Educational Assortative Mating and Changes in Fertility in Cameroon: A Decomposition Analysis

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Abstract

This paper investigates the implications of educational assortative mating for changes in fertility in Cameroon over the period 2004-2018. To achieve the objectives, the paper employed Instrumental Variable Negative Binomial regression to examine the effect of positive educational assortative mating on fertility behaviour. Furthermore, used Multivariate Negative Binomial Regression decomposition to assess the specific contribution of positive educational assortative mating to changes in fertility. Results show that positive educational assortative mating is associated with decreased fertility in Cameroon. Additionally, we observed a significant decline in fertility between 2004 and 2018. Decomposition results show that returns to endowment contribute largely to the decline in fertility from 2004-2018. Furthermore, positive educational assortative mating, in terms of endowment, has a mitigating effect on fertility. Policy implications suggest that investing in education emerges as a promising long-term approach for promoting fertility reduction and ensuring demographic stability within Cameroon.

Keywords: Educational assortative mating, Fertility, Negative Binomial regression, Multivariate Decomposition analysis, Cameroon

1. Introduction

In the realm of international demographic research, the relationship between education and fertility emerges as a critical dimension influencing population dynamics. The World Bank (2020) highlights that the educational landscape, not only shapes the reproductive decisions of individuals but also acts as a catalyst for broader demographic shifts. As such Understanding how education influences fertility is key to addressing population growth, gender disparities, and socio-economic inequalities. Casterline et al. (2019) assert that investigating the effects of fertility choices provides insights into demographic shifts and their consequences for population growth, a crucial aspect for informed policy planning and resource allocation. As nations undergo socio-economic transformations, the dynamics of partner selection with regards to educational attainment and its consequences for family planning have become pivotal areas of research. In the demographic landscape of Cameroon, the interplay between educational assortative mating and fertility outcomes remains a compelling and underexplored area of research. As the nation undergoes socio-economic transformations, understanding how educational homogamy or heterogamy influences fertility patterns is crucial for informed policy formulation and societal development.

Education has become an increasingly crucial factor in the union formation process, coinciding with global changes in educational assortative mating patterns over the past few decades. According to Huber and Fieder (2011), this shift is considered one of the indicators and components of changes in family structures, including fertility behavior. The systematic negative association between female education and fertility is a central stylized fact across the social sciences, where more educated mothers tend to have smaller families (Lutz and Samir, 2011). However, the decision to have children is no longer solely an individual choice; recent years have seen fertility decisions arising from the mutual agreement and desire between husband and wife. This agreement is shaped by various considerations of the costs and benefits for both spouses (Doepke & Fabian, 2016). Therefore, understanding the changing aspects of couple formation is likely to shed light on their consequences for family-related aspects, such as fertility decisions (Trimarchi & Van Bavel, 2019). Yet, there are very few empirical studies that have examined the relationship between educational assortative mating and fertility patterns in the developed world. Thus, we aim to provide new insights from a developing country.

The United Nations (2019) highlighted that fertility stands as a pivotal element in population dynamics, influencing the size, structure, and composition of the human population. It holds significance in resource planning and development. The total fertility rate for a specific year is defined as the total number of children that would be born to each woman if she were to live through her child-bearing years, giving birth in accordance with prevailing age-specific fertility rates. Literature consistently reveals a negative relationship between fertility and economic growth, suggesting that unchecked high fertility rates could lead to poverty at both household and national levels. Elevated fertility rates are likely to contribute to rapid population growth, placing strain on various aspects and posing challenges to the achievement of sustainable development goals. Sustained high fertility and rapid population growth hinder the realization of sustainable development goals. Schultz (2008) argues that reducing the number of children would decrease maternal and child mortality, empower women through enhanced training and work experience, thereby increasing their productivity and wages in the labor market.

