1]

Affiliations: Master of Science MSc[1]

Orcid ids: 0000-0003-1027-8308[1]

Contact e-mail: sassimohamedtaher@gmail.com

License information: This work has been published open access under Creative Commons Attribution License <http://creativecommons.org/licenses/by/4.0/>, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Conditions, terms of use and publishing policy can be found at <https://www.scienceopen.com/>.

Preprint statement: This article is a preprint and has not been peer-reviewed, under consideration and submitted to ScienceOpen Preprints for open peer review.

DOI: 10.14293/S2199-1006.1.SOR-.PPUOUNE.v1

Preprint first posted online: 31 May 2020

Keywords: Tunisia, Fertility Rates, Determinants, Regression Analysis, socioeconomics, Political Stability

Philipps-Universität Marburg

Fachschaft Wirtschaftswissenschaften

Determinants of Fertility Rate: a regression analysis case of Tunisia

Sassi Mohamed Taher¹

Email: sassimohamedtaher@gmail.com

Abstract

The objective of this paper is to investigate the determinant of the Tunisian fertility rates over the time period from 1960 to 2015. A Multivariate regression model has been used on various socioeconomic variables using a data base collected from World Bank (2015). The result has confirmed the previous output of the literature concerning the negative relationship of Education, Economic Growth, and Urbanization to fertility rates. The new results was that female Employment and Political Stability could also affect the fertility rates negatively. The Male employment variable had a positive relationship with the dependent one. Although many other factors were influencing the lowering rates over time in Tunisia, the main reason for a decrease in fertility rates defined by this paper is the development of the education system after the independence. Expanding women's rights in term of education and employment, the urbanization factor and going from rural to modern women, also had a negative impact on the rates over time, as well as the inclusion of female labor force into the economy. All these significant factors have made Tunisia an exception in the Arab countries that have implemented a policy and tools to birth control. This demographic change resulting in smaller family size might also be one of the indirect reasons that conducted the country to be the first nation starting the Arab Spring through the revolution of January 2011.

Keywords: Tunisia, Fertility Rates, Determinants, Regression Analysis

Introduction

Today earth is occupied by 6.1 billion inhabitants. Demographic transition and fertility rates are two of the most important factors to analyze as population change could influence the future of continents or countries on a large scale. This human capital could also determine the economic growth and the democratic trend of a country.

Tunisia is one of the smallest North African countries covering 163 610 km². It has access to the Mediterranean Sea from the North and East part of its border, which makes her geographic localization strategic to connect the European and African continents. The Capital Tunis and its surrounding area have the highest density in population across the country with a centralized system of administration in the capital as one of the remaining traces from the French colonization. The population in Tunisia according to the Institute of National statistics (INS) in 2015 has reached 11.253.554. The country is divided into 24 governorates. The general climate of the country from the north is characterized by a humid climate and the south is dominated by an arid and dry climate.

Tunisia from an Economic point of view is based on agriculture, manufacturing, service and tourism as main sectors. The annual percentage of GDP per capita growth was -0,112 per cent in 2015 according to the World Bank data source.

Its political system has been through three major political steps after the independence in 1956. The first step was from 1959 until 1987 influenced by Mr. Habib Bourguiba's ideology, which has been reflected into major reforms such as enforcing women's rights by the Personal Status Code and focusing on developing an educational system. The economy at that time was mainly based on agriculture as Mr. Bourguiba was reinforcing that sector. The Bourguiba ruling time was an autocrat regime as he was in power as president almost for life. The second step from 1987 until 2011 was initiated by President Ben Ali who had come to power after a coup against Bourguiba by proving he was too old to rule and to make decisions. That time was influenced by the idea of developing the touristic sector and focusing more effort on security, which deeply affected the population's freedom and the freedom of expression in general. President Ben Ali mainly surrounded himself with his own and his wife's family, thus creating a corrupted system. Concerning women's rights and freedom the Ben Ali regime followed almost the same path as the Bourguiba idea. The autocratic regime conducted by force, the difficult economic situation of the country, the corruption and the high rate of

unemployment among the young generation created an atmosphere of hate and mistrust by the people towards the government which has initiated the third step. Started on January 2011 after a series of violent events and protests against the government and the president all over the country, which rapidly removed the president from power, resulting in him escaping the country. That event has later been called the start of the Arab spring.

