ISSN :2550-1429 Volume 3, (1) June 2018

An Econometric Analysis of the Determinants of Fertility: International Evidence

Wun Kim Yen, Ratneswary Rasiah, Jason James Turner

Taylor's Business School, Taylor's University, Malaysia

***Abstract* — This study aims to analyse the socio and macroeconomic determinants of fertility in 108 countries across the globe. Focusing on the variables of inflation, income, education level and urbanization, this study employs the cross-sectional econometrics technique of Ordinary Least Squares to analyse the causal relationship between these variables and fertility. The empirical results reveal a significant and negative relationship between income and fertility in the overall model of the 108 countries, as well as in the models involving developing countries, and countries in the African, American and Asian regions. Education was found to also have a significant and negative relationship with fertility in the overall model and the developing countries. Urbanisation, on the other hand, was found to have a significant and positive relationship with fertility in the overall model, developing countries and in countries in the African and Asian regions. Inflation was the only predictor found to be not significant in all the models. As far as the least developed countries, developed countries and the countries in the European region were concerned, none of the independent variables were significant predictors of fertility. The study concludes with an examination of policy implications of the findings**

Keywords *– Education, Fertility, inflation, Income, Urbanisation*

ARTICLE INFO

Received 1 April 2018
Received in revised form 5 June 2018
Accepted 12 June 2018
Published 30 June 2018

I. Introduction

The United States experienced the steepest fertility drop in its history during 2016, which catalysed the U.S. to experience a baby crisis (Centers for Disease Control and Prevention, 2017; Hamilton et al., 2017). The overall declining fertility rate has become a concern not only for the U.S., but also globally because the birth rate was deemed insufficient to replace an aging labour force, a trend which could directly affect the long term economic stability of a number of countries worldwide. As reported by the United Nations (2015), while global fertility was high during the 1990s, almost 46% of the global population is currently facing low fertility rates of below the 2.1 replacement level.

As of 2015, only 8% of the world's population is categorised in countries with high fertility of five children per woman on average. Europe, Northern America and Asia are labeled as the new low-fertility countries. Notably, only Europe was in the top ten lowest fertility lists during the 1970s, but between 1990 and 1995, three Asian countries, including Japan, Macau and Hong Kong appeared in the lowest fertility list, with Hong Kong topping the list with only 1.2 fertility rate in 1995 (The World Bank, 2017). The number of Asian countries considered as having low fertility rates continues to grow and now they dominate the top five positions of the lowest fertility countries between 2010 and 2015. During this period, Taiwan climbed to the top spot of the list, followed by Macau, Hong Kong, Singapore and Republic of Korea (The World Bank, 2017).

In 2015, the lowest global fertility rate was in Europe with only 1.6 children per woman, with the highest fertility of 4.7 children per woman in Africa. However, even in Africa it is also expected to face a fertility reduction in the future, with anticipated figures of 3.9 children per woman by 2030 and 3.1 children per woman by 2050 (United Nations, 2015). Global fertility is expected to depress further in the future, with the United Nations (2015) estimating that fertility would be reduced to 2.4 children per woman by 2030 and 2.2 children per woman by 2050. The expected decline in global fertility rates in the future will translate into lower levels of future replacement labour, and as the current workforce slowly enters their retirement age, this will lead to severe consequences for the economy and society. The World Bank (2017) has reported that the overall population of the age group 0-14, which was 38% of the total population in 1966, has slumped to 26.064% in 2016. This is in contrast to the increases in the population of the over 65-age group which was circa 5% of the total population in the 1960s, but has increased to 8.482% in 2016. This trend denotes the seriousness of the insufficient current and future labour replacement.

To address the current fertility issue, this paper aims to study the determinants of fertility to address two key research questions:

- What are the socio and macroeconomic determinants of fertility?
- How do these factors affect fertility, in terms of magnitude and direction?

These questions will address current gaps in the literature surrounding the antecedents of fertility, their impact on the global economy and the implications for the future workforce.