Over the past century, there has been a global decline in national-level total fertility rates, although this decline began at different times and evolved at varying rates. Despite policies implemented by international organizations and governments, fertility trends in sub-Saharan Africa (SSA) have not been effectively addressed. Compared to other regions worldwide, the transition in SSA countries occurred later, progressed at a slower pace, and even stagnated in mid-transition (Schoumaker, 2019). According to the 2022 World Population Data, the world's total fertility rate (TFR) in 2022 was 2.3 births per woman, while it was 4.3 for African countries, 4.7 for SSA countries, and 4.5 in Cameroon. The World Population Prospects 2022 indicates that sub-Saharan African countries are expected to continue growing through 2100, contributing more than half of the global population increase anticipated through 2050.

Kreyenfeld (2002) suggested that the positive association between education and fertility for women may be influenced by the fact that highly educated women often partner with highly educated men. Microeconomic theories of the family also anticipate a positive association between education and fertility for men due to income effects, while predicting a negative association for women due to opportunity costs (Becker 1991). Given these gender-specific effects of education on fertility, focusing on only one partner complicates result interpretation, (Trimarchi and Van Bavel 2017). Moreover, since the majority of births occur within unions, failing to account for the partner's educational characteristics introduces an omitted variable bias. Singley and Hynes (2005) note that gender differences in work and family involvement are associated with different educational levels, emphasizing the need for a couple-level approach to fertility studies.

To propose effective policies for reducing fertility rates in sub-Saharan Africa (SSA), this study examines the impact of educational assortative mating on fertility rates in Cameroon. Despite educational homogamy being a widespread phenomenon, little is known about whether it affects fertility in developing countries. While a few studies have analyzed the relationship between educational assortative mating and fertility behavior in developed countries (Nomes and Van Bavel 2017), most of these studies found that women who married husbands with equal or higher education tended to have more children than those who married husbands with lower education. However, these studies have not elucidated the contribution of changes in assortative mating patterns to changes in fertility behavior. Our study aims to fill this gap.

The contemporary literature in Cameroon has not delved into the disparities in husband-wife characteristics and their impact on couples' fertility behavior. Investigating the implications of educational assortative mating for differences in fertility rates among couples is crucial for Cameroon, as it has the potential to inform targeted policy interventions and address critical demographic challenges. This research aims to assist policymakers in designing programs that promote access to education, gender equity, and reproductive health services, empowering couples to make informed fertility decisions. In this light, the main objective of the study is to investigate the contribution of educational assortative mating to changes in fertility rates in Cameroon from 2004 to 2018. The corresponding specific research objectives of the study are; (1) to investigate the effect of educational assortative mating on fertility in Cameroon and (2) to analyze the role of educational assortative mating in explaining changes in fertility in Cameroon over the period 2004-2018.

2. Stylized Facts on Fertility in Cameroon

In Cameroon, the fertility rate has shown a gradual decline, decreasing from 6.7 births per woman in 1983 to 4.8 births per woman in 2018, representing a reduction of approximately two births per woman over 35 years, as reported by the Cameroon Demographic Health Survey (CDHS). The United Nations Population Division World Population Prospects (2022) indicates a further decrease to 4.4 births per woman. Various factors contribute to this decline, with female education identified as a crucial factor (Eloundou et al., 2000, and Ekane, 2016).

Despite this decline, the total fertility rate in Cameroon remains comparatively low when compared to other African countries.

Table 1: Cameroon Trends in Fertility Rate from 1983 to 2022

Year	Fertility Rate	Growth Rate
2022	4.4	-8.3%
2018	4.8	-5.9%
2011	5.1	2%
2004	5.0	4.1%
1998	4.8	-17.2%
1991	5.8	-13.4%
1983	6.7	0.6%

Source: United Nations Population Division. World Population Prospects: 2022

According to the 2018 Cameroon Demographic and Health Survey, fertility is at its peak in rural areas, where women have an average of 6.0 children, in contrast to 3.8 children per woman in urban areas. Regional variations in fertility rates reveal the highest rates in the North and Far North regions, with total fertility rates of 6.2% and 5.9%, respectively. Conversely, Douala and Yaoundé exhibit lower total fertility rates of 2.8% and 3.5%, respectively. Regarding education, fertility decreases with women's educational levels. On average, women with no education have double the number of children compared to those with higher than secondary education, with total fertility rates of 6.2% and 3.0%, respectively. Similarly, fertility diminishes with household wealth in Cameroon, with women in the poorest households having an average of 6.6 children, while those in the wealthiest households have an average of 3.0 children.