After the presentation of the country from an economic, political and modern history point of view, we will try to investigate in this paper the determinant of the fertility rate in Tunisia and try to provide an explanation using analytical and empirical evidence. To start we will go through recent literature and exhibit the main results provided. Secondly we will try to investigate the determinant using an empirical method using data from the World Bank. The last part of this paper will consist of the presentation and discussion of our results and we will then draw a conclusion that might help provide a clear picture about the fertility rate and its determinant to decision makers and outline the demographic transition of the country in the future.

Review of Literature

According to the literature that was investigating the effect of the fertility and its determinant, (Koenraad Matthijs et al. 2016) has mentioned in his book titled "Population Change in Europe, the Middle-East and North Africa: Beyond the Demographic Divide" that a decrease in fertility and smaller family size would accelerate and help the democratic transition in a country. He also highlighted the problem of contraceptive use in Arab and North African countries in relation to the religious and traditional characteristics of these states. As for the case of Tunisia where the system was controlled by two autocrats following the independence, the implementation of women's rights and a birth control policy together with the development of the education system have created conditions for a decline in fertility rates resulting in a population with smaller family units over time. This demographic transition and change of the demographic shape of the country have been stimulants for the coming of the revolution in January 2011.

In 1964 during the time of Bourguiba as man in power a program of family planning has been initiated, which has changed the demographic shape of the country over the time, starting by a fertility rate 6, 94 in 1960 and reaching 2, 13 in 2015 World Bank (2015). Another factor to the decrease of the rates over time was the introduction of the personal status code in 1956, which has organized the family marriage relations by abolition of polygamy. This made

Tunisia an exception within the Arabic countries concerning women's rights and family planning until today.

Nour Chida (2014) has investigated the relationship between the fertility rate and socioeconomic factors in Tunisia using a comparison method and data from the 24 different existing governorates. Her explanation for the change in the fertility rates in Tunisia is the easy access to contraceptive methods for Tunisian women although the study was focusing on the socioeconomic impact of such change and its relation to poverty.

The economic situation of the country could also have affected the fertility rates as well as the contraceptive use and education, these factors could rise or decline the fertility rate since in a difficult economic situation a couple would see that having many children is a burden that will affect their quality of life according to Nour Chida (2014).

The use of contraceptives is a major problem in the Arab and North African world as due to its ethic, religious and traditional characteristics they are either forbidden, not commonly used or tabooed. In this matter Tunisia made the exception, although the data concerning this variable is unavailable due to the difficulty of the subject in a traditional society.

Education could also play a major role in the development of a country's fertility rate, specifically the percentage of educated women as a share in population, because the more women are educated the more their willingness to have many children will decrease following the idea of time investment and the economic implication of life quality.

Another paper by (Olfa Frini and Christophe Muller. 2012) has examined the opposite compared to the previous one by analyzing the impact of fertility and education on the economic growth of a country. A positive effect of rising income on the fertility rate and an intense interaction between education and fertility have been proven, especially for the long term.

Furthermore fertility rates convergence has been investigated starting from the fact that in many countries fertility rates have been declining to reach almost one child per woman. This decrease could be explained not only by socioeconomic factors and education, but also by the birth control program starting in the 1960s, the mass media effort and easy access to contraceptive methods, which all have direct and indirect effect on the lowering rate of fertility in many countries. (Tiloka de Silva and Silvana Tenreyroa .2016)

Using co-integration analysis (Marc Audi and Amjad Ali .2016) have investigated a causal relationship between socioeconomic factors, such as urbanization, education and per capita

income on the fertility rate in Tunisia. This study has demonstrated that female education and urbanization have a significant negative relationship with the fertility rate in Tunisia in the long run and that per capita income has a significant positive relationship. To verify the results a variance decomposition method was used. The panel data used dated from 1971 to 2014 for the case of Tunisia. The main results were that social and economic factors are the key to explain changes in fertility rates.

Dierk Herzer et al. (2011) has analyzed the long run determinant of fertility using three main factors, which are mortality rates, fertility rates and income. The data was used for selected countries where it was steadily available for a 100 years. The most significant result was that demographic transition in many countries was conducted by a low mortality rate and growth of income. Low mortality rate due to the devolvement of the health system and technological progress and the economic situation are the main variables that have influenced population growth and fertility rates in different countries.