II. Literature Review

The notable fertility model established by Becker (1960) is used as the basis of this study. Becker (1981) proposed that a high housing price increases parents' total expenditure, which then implies a negative income effect on parents' demand for children. Several studies (Sato, 2006; Pan and Xu, 2012; Clark, 2012; Dettling and Kearney, 2014) had used housing price as a proxy for inflation. According to Pan and Xu (2012), housing price affects fertility decisions through 'housing price constraint' whereby buying a house and raising a child incur costs, thus, when parents allocate income between the two, the high inflation of house prices will squeeze out the expenditure on childbearing (Asmare, 2010; Clark, 2012; Dettling and Kearney, 2014). This indicates that inflation plays a strong role in fertility and has a negative relationship on demand for children (Marshall, 1920; Sato, 2006). However, Simon and Tamura (2008) conclude that housing prices and the size of the houses had a relatively minor negative impact on fertility in the United States for the period of 1940 to 2000. Although high inflation may reduce fertility due to the increase in the cost of living, Abo-Zaid (2015), conversely, claims that high inflation that is driven by demand signifies an expansion in the economy, with a possible increase in fertility rates. Mckelvey, Thomas and Frankenberg (2012) also conclude that there is no significant relationship between contraceptives,' inflation and fertility.

According to Becker's (1960) quantity-quality tradeoff model, parents' utility comes either from a higher number of children or better wellbeing of each child. A rise in both quantity and quality of children is induced by higher income, but the elasticity of quality is larger than that of quantity, thus, indicating that a rise in income discourages fertility (Becker and Lewis, 1973; Willis, 1973). Based on the cost of time analysis by Mincer (1963) and Becker (1965), as income increases the cost of time also increases, explaining the inverse relationship between income and fertility. As parents' wages improve, it will be tougher for them to take time out from their work to rationalise home formation (Asmare, 2010; Vitali and Billari, 2015; Basso, 2015). Conversely, Shapiro and Gebreselassie (2013) find that the higher the income in sub-Saharan Africa, the slower the decline in fertility rates, revealing a positive relationship between income and fertility rates. This result suggests that declining and delaying fertility is very much determined by socioeconomic factors (Bongaarts, 2008). Lee and Ng (2012) also show that income positively affects fertility in their study using data on Singapore, though it is only a temporary effect in the short-run, whereby tax increment can reduce fertility, while tax reductions appear to have no effect on fertility.

As discussed in the previous section, the determinants of fertility are both complex and inter-dependent, with a degree of case and effect where the influence of certain antecedents are symptomatic of the changes in other antecedents. As education enhances a woman's job opportunities and labour market involvement, the opportunity cost of time-intensive activities will be increased, hence, affecting fertility decisions (Schultz, 1973; Becker, 1981). In contrast to the less-educated parents' perception that view children as a source of social status, the increase in opportunity cost of time among highly educated women may lead to a reduction in fertility (Willis, 1973; Asmare, 2010; Lee and Ng, 2012; Shapiro and Gebreselassie, 2013; Basso, 2015). Khraif et al. (2017) suggest that as education levels get higher, the age of marriage is more likely to increase too, indirectly leading to a reduction in fertility. In contrast, McCrary and Royer (2011) conclude that women in the United

States are not affected by the school entry policies and will still get pregnant around the same age, thereby indicating that education levels do not have a significant relationship upon fertility decisions.

Becker (1981), Becker and Barro (1988) explain that when parents are facing time and money constraints, fertility will fall as explained by the quantity-quality tradeoff model whereby parents prefer fewer children (less quantity) and invest more in their children's wellbeing (quality). The general consensus based on the empirical studies thus far (White et al., 2008; Guo et al., 2012; Kamaruddin, 2016), have revealed urbanisation to have a negative association with fertility rate. The cost of bringing up children is higher in urban areas, as costs of living in urban areas are much higher than in rural areas. Urbanisation has also witnessed increases in house prices, as well as improvements in birth control techniques (White et al., 2008; Guo et al., 2012). Caldwell's Theory of Wealth Flow (1976), suggests that fertility can be increased in developing countries, as modernisation takes place. Asmare (2010) found urban population growth to have a positive relationship with fertility in East Africa. However, Hirschman (1994) pointed out that the role of socioeconomic development is over-emphasised by various fertility theories in explaining fertility transition. The European Fertility Project by Coale and Watkins (1986) suggests that economic factors have a minor impact on fertility changes in Western countries, while Murphy (2010) found urbanisation to have an ambiguous impact on fertility, depending on the intensity of skilled jobs in developing countries, as cited by Gries and Grundmann (2015). In Tadesse and Headey's (2011) study, it is concluded that urbanisation (in terms of access to the nearest health center) is insignificantly related to fertility in Ethiopia. Tadesse and Headey (2011) also argued that religious beliefs, child mortality rate and the type of occupations available varies when urbanisation takes place, and it is these factors that affect fertility.