The 2018 Cameroon Demographic and Health Survey also reported that 24% of adolescent women aged 15-19 are already mothers or pregnant with their first child. Teenage childbearing ranges from 6% in Douala to 44% in the East region. This phenomenon diminishes with education, as approximately 48% of young women with no education have initiated childbearing, compared to only 1% of those with higher education.

3. Literature Review

3.1 Theoretical Approach

Three main theoretical approaches guide the study of the relationship between couple pairings and fertility pathways. Becker's microeconomic framework suggests that couples with a higher degree of specialization in both paid and unpaid labor dimensions are more likely to have higher fertility rates. Oppenheimer's theory proposes that couples with dual earners can better adapt to challenges by pooling resources, potentially leading to higher fertility. The second demographic transition (SDT) theory suggests that highly educated women, embracing certain lifestyle choices, may exhibit lower fertility rates.

This study is founded on Gary Becker's microeconomic framework. Marriage serves as a platform for realizing the desire to have and raise children, as posited by Becker (1974). Children, being non-market commodities, are products that couples must produce within the household. In this context, Becker and Lewis (1974) propose that married couples face a trade-off between the quality and quantity of children when making decisions as parents. Economic choices come into play, where couples must decide between having more children or investing in better-quality offspring. Building upon Becker's (1974) theory, which underscores the influence of individual characteristics on household output, couples, based on their unique characteristics, will exhibit varying fertility outcomes. Becker (1974) further emphasizes in his marriage theory that assortative mating is intricately linked to the couple's desired balance between the quantity and quality of children.

Higher education, particularly for women, is commonly associated with delayed marriage entry (Becker and Lewis, 1974). Beyond the extended duration spent in school, increased education creates additional economic opportunities outside of marriage and child-rearing. This shift enhances the utility of remaining single for women compared to the utility derived from marriage (Becker, 1974). The specific combination of the educational achievements of potential spouses may also play a crucial role, as suggested by Oppenheimer's (1988) theory on marriage timing. In a competitive scenario where men and women vie for partners, a marriage market is presumed to exist (Becker, 1974).

Moreover, educational attainment significantly influences each partner's financial contribution to the household budget. Higher education augments income potential, potentially exerting both positive and negative effects on fertility. The positive income effect arises from the expensive nature of child-rearing, while the negative effect stems from higher wages translating to increased opportunity costs when childbearing negatively impacts labor market activity (Kravdal & Rindfuss, 2008). Given the wage disparity between genders and differing expectations for involvement in housework and child-rearing, the impact of educational attainment on fertility varies markedly by gender (Becker, 1981). Consequently, it becomes crucial to consider the educational levels of both spouses. The husband's educational attainment may influence the effect of the wife's educational attainment and corresponding income potential on fertility decisions, and vice versa. In situations where both partners are highly educated, the opportunity cost of having children might have a less pronounced effect on childbearing decisions. The household might manage with the income of just one partner, or the combined income may be substantial enough to outsource child care, such as hiring a nanny. Consequently, each unique combination of the husband's and wife's educational attainment could give rise to a distinct pattern of marital fertility.