A research conducted in over 74 countries for the period from 1995 to 2000 by the Department of Economic and Social Affairs (United Nations) in 2015 using descriptive statistics and data collected from United Nations database was looking at the decline of fertility levels over time and reasons behind it. The first reason stated is an increase of the marriage age due to the change in the economic conditions, as late marriage would affect fertility negatively. The second one is the contraceptive use and the development of its methods over time. Other factors were education and urbanization. More educated women would consider investing time in children and its impact on their quality of life similar to the concept of male education, which has implemented the idea of having less children means less life expenses. Urbanization also has a deep impact on fertility rates because the more people migrate to the city looking for work and better economic situation the more their ideology about time will change which will affect the fertility rate negatively. The transition from rural women into urban women would also have an impact on the women's way of thinking as well as better access to contraceptive methods.

Mina Baliaoune-Lutz. (2016) has examined the relationship of fertility and devolvement in North African countries as well. This study has shown that high fertility rates correlate with a high unemployment rate, and that the economic situation of such a country will be difficult. The case of Algeria was also discussed as an economy relying on natural resources and underuse of human capital that is available which will create more unemployment among young generation and lead to more instability.

To explain the change of fertility rates we could also use Becker's theory published in 1973, which reflected marriage and the effect of working women on the society. In this theory Becker professes that fertility rates could be strongly influenced in a society with a higher percentage of women working is higher as this would lead to less time for women to be home. On top women would develop the preference of investing time on their work rather than being a homemaker and taking care of children to improve the economic situation of the family

Data and Methodology

Our Data selection process was based on some on the previous literature. With the difficulties of finding a continuous data set for Tunisia we have tried to add some descriptive analysis with the empirical ones to include more variables in our result. The data was collected from the World Bank data set covering the period of time from 1960 until 2015. Some variables were not available for some years. Accordingly we chose to do a multivariate regression analysis to investigate the relationship between the independent variables with its dependent variable the fertility rate.

The data can be presented as follows (World Bank.2015):

Employment to population ratio, 15+, female (%): Employment to population ratio is the proportion of a country's population that is employed. Employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit. Ages 15 and older are generally considered the working-age population. This variable was available on the World Bank data set collected from 1991 until 2015 using a weighted average method (ILO estimate). We chose this variable because it might reflect how women's employment could affect the fertility rate in a country. This variable is represented as (EmpFem) in the database and the result.

Employment to population ratio, 15+, male (%): Employment to population ratio is the proportion of a country's population that is employed. Employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit. Ages 15 and older are generally considered the working-age population. This variable was also available on the World Bank data set from 1991 until 2015 collected using a weighted average method (ILO estimate). We choose this variable because it might reflect how the economic situation of males could affect the marriage decision and its relationship with fertility, as traditionally in the North African

countries a man should be in charge of his family. It is represented as (EmpMal) in the database and the result.

Political stability and absence of violence: This is one of the Worldwide Governance Indicators (WGI) and it ranges from approximately -2.5 (weak) to 2.5 (strong) governance performance. We chose this variable to see its impact on the fertility rate in Tunisia. The factor is presented as (PS).

GDP per capita (current US\$): GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies, which are not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data is listed in current U.S. dollars. This variable was chosen to reflect the economic factor that could influence our dependent variable. It is represented as (GDPc) in the database and the results.

Total number of students in the secondary cycle of basic education: this variable has been chosen to reflect the education in our analysis. We chose the number of students enrolled in the secondary level as at this educational level in Tunisia students will be able to write, speak and express themselves in a more scientific way than the primary one. This variable is represented as (Education) in the database and the results.

Fertility rate, total (births per woman): The total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year. This variable was available for the whole selected time period and has been chosen as a dependent variable. It is represented in the model and the database as (Fer).

Year: this variable is reflecting the period of time from 1960 till 2015 in Tunisia represented in the model and the database as (Year).

Urban population: Urban population refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects. The choice of this variable was based on analyzing the effect of urbanization and the change from rural to modern women's and style of life on the dependent variable. It is represented as (Urban) in the database and the result.