The review of literature thus far on the economic determinants of fertility, reflect the existence of gaps in the literature. The contradictory findings in various empirical studies reviewed reveal confusion spotting gaps, where "some kind of confusion in existing literature" (Sandberg and Alvesson, 2011; p. 29) exist. This study therefore contributes to the body of literature on the role of inflation, income, education and urbanisation in explaining fertility.

III. Methodology and Data

The objective of this study focuses on the relationship between fertility and its chosen explanatory variables comprising of inflation, income, education, and urbanisation, in 108 countries in the year 2012. The cross-sectional data was obtained from the World Development Indicator of World Bank. The data from the year 2012 was chosen as it had a complete data set for 108 countries. This was not the case for the more current datasets (2015, 2016 and 2017) which was incomplete, especially as far as education data was concerned. As this study required a large cross-sectional dataset in order to segment the countries by economic progress and by regions, the authors decided to use the 2012 dataset which was complete, to fulfill the aims of this study.

The data was transformed using natural logarithms, as it was useful to find out the impact of the variables (in different unit of measurements) in percentage form. Hence, all the data collected in this study underwent natural log transformation to help determine how responsive fertility is towards changes in inflation, income, education level, as well as urbanisation. Natural log transformation of data also helps in linearising exponential trends of non-linear models (Asteriou and Hall, 2007). The logged data is then used to run a regression analysis using Ordinary Least Squares (OLS) technique using the EViews software. OLS is an econometric technique that minimises the sum of squares of residuals, which is useful to estimate a best-fitted regression model by having a line of best fit that is closest to the actual data. By using the OLS technique, and by following the United Nation Statistics Division's (2017) grouping of countries, this study's analysis are based on three groupings, which are overall countries, economic progress (least-developed, developing and developed countries) and regions (African, American, Asian and European regions) to compare each category's fertility trend in the year 2012.

This study carried out several crucial diagnostic tests to ensure that the data did not violate the Classical Linear Regression Model (CLRM) assumptions, as violations of any of these assumptions will deem the results yielded by a regression model as spurious or misleading. The diagnostic tests of serial correlation, heteroskedasticity and multicollinearity were conducted to confirm that the data did not contain unusual characteristics that could possibly affect the results (Cook and Weisberg, 1983). To check for serial correlation and heteroskedasticity problems, the Chi-Square p-value of Obs*R-squared for both Breusch-Godfrey Serial Correlation LM Test and Breusch-Pagan-Godfrey Heteroskedasticity Test are analysed. In addition, the centered Variance Inflation Factors (VIF) are analysed to check for multicollinearity. Finally, in the regression analyses of the study, the R^2 value determines the overall fitness of the model (Asteriou and Hall, 2007), whereby it describes the total variation in fertility that can be explained by the explanatory variables. OLS is particularly sensitive towards outliers, thus, given that this study covers a large sample of data, the extreme data of certain countries can affect the accuracy of OLS results. Besides that, OLS also assumes that the explanatory variables are not correlated with each other, in which serial correlation and multicollinearity are absent in the model.

However, in reality, the variables will somehow influence each other in the long run, causing the reduced accuracy of results (Studenmund, 2013). In addition, for a research to be well acknowledged, all the explanatory variables have to be included to improve the accuracy of results. Apart from the variables considered in the study, there may be other variables that have significant impact on fertility, which may vary the results. Some of the data may also not be found for certain countries (again underlining why this study selected 2012 data to ensure completeness of the data), which can affect the results. Moreover, when data for certain proxy variables are unavailable, the alternative indicators used for the variables may not best describe the variables, thus affecting the desired findings. As ***p***-values are analysed in this study to assess the existence of relationships between the explanatory variables and the dependent variable, it is important to be aware of its limitations that it does not take into consideration the validity of theories. The ***p***-value is only limited and applicable for the sample and not the entire population (Greene, 2011).