3.2 Empirical Review

3.2.1 Determinants of Fertility

In the field of fertility studies, a historical focus on women's characteristics and choices has been predominant, often overlooking the role of partners in reproductive decision-making. Ekane's (2016) investigation using the 2011 Cameroon Demographic Health Survey addressed this gap by exploring the influence of educational attainment on women's decisions to have another child in Cameroon. The study revealed that educational level significantly impacts women's choices. In a context of greater gender egalitarianism, Jaloovara and Mittienen (2013) conducted a study in Finland, emphasizing that the socio-economic resources of the female partner played a more influential role in predicting first birth rates compared to those of the male partner.

In the realm of fertility studies in developed countries, the relationship between education and fertility is nuanced. While studies in Sweden, such as the one by Hoem et al. (2006), observed that highly educated women, including Ph.D. holders, tend to have fewer children and higher rates of childlessness. Van Bavel (2010) distinguished between earning profiles and attitudes towards gender roles within fields of study, revealing that women in disciplines with higher earning profiles tended to postpone motherhood, and those in fields with more progressive attitudes towards gender roles also delayed motherhood. Additionally, Kravdal's (2012) study in sub-Saharan Africa suggested that the inverse relationship between women's education and birth rate may be attributed to the relatively high net cost of childbearing and rearing among better-educated women who are more knowledgeable and open to modern contraceptive usage.

3.2.2. Effects of Educational Assortative Mating on Fertility

Existing research has predominantly focused on developed countries, with limited attention to the dynamics in less developed regions. Nomes and Van Bavel (2016) delved into the relationship between educational assortative mating and marital fertility, particularly examining trends during the Baby Boom and subsequent Baby Bust. Their findings highlighted that couples with low education levels exhibited the highest fertility rates among most Baby Boom cohorts, closely followed by hypergamous couples, in a different context, Wisana and Pukuh (2018) utilized Indonesian National Socio-economic Surveys to explore assortative mating changes by age and education, and their impact on fertility behaviour in Indonesia from 1996 to 2016. Poisson Regression results revealed that hypergamous couples in both age and education categories demonstrating the highest Children Ever Born.

Huber and Fieder (2011) explored the impact of educational assortative mating on reproductive performance parameters in the US. They observed that the prevalence of childlessness tends to be minimal among women married to husbands with the same educational level, especially among those with the highest and lowest educational attainment. Interestingly, educational homogamy did not have a discernible effect on a woman's average offspring number; instead, mean offspring number generally increased with decreasing educational attainment for both women and their husbands. In a European context, Trimarchi and Van Bavel (2019) investigate the influence of educational assortative mating on couples' fertility. Their findings indicated that couples where the man is more educated than the woman exhibit higher second and third birth rates compared to pairings where the woman is more educated than the man.

Dribe and Stanfors (2010) suggests that when both partners are highly educated, second and third birth rates tend to be higher compared to couples with a medium level of education. However, for the first birth, studies conducted in the Netherlands and Finland found that including male partner characteristics improved model fit, though female partner characteristics were deemed more relevant in predicting first birth rates. Interestingly, these studies did not identify a significant effect of educational pairing (Begall 2013; Jaloovara and Mittienen 2013).

In line with this finding, Nitsche et al. (2018) found that in Belgium, Denmark, Finland, France, Luxembourg, the Netherlands, and the UK, homogamous highly educated couples were more likely to postpone the first birth compared to other pairings. In Italy, a more traditional context with regard to gender roles, Vignoli et al. (2012) found that men's income was more important than women's in predicting a first birth. The authors, however, noted that having a permanent type of contract increased the likelihood of the first birth for both men and women.