Table 1: Statistical description of the data set

Variable	Obs	Mean	Std. Dev.	Min	Max
Fer	56	4.214714	1.962358	1.998	7.015
Education	36	742505.6	270828.8	275133	1088816
GDPc	51	1879.504	1311.397	218.036	4309.78
PS	17	-.1183154	.4446833	-.9306826	.3036289
EmpFem	25	18.56876	1.158805	16.386	20.227
EmpMal	25	62.44664	1.851218	59.879	66.226
Urban	56	4410669	1969068	1566559	7522101

Stata software using the collected data base

The table above summarizes the data used in our regression model. It shows that the fertility rate in Tunisia over the selected time period of 56 years has an average of 4.2 children per woman with a variance of almost 4. The variable Education shows that the average number of students enrolled in a secondary level is almost 750000 during the period of 36 years, while the maximum number of students reaches 109000. The average GDP per capita during 51 years is 1879, 5 US\$. For the political stability indicator the maximum reach by Tunisia during the 17 years of available data was 0, 3 with a minimum of -0, 9. Knowing that this indicator range between -2, 5 to 2, 5 we could assume that Tunisia has a moderated average around zero comparing to the other countries that went through the Arab Spring movement. The female employment factor has an average of 18, 5%, which is quite high comparing to other Arab countries but still under the male percentage, which has an average of 62 %. The urbanization variable which refers to the number of people living in urban areas has a mean of 4, 5 million reaching a maximum of 7, 5 million and a minimum of 1, 5 million during the 56 years study period. Using this dataset we will use a multivariate regression model to examine the relationship between the dependent and independent variables.

Results and discussion

In this part of the paper we will start by presenting the results of the descriptive analysis followed by the empirical one.

World Bank, Tunisia 2015

Figure 1: fertility rates in Tunisia from 1960 to 2015

Figure 1 above presents the fertility rates (births per woman) in Tunisia from 1960 until 2015. A decrease in the fertility rates over this period of time is obvious starting from 7 births per woman in 1960 and reaching the level of almost 2 births in 2015. The descriptive analysis has shown that this decrease in the fertility rates is a resulting process of many changes influenced also by specific factors. Some factors that have affected the change in the rates of fertility in Tunisia will be investigated in the upcoming parts of the paper.

World bank, Tunisia 2015

Figure 2: Contraceptive use in Tunisia from 1978 to 2000

Figure 2 shows the development of the percentage of women using contraceptive methods to control births in Tunisia. The percentage has been increasing during the past years going from 30% in 1978 to almost 65% in 2000. This variable was excluded from the regression analysis due to the insufficiency of the data available. The increase in percentage of women using contraceptive methods could be mainly explained as mentioned above by the launch of the

program of family planning in 1960. The use of such methods has had a significant impact on reducing the fertility rates in Tunisia over the last years.

After regressing the dependent variable (Fertility rate) on the independent selected variables from 1960 until 2015 in Tunisia, we get the following results as shown in the figure below.

Source	SS	df	MS	Number of obs = 17		
Model	.23688299	7	.033840427	F(7, 9) = 188.87		
Residual	.00161254	9	.000179171	Prob > F = 0.0000		
Total	.238495529	16	.014905971	R-squared = 0.9932		
				Adj R-squared = 0.9880		
				Root MSE = .01339		

Fer	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
year	.1405933	.0314239	4.47	0.002	.0695075	.2116791
Education	-7.33e-07	1.39e-07	-5.28	0.001	-1.05e-06	-4.19e-07
GDPc	-.000005	.0000221	-2.27	0.050	-.0001	-6.56e-08
PS	-.085252	.0279085	-3.05	0.014	-.1483853	-.0221187
EmpFem	-.0155316	.0086624	-1.79	0.107	-.0351274	.0040642
EmpMal	.020405	.0078749	2.59	0.029	.0025907	.0382193
Urban	-1.60e-06	3.20e-07	-5.00	0.001	-2.32e-06	-8.75e-07
_cons	-269.3334	60.83553	-4.43	0.002	-406.9529	-131.7139

Figure 3: Stata output of the regression analysis

The results show that the variables Education, GDP per capita, Political stability, and urbanization are significant at a level of 5% and they have a negative relationship to the dependent variable fertility rates. This could be explained by the fact that as education levels increase the fertility rates will decrease and vice versa, so the more educated people live in a society the more the fertility rates will be affected negatively. The GDP per capita has a negative relationship to the fertility rates as well, as with an increase in the GDP and the economic conditions getting better the fertility rates will decrease. The political stability of the country is negatively affecting the fertility rate, too. Lastly also the variable urbanization meaning the growth of urban area and more people migrating to the cities looking for work and better life has a negative relationship with the dependent variable as the more modern and urban the peoples' lifestyle gets the more the fertility rates will decrease.