IV. Model Specification and Variable Definitions

Lee and Ng (2012), as well as Masih and Masih's (2000) time-series models are adopted and adapted into this cross-sectional study in order to capture the impact of inflation, income, education level and urbanisation on fertility, hence, the double-log model specification for this study is presented as follows:

$$LFERTi = \beta 0 + \beta 1LINFi + \beta 2LRGDPi + \beta 3LEDUi + \beta 4LURBi + \varepsilon i \quad (1)$$

where i indicates the cross-country indicator; LN denotes the natural logarithm; FERT indicates total fertility rate (births per woman) that is a proxy for fertility; INF indicates inflation rate (GDP Deflator); RGDP indicates GDP per capita (constant 2010 US$) that is a proxy for income; EDU indicates secondary education (general pupils) that is a proxy for education level; URB indicates urbanisation that is proxied by urban population growth (annual %); β0 is the constant; β1 , β2 , β3 , and β4 are the coefficients of explanatory variables; and ε signifies the error term. According to Asmare's (2010) study, inflation rate and urban population growth are in annual percentage, with secondary education in terms of general pupils. Following Lee and Ng (2012), income is proxied by GDP per capita, which is in constant 2010 US$ and total fertility rate is in births per woman. The constant term is used for GDP because it has been adjusted for inflation.

V. Results and Discussion

Prior to discussing the main estimation of the fertility model, this study will initially run some diagnostic tests to ascertain the basic features of the data. The diagnostic tests (serial correlation, heteroskedasticity and multicollinearity) are analysed for the overall model with the results as shown in Table 1.

Table 1: Diagnostic Tests' Results

Diagnostic Tests		
Breusch-Godfrey Serial Correlation LM Test		0.088
Breusch-Pagan-Godfrey Heteroskedasticity Test		0.385
Centered Variance Inflation Factor	LNINF:	1.207
	LNRGDP:	1.36
	LNEDU:	1.123
	LNURB:	1.188

Note: The values stated for serial correlation and heteroskedasticity tests represent Prob. Chi-Square of Obs*R-squared.

The serial correlation diagnostic test was carried out using the Breusch-Godfrey Serial Correlation LM Test and the results in Table 1 indicate that there is no serial correlation. The absence of serial correlation is expected as this study is based on cross-sectional data. The Breusch-Pagan-Godfrey Heteroskedasticity Test reveals the existence of homoskedastic residuals. Since serial correlation and heteroskedasticity do not exist in the overall model, the OLS estimators are the best, linear and unbiased estimators (BLUE). Based on the Centered Variance Inflation Factor (VIF) for the explanatory variables in Table 1, the problem of multicollinearity does not exist, as the VIF values are all below 5. As the overall diagnostic tests prove that there is no serial correlation, heteroskedasticity and multicollinearity in the overall model for the 108 countries being analysed, the OLS estimators are proven to be the best, linear and unbiased estimators. Since the diagnostic tests have confirmed that the OLS estimators are BLUE, further empirical exploration using the OLS regression can be carried out to confirm or reject the existence of relationships between the explanatory variables and the dependent variable, fertility.

The results in Table 2 reveal that all the predictor variables have a statistically significant impact on fertility, except for inflation, with income being the most significant.

Table 2: Ordinary Least Squares Regression Results (Overall Model)

Variable	**Model 1 Overall**	
	Coefficient	**Prob.**
C	2.751	
LNINF	0.013	0.696
LNRGDP	-0.165	0.000***
LNEDU	-0.036	0.043**
LNURB	0.146	0.000***
R-squared	0.704	
Prob(F-statistic)	0.000***	

Note:***, ** and * refer to significance at 1%, 5% and 10% in rejecting null hypothesis, respectively.