4. Methodology

4.1 Measure of Educational Assortative Mating

In order to capture the variable of interest-educational assortative mating, we use the measure used by Kollamparambil (2019) to capture the degree of Positive Educational Assortative Mating (PAM) among couples. Contrary to some previous works on educational assortative mating such as Dribe and Nystedt (2013) and Hu and Qian (2015) that captures educational homogamy in a categorical manner, this measure captures Positive educational assortative mating in a continuous fashion. In order to construct the degree of positive educational assortative mating index, educational variables of the partners are first normalized thereby constraining the education variables of the partners to take values between 0 and 1. Letting ${E^h}_i$ and ${E^w}_i$ to represent respectively the husband education variable and wife education variable, the standardized variables are given as:

$$ {R^h}_i = \frac{{E^h}_i - \overline{E_h}}{\sigma_h} \qquad (1) $$

$$ {R^w}_i = \frac{{E^w}_i - \overline{E_w}}{\sigma_w} \qquad (2) $$

Where ${R^h}_i$ and ${R^w}_i$ are the standardized education variables for the husband and wife respectively. $\overline{E_h}$ and $\overline{E_w}$ are the average husband education and the average wife education respectively meanwhile σ_h and σ_w are respectively the standard deviations of the husband education and wife education. The indicator for degree of positive educational assortative mating (PAM) is thus given as:

$$PAM_i = |{R^h}_i + {R^w}_i| \quad (3)$$

Using the sum of the standardized years of schooling between spouses in Equation 3 effectively captures positive educational assortative mating. Higher values signify greater educational similarity between spouses.

4.2 The Effects of Educational Assortative Mating on Fertility: Poisson Regression/Negative Binomial Regression

To address our first objective, we can employ a count data framework to model fertility as a function of educational assortative mating, while also controlling for other relevant correlates, as depicted in the equation below.

$$FER_i = \gamma_0 + \gamma_1 D_{2011} + \gamma_2 D_{2018} + \gamma_3 PAM_i + \sum_{k=4}^{m} \gamma_k X_{ik} + \varepsilon_{1i} \quad (4)$$

Where FER denotes the fertility proxied by the number of children ever born by a woman, D_{2011} represents the year dummy for 2011 which is given the value of 1 if the observation is from the 2011 records and 0 otherwise while D_{2018} is the year dummy for 2018 taking the value 1 if the observation is from the 2018 survey and zero otherwise. PAM is the degree of positive educational assortative mating. γ_0 is the intercept for the base year 2004 and γ_0+γ_1 the intercept for 2011 and γ_0+γ_2 is the intercept for 2018. γ_3 is the effect of educational assortative mating on fertility. $\gamma_k$denotes the set of parameters to be estimated, and X stands for the vector of the other households and individual factors that correlate with fertility.

In statistical analyses, outcome variables may be constrained as count data, assuming only nonnegative (or solely positive) integer values. A count variable is a type of limited dependent variable, taking on nonnegative integer values (0, 1, 2, and so forth), and a limited dependent variable is one with a substantially restricted range of values (Wooldridge, 2005). This form is natural for data like the number of children ever born per woman, which serves as the dependent variable in this study. Linear regression, used for other limited dependent variables, is unsuitable for count data, as it neglects the limited number of potential values for the response variable. The most employed technique to model count data is Poisson regression, named for assuming the error process follows the Poisson distribution, notable for its mean being equal to its variance.

A limitation of the Poisson distribution is the equality of its mean and variance. We may often observe count data processes where this equality is not reasonable, in particular, when the conditional variance is larger than the conditional mean. This phenomenon is termed overdispersion, and its presence assumes of a Poisson distribution for the error process untenable, especially in cases of unobserved heterogeneity. In such circumstances, a reasonable alternative is the negative binomial regression. This model allows the variance to differ from the mean. In its Stata implementation as "nbreg," a Poisson model is also estimated, and a test of overdispersion is provided. If the dispersion parameter is zero, it is appropriate to fit a Poisson regression model. Hence, we will resort to the negative binomial regression model in case we experience over-dispersion in our data. Alternatively, we will appeal to fitting a Poisson regression model if our dispersion parameter is zero after the STATA implementation of "*nbreg*" to estimate our fertility equations.