The variable employment male is significant at the level of 5% and has a positive sign which means that the more employment for the male gender the more the fertility will increase. So as a husband has a job and a stable income his willingness to have children will increase.

For the employment female variable we can see a negative relationship with the dependent variable and significance at the level of 10%. So we could say the more women are employed

the more the fertility rates will decrease as the ideology and the time conditions experienced by these women will change respectively after being engaged in a job.

The functional form of the model:

$$Fer = \alpha + \beta_1 year + \beta_2 Education + \beta_3 GDPc + \beta_4 PS + \beta_5 EmpFem + \beta_6 EmpMal + \beta_7 Urban + \mu$$

Where: α = Constant and μ = Error Term

We have applied both tests of Normality and Heteroscedasticity for the regression model.

Using the Jarque-Bera test for Normality we get a result that shows, we cannot reject the null hypothesis so the error terms are normally distributed at a significance level of 5%. We have also checked our result graphically. As the variance in the residuals has to be homoscedastic or constant we have also used the Breusch-Pagan test for Heteroscedasticity. This test also resulted in accepting H_0 with a constant variance, so Homoscedasticity is verified at the same level of significance at 5%.

There are still other factors that should be taken into consideration when analyzing the determinant of the fertility rates in Tunisia. The family planning program started in 1960 with familiarizing contraceptive methods and securing more women's rights by the Personal Status Code of 1956 and especially the abolition of polygamy. All these factors have played a major role to conduct Tunisia to low fertility rates.

Conclusion

Fertility rates are one of the most important factors to be analyzed in country scale. The explication of its determinant could help the decision makers of a country to implement the best policies in the economic, social and political sectors. In the case of Tunisia's fertility rates are determined by various factors as our investigation has shown. These determinants are better Education, female employment, economic growth and more urbanization and political stability. The other determinant that affect fertility positively is the male employment factor. Controlling births in a country could help avoid many problems such as unemployment as presented in the paper of (Mina Balamoune-Lutz. 2016). Also low fertility rates could be a factor to catalyze democracy in a country as discussed in the book of (Koenraad Matthijs et al. 2016). Controlling fertility rates must also be a moderate one taking into consideration the future situation of the country in the demographic transition, the food demand and the other economic levels.

References

- Dierk Herzer, Holger Strulik, Sebastian Vollmer, 2010. *The Long-Run Determinants of Fertility: One Century of Demographic Change 1900-1999*. PROGRAM ON THE GLOBAL DEMOGRAPHY OF AGING, Harvard University, PGDA Working Paper No. 63
- Gary S. Becker, 1974. *Economics of the Family: Marriage, Children, and Human Capital: A Theory of Marriage*, pp. 299 – 351. University of Chicago Press 0-226-74085-4
- Koenraad Matthijs, Karel Neels, Christiane Timmerman, Jacques Haers, 2016. *Population Change in Europe, the Middle-East and North Africa: Beyond the Demographic Divide*, pp. 218-221.
- Marc Audi and Amjad Ali, 2016. *A Causality and Co-integration Analysis of Some Selected Socio-Economic Determinants of Fertility: Empirics from Tunisia*. Centre d'Economie de la Sorbonne Universite Paris 1; AZM University Business Faculty, Department of Economics, University of the Punjab, Lahore. MPRA Paper No. 72006
- Mina Balamoune-Lutz, 2016. *Fertility and Development: Evidence from North Africa*. University of North Florida
- National Institute of Statistics (INS), 2015. Statistics Tunisia
- Nour Chida, 2014. *Association Between Fertility Rates and Socioeconomic Status in Tunisia*. University of Washington Master Thesis
- Olfa Frini, Christophe Muller, 2012. *Demographic transition, education and economic growth in Tunisia*. Economic Systems 36 (2012) 351–371
- Tiloka de Silva and Silvana Tenreyro, 2016. *Population Policies and Fertility Convergence*. London School of Economics, CfM, CEP, CEPR
- United Nations, 2013. *FERTILITY LEVELS AND TRENDS IN COUNTRIES WITH INTERMEDIATE LEVELS OF FERTILITY*. Population Division, Department of Economic and Social Affairs, United Nations Secretariat.
- World Bank, 2015. World Development Indicators. Tunisia