The negative relationship between income and fertility is inconsistent with Becker and Lewis' (1973) quantity-quality tradeoff model. The studies of Asmare (2010), Vitali and Billari (2015) and Basso (2015) however support this study's negative income-fertility findings. In addition, urbanization has the second largest impact on fertility, with a positive relationship whereby fertility levels increase, as urbanisation takes place. This is inconsistent with the Caldwell Theory of Wealth Flow (1976), as well as the study performed by Asmare (2010). Education has the least significant impact on fertility, whereby a 1% increase in education level will lead to a 0.036% fall in fertility, while holding other variables constant. The negative relationship between education and fertility is supported by the opportunity cost of time (Schultz, 1973; Becker, 1981), whereby parents with higher education prioritise career over family formation, and is consistent with previous studies (Asmare, 2010; Lee and Ng, 2012; Shapiro and Gebreselassie, 2013; Basso, 2015; Khraif et al., 2017). Inflation is the only explanatory variable that does not have a significant effect on fertility, consistent with the findings of Mckelvey, Thomas and Frankenberg (2012). The R^2 value of the overall model for 108 countries in year 2012 is 0.704, indicating that 70.4% of the variation in fertility can be explained by income, education and urbanisation, with only 29.6% variation in fertility being explained by other variables outside the model. The R^2 value suggests that the overall model is of good fit.

Table 3 shows the results from analysing data of various sub-groups of countries based on their economic progress (least developed, developing and developed countries).

Table 3: Ordinary Least Squares Regression Results (by Economic Progress)

Variable	Model 2 Least Developed		Model 3 Developing		Model 4 Developed	
	Coefficient	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
C	4.967		3.041		0.461	
LNINF	0.167	0.294	0.050	0.2987	-0.017	0.603
LNRGDP	-0.138	0.684	-0.186	0.0000***	0.016	0.662
LNEDU	-0.263	0.135	-0.053	0.0379**	-0.006	0.724
LNURB	0.680	0.331	0.209	0.0013***	0.041	0.132
R-squared	0.703		0.613		0.214	
Prob (F-statistic)	0.333		0.000***		0.237	

Note:***, ** and * refer to significance at 1%, 5% and 10% in rejecting null hypothesis, respectively.

For the least developed countries as shown in Model 2, all four predictor variables are statistically insignificant in predicting fertility for year 2012. Hirschman (1994) supports the insignificance of the least developed model, whereby the role of socioeconomic development is over emphasised in explaining fertility transition. In Model 3, income, education and urbanisation have statistically significant impact on fertility. Urbanisation has the largest impact on fertility in Model 3, whereby a 1% increase in urbanisation leads to a 0.209% increase in fertility, while holding other variables constant. This finding supports Caldwell's (1976) hypothesis and the study performed by Asmare (2010), in which urbanisation stimulates fertility in developing nations. Income has the second largest impact on fertility in developing nations, whereby a 1% increase in income leads to a 0.186% fall in fertility, holding other variables constant, which further confirms the quantity-quality tradeoff models by Becker and Lewis (1973), whereby quality of children is preferred over quantity as income increases. This is followed by education, whereby a 1% increase in education leads to a 0.053% fall in fertility, while holding other variables constant. This result supports the findings of Willis (1973), whereby the higher opportunity cost of time among higher educated women discourages fertility. Model 3 does not have any significant predictors, which is inconsistent with the results of Tadesse and Headey (2011) because the rural population in developed countries has the same access to health facilities as urban areas, thus the difference in urban and rural areas is almost indistinguishable and is perhaps rather irrelevant in affecting fertility in developed countries. Among the three models, excluding the insignificant results of Model 2 and Model 4, Model 3 has the highest R^2 value of 0.613, indicating that 61.269% variation in fertility can be explained by income, education and urbanisation.

Table 4 shows the results from analyzing data of various sub-groups of countries by region Africa, America, Asia and Europe).

Table 4: Ordinary Least Squares Regression Results (by Region)

Variable	Model 5 Africa		Model 6 America		Model 7 Asia		Model 8 Europe	
	Coefficient	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
C	3.381		1.754		2.486		0.585	
LNINF	0.07	0.122	0.075	0.178	-0.001	0.9892	-0.020	0.558
LNRGDP	-0.225	0.0001***	-0.133	0.017**	-0.137	0.0137**	0.012	0.753
LNEDU	-0.054	0.11	0.005	0.870	-0.045	0.3777	-0.012	0.529
LNURB	0.280	0.022**	0.161	0.235	0.160	0.0835*	0.043	0.135
R-squared	0.866		0.688		0.448		0.224	
Prob (F-Statistic)	0.000***		0.005***		0.04**		0.257	

Note:***, ** and * refer to significance at 1%, 5% and 10% in rejecting null hypothesis, respectively.