Our independent variable of interest, positive educational assortative mating, is likely to be endogenous. Consequently, simply using a Poisson or negative binomial regression model may result in estimates that are biased and inconsistent. To correct for endogeneity, we follow Wooldridge (2015) control function procedure based on the residual inclusion approach. This entails estimating a reduced form of positive educational assortative mating (PAM and generating the residual. The reduced form of PAM is given as:

$$PAM_i = \theta_0 + \sum_{k=4}^{m} \theta_k X_{ik} + \delta Z_i + \varepsilon_{2i} \quad (5)$$

In Equation (5), the vector X represents the explanatory variables expected to influence educational assortative mating, while Z is an instrumental variable. The instrument employed in this study is the non-self-cluster mean of positive educational assortative mating. The identification relies on the concept of social interactions to compute a non-self-cluster mean of educational assortative mating. This identification strategy has been employed by Rahman and Mishra (2019) and Epo et al. (2023). In line with Epo et al. (2023), the fundamental concept behind the non-self-cluster identification strategy is that the average behavioral tendencies within a neighborhood, influenced by imitation and emulation channels, are likely to impact individuals' decisions to enter marriages with similar education levels. However, this influence may not directly affect fertility but rather operates through the mating pattern. After the estimation of the reduced form, we predict the residual $\hat{\varepsilon}_{5i}$. The predicted residual is then included as an additional explanatory variable in Equation 4.

$$FER_i = \varphi_0 + \varphi_1 D_{2011} + \varphi_2 D_{2018} + \varphi_3 PAM_i + \sum_{k=4}^{m} \varphi_k X_{ik} + \rho\hat{\varepsilon}_{2i} + \varepsilon_{3i} \quad (6)$$

In Equation 6, the predicted residual accounts for the endogeneity of the variable of interest-positive educational assortative mating.

4.3 Measuring changes in Fertility between 2004 and 2018: A Multivariate Nonlinear Decomposition

To assess the factors that are associated with the changes in fertility in Cameroon between 2004 and 2018, we employed a Multivariate Poisson/Negative Binomial decomposition technique. This technique enables us to characterize the contribution of each variable in terms of the endowment effect and in terms of the returns to endowment effect.

Without loss of generality, letting X denote the vector of explanatory variables including educational assortative mating, and β a vector of corresponding parameters. The fertility rate for each year (FER^T) is equal to the predicted average given as:

$$\overline{FER^T} = \overline{F(X^T\hat{\beta}^T)} = \frac{1}{N^T}\sum_{i=1}^{N^T} F({X_i}^T\hat{\beta}^T) \quad (7)$$

The change in fertility between two period is given as difference in the average fertility:

$$\Delta\overline{FER} = \overline{FER^1} - \overline{FER^0} = \overline{F(X^1\hat{\beta}^1)} - \overline{F(X^0\hat{\beta}^0)} \quad (8)$$

Let us now consider the following counterfactual distribution: $\overline{F(X^1\hat{\beta}^0)}$. It estimates the fertility of fertility of year T=0 with the characteristics of the year T=1 (X^1) , while keeping the coefficient of the year T=0 (determined by $\hat{\beta}^0$). Adding and subtracting this counterfactual, the change in fertility can decompose into two distinct terms:

$$\Delta\overline{FER} = \left\{\overline{F(X^1\hat{\beta}^1)} - \overline{F(X^1\hat{\beta}^0)}\right\} + \left\{\overline{F(X^1\hat{\beta}^0)} - \overline{F(X^0\hat{\beta}^0)}\right\} \qquad (9)$$

The explained or characteristics effect, the second term in Equation (9), provides a measure of the change in fertility that can be attributed to changes in endowments or characteristics (e.g., educational assortative mating, urban residency, religion, age at first birth, etc.). The return to endowments or coefficients effect, the first term in Equation (9), provides a measure of the extent to which the change in fertility is explained by variations in coefficients when individuals share the same average characteristics in both years.