ISSN :2550-1429 Volume 3, (1) June 2018

In Model 5, only income and urbanisation have statistically significant impact on fertility at 1% and 5% significance levels respectively. As reported by UNESCO (2015), there are seven out of ten nations in Africa experiencing a severe shortage of teachers. As a result of the severe shortage of teachers, lower level of quality education and student learning experience, these could be the plausible reasons explaining the insignificance of education on fertility. The findings in Model 6 show that only income is a significant predictor in the American region and this is inconsistent with the cost of time theory by Mincer (1963) and Becker (1965). In Model 7, income and urbanisation are statistically significant in predicting fertility at 5% and 10% significance levels respectively, whereby income has a negative impact on fertility, while urbanisation has a positive impact on fertility. In Model 8, all the variables are insignificant in predicting fertility. The sanitised nature of facilities in Europe's rural areas have improved, in which 95% of the rural population in Europe has access to a cleaner water supply as reported by The World Bank (2017), hence, causing the insignificance of urbanisation in impacting fertility in Europe. Among the four models, Model 5 has the highest R^2 value of 0.866, followed by Model 6, with the R^2 value of 0.688 and Model 7, with the R^2 value of 0.447. The results for the European region are similar to those in developed countries as Europe is part of the developed region, and it concurs with Coale and Watkins's (1986) findings, whereby economic factors have a minor impact on fertility changes in Western countries. Another interesting fact is found in the results on inflation, found to have an insignificant impact on fertility irrespective of economic progress and regions. This is probably because the price stabilisation measures such as fiscal policies introduced during periods of high inflation increases uncertainty and makes family planning tougher. Concerning the price stability, this can lead to the conclusion that inflation plays a rather insignificant role in predicting fertility (Adsera and Menendez, 2006).

VI. Conclusion and Recommendations

This study investigated the impact of inflation, income, education level and urbanisation on fertility based on 108 countries for the year 2012. The results reveal that there is no serial correlation, no heteroskedasticity and no serious multicollinearity in the overall models of this study, clearly fulfilling the classical assumptions to ensure the OLS estimators are best (meaning minimum variance), linear and unbiased (BLUE) estimators.

The OLS regression results indicate that income has a significant and negative relationship with fertility in overall model, developing countries, and all regions except Europe. This implies that women are more inclined towards a career as income increases, due to the higher opportunity costs of raising a child relative to the loss of income, thus, leading to a fall in fertility as income rises. Education has a significant and negative relationship with fertility in the overall model and developing countries. This suggests that in the developing region, more educated people have better exposure to information regarding contraceptives, as well as a better understanding about child health, thus lowering fertility due to the greater confidence of parents in improving the living standards of a child (inconsistent with Becker's quantity-quality tradeoff model). Urbanisation has a significant and positive relationship with fertility in the overall model, developing countries and African region. This implies that people in urban areas have better access to medical centers and cleaner water supply than in rural areas, thus, increasing birth rates. It is also found that urbanisation generally has the largest impact on fertility in most of the models, except for least developed models. This implies that the access to family planning centers and cleaner water supply is very important in affecting fertility. An unexpected finding is highlighted, as all the predictor; variables are statistically insignificant in predicting fertility in least developed countries, as well as in the European region.

The empirical results of this study does contribute to existing literature by identifying the significant factors of reduce fertility. As this study shows that urbanisation is the main contributor to boost fertility through the accessibility to better and cheaper healthcare, as well as cleaner water supply in urban areas, policymakers need to come up with effective and efficient policies to provide better living conditions in under-urbanised areas. In order to bridge the living standards gap between urban and rural areas globally, measures such as financial assistance and land transfer can motivate rural residents to migrate to urban areas, while for those who remain in rural areas, governments need to invest in health services in order to motivate fertility. This is a more practical effort in encouraging fertility than implementing incentives such as tax reductions and cash assistances, which are proven to be ineffective in encouraging fertility (Lee and Ng, 2012). As Davies (2013) explains "Creating the expectation of comprehensive and continuous policy support to families in the future may be a key factor in encouraging men and women to have more children." (p. 6) As all the predictor variables are unable to significantly explain fertility in least developed countries, future studies should consider other economic variables, such as the use of female labour force participation rates, infant mortality rates, unemployment rates, and government health expenditure.

References

Abo-Zaid, S.M. (2015). Altruism, Macroeconomic Aggregates and the Cyclical Behavior of Fertility: Theory and Evidence from US Data.

Adsera, A. & Menendez, A. (2006). Fertility changes in Latin America in the context of economic and political uncertainty. In XX Annual Conference of the European Society for Population Economics, Verona.

Asmare, D.M. (2010). Fertility in East Africa countries.

Asteriou, D. & Stephen, G., Hall. (2007). Applied Econometrics: A Modern Approach Using Eviews and Microfit (Revised Edition).

Basso, A. (2015). Does Democracy Foster the Fertility Transition? *Kyklos*, 68(4), 459-474.

Becker, G. (1981). A treatise on the family. Harvard University Press. Cambridge, MA, 30.

Becker, G.S. (1960). An economic analysis of fertility. In Demographic and economic change in developed countries (209-240). Columbia University Press.

Becker, G.S. (1965). A Theory of the Allocation of Time. *The Economic Journal*, 493-517.

Becker, G.S. & Barro, R.J. (1988). A reformulation of the economic theory of fertility. *The Quarterly Journal of Economics*, 103(1), 1-25.

Becker, G.S. & Lewis, H.G. (1973). On the Interaction between the Quantity and Quality of Children. *Journal of Political Economy*, 81(2, Part 2), S279-S288.

Bongaarts, J. (2008). Fertility transitions in developing countries: Progress or stagnation? *Studies in Family Planning*, 39(2), 105-110.

Caldwell, J.C. (1976). Toward a restatement of demographic transition theory. *Population and Development Review*, 321-366.

Centers for Disease Control and Prevention. (2017). NVSS - Birth Data. [online] Available at: https://www.cdc.gov/nchs/nvss/births.htm [Accessed 10 March. 2018].

Clark, W.A. (2012). Do women delay family formation in expensive housing markets? *Demographic Research*, 27(1),1.

Coale, A.J. & Watkins, S.C. (1986). The Decline of Fertility in Europe: The Revised Proceedings of a Conference on the Princenton European Fertility Project. Princeton University.

Cook, R.D. & Weisberg, S. (1983). Diagnostics for heteroscedasticity in regression. *Biometrika*, 70(1), 1-10.

Davies, R. (2013). Promoting fertility in the EU Social policy options for Member States. Library Briefing, Library of the European Parliament, 1-10.

Dettling, L.J. & Kearney, M.S. (2014). House prices and birth rates: The impact of the real estate market on the decision to have a baby. *Journal of Public Economics*, 110, 82-100.

Gries, T. & Grundmann, R. (2015). Fertility and modernization: the role of urbanization in developing countries. *Journal of International Development*.

Guo, Z., Wu, Z., Schimmele, C.M. & Li, S. (2012). The effect of urbanization on China's fertility. *Population Research and Policy Review*, 31(3), 417-434.

Hamilton, B., Martin, J., Osterman, M., Driscoll, A. & Rossen, L. (2017). Births: Provisional Data for 2016. [online] National Center for Health Statistics, 1-20. Available at: https://www.cdc.gov/nchs/data/vsrr/report002.pdf [Accessed 15 June. 2018].

Hirschman, C. (1994). Why fertility changes. *Annual Review of Sociology*, 20(1), 203-233.

Kamaruddin, R. (2016). Demographic Determinants of Women's Fertility Decision. *Journal of International Business, Economics and Entrepreneurship*, e-ISSN :2550-1429 1(1), 30-34.

Lee, C.G. and Ng, P.K. (2012). Fertility Determinants in Singapore. *International Journal of Economic Perspectives*, 6(2), p.206.

Masih, A.M. & Masih, R. (2000). The dynamics of fertility, family planning and female education in a developing economy. *Applied Economics*, 32(12), 1617-1627.

McCrary, J. & Royer, H. (2011). The effect of female education on fertility and infant health: Evidence from school entry policies using exact date of birth. *The American Economic Review*, 101(1), 158-195.

McKelvey, C., Thomas, D. & Frankenberg, E. (2012). Fertility regulation in an economic crisis. *Economic Development and Cultural Change*, 61(1), 7-38.

Mincer, J. (1963). Market prices, opportunity costs, and income effects. *Measurement in Economics*, 67-82.

Murphy, T.E. (2010). Old Habits Die Hard (Sometimes). Can département heterogeneity tell us something about the French fertility decline. Bocconi University Innocenzo Gasparini Institute for Economic Research Working Paper, 364.

Pan, L. & Xu, J. (2012). Housing price and fertility rate. *China Economic Journal*, 5(2-3), 97.

Sandberg, J. & Alvesson, M. 2011. "Ways of constructing research questions: gap-spotting or problematization?" *Organization*, 18(1) 23–44.

Sato, Y. (2006). Economic geography, fertility and migration. Journal of Urban Economics, 61(2), 372-387.

Schultz, T.P. (1973). Explanation of birth rate changes over space and time: A study of Taiwan. *Journal of Political Economy*, 81(2, Part 2), S238-S274.

Shapiro, D. & Gebreselassie, T. (2013). Fertility transition in sub-Saharan Africa: falling and stalling. *African Population Studies*, 23(1).

Simon, C.J. & Tamura, R. (2008). Do higher rents discourage fertility? Evidence from US cities, 1940–2000. *Regional Science and Urban Economics*, 39(1), 33-42.

Tadesse, F. & Headey, D. (2011). Urbanization and fertility rates in Ethiopia. *Ethiopian Journal of Economics*, 19(2), 35-72.

The World Bank. (2017). Improved sanitation facilities, rural (% of rural population with access) | Data. [online] Available at: https://data.worldbank.org/indicator/SH.STA.ACSN.RU?locations=EU [Accessed 28 Feb 2018].

The World Bank. (2017). Inflation, consumer prices (annual %) | Data. [online] Available at: https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG [Accessed 10 Sep. 2017].

The World Bank. (2017). Population ages 0-14 (% of total) | Data. [online] Available at: https://data.worldbank.org/indicator/SP.POP.0014.TO.ZS?end=2016&start=1964 [Accessed 10 Sep. 2017].

The World Bank. (2017). Population ages 65 and above (% of total) | Data. [online] Available at: https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?end=2016&start=1964 [Accessed 10 Sep. 2017].

The World Bank. (2017). Urban population growth (annual %). [online] Available at: https://data.worldbank.org/indicator/SP.URB.GROW?locations=Z7&name_desc=false [Accessed 18 Oct. 2017].

UNESCO. (2015). Children Out of School or at School but Still Not Learning. [online] Available at: http://uis.unesco.org/sites/default/files/documents/children-out-of-school-or-in-schoolbut-still-not-learning-en.pdf [Accessed 18 Oct. 2017].

United Nation Statistics Division. (2017). UNSD — Methodology. [online] Available at: https://unstats.un.org/unsd/methodology/m49/ [Accessed 10 Sep. 2017].

United Nations. (2015). Population ageing and sustainable development. Department of Economic and Social Affairs, Population Division.

United Nations. (2015). World Fertility Patterns 2015 – Data Booklet (ST/ESA/ SER.A/370). Department of Economic and Social Affairs, Population Division.

United Nations. (2015). World Population Ageing 2015 (ST/ESA/SER.A/390). Department of Economic and Social Affairs, Population Division.

Vitali, A. & Billari, F.C. (2015). Changing determinants of low fertility and diffusion: A spatial analysis for Italy. Population, *Space and Place*, 23(2).

White, M.J., Muhidin, S., Andrzejewski, C., Tagoe, E., Knight, R. & Reed, H. (2008). Urbanization and fertility: An event-history analysis of coastal Ghana. *Demography*, 45(4), 803-816.

Willis, R.J. (1973). A new approach to the economic theory of fertility behavior. *Journal of Political Economy*, 81(2, Part 2), S14-S64.