An advantage of multivariate decomposition is that it provides a detailed decomposition for non-linear models, such as the Poisson and negative binomial models. That is, the contribution of each variable in explaining the changes in fertility between 2004 and 2018. Indeed, we wish to partition *endowment component(E)* and *returns to endowment component* (*C)* into portions, *Ek* and *Ck* (*k* = 1, . . . , *K*), that represent the unique contribution of the *k*th covariate to *E* and *C*, respectively. Yun (2004) suggested a method which entails obtaining weights from a first-order Taylor linearization of around $X^1\beta^1$ and $X^0\beta^0$. The detailed decompositions obtained this way are invariant to the order that variables enter the decomposition, thus providing a convenient solution to path dependency. After linearization, the weight component for *E* is:

$$w_{\Delta_{X_k}} = \frac{{\hat{\beta}^1}_k\left(\overline{X_k}^1 - \overline{X_k}^0\right)}{\sum_{k=1}^{K} {\hat{\beta}^1}_k\left(\overline{X_k}^1 - \overline{X_k}^0\right)} \qquad (10)$$

$$w_{\Delta_{\beta_k}} = \frac{\overline{X_k}^1\left(\widehat{\beta_k}^1 - \widehat{\beta_k}^0\right)}{\sum_{k=1}^{K} \overline{X_k}^1\left(\widehat{\beta_k}^1 - \widehat{\beta_k}^0\right)} \qquad (11)$$

$$Where, \qquad \sum_k w_{\Delta_{X_k}} + \sum_k w_{\Delta_{\beta_k}} = 1$$

$w_{\Delta_{X_k}}$ reflects the contribution of the *k*th covariate to the linearization of *E* as determined by the magnitude of the change in means weighted by the reference group's effect. Similarly, the coefficient weights $w_{\Delta_{\beta_k}}$ reflect covariate *k*'s contribution to the linearization of *C* as determined by the magnitude of the change in the effects weighted by the comparison group's mean. Thus, the weights are proportional to the contributions to the decomposition of the linear predictor, in which the relative sizes of the contributions to the endowment or returns to endowments portions of the change in fertility are equal to the relative contributions to the decomposition of the linear predictor.

$$\Delta\overline{FER} = E + C = \sum_{k}^{K} w_{\Delta_{X_k}} E + \sum_{k}^{K} w_{\Delta_{\beta_k}} C = \sum_{k}^{K} E_k + \sum_{k}^{K} C_k \quad (12)$$

The above decomposition can be easily implemented using the Stata command 'mvdcmp' for non-linear models, such as Poisson and negative binomial models. It reveals the specific contributions of each variable to the changes in fertility between 2004 and 2018.

5. Data Sources and Descriptive Statistics

The study makes use of a pooled of the recent three waves of the Cameroon Demographic and Health surveys (DHS 2004, DHS 2011 and DHS 2018). The Cameroon Demographic and Health surveys are nationally representative data collected by the National Institute of Statistics. The Surveys provides detailed information on marriage and sexual activity, fertility and fertility preferences, family planning, infant and child mortality, reproductive health, child health, nutrition of children and women, malaria, HIV/AIDS related knowledge, attitude, and behavior, adult and maternal mortality, domestic violence, and female genital cutting.

Table 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Fertility	5.5135	2.7925	1	18
Positive Assortative Mating	1.5506	1.0442	0.006	5.7736
Urban residency	0.4088	0.4916	0	1
Christian	0.6854	0.4644	0	1
Muslim	0.2369	0.4252	0	1
Other religion	0.0760	0.2650	0	1
Male headed	0.7810	0.4136	0	1
Sudano sahel	0.2688	0.4434	0	1
high savannah	0.0834	0.2765	0	1
Western highlands	0.1743	0.3794	0	1
Monomodal rainforest	0.1711	0.3766	0	1
Bimodal rainforest	0.3023	0.4593	0	1

Age at first birth	18.2451	3.5157	10	41
D2004	0.2785	0.4483	0	1
D2011	0.4001	0.4899	0	1
D2018	0.3214	0.4670	0	1

6. Empirical results

6.1 Effects of Positive Educational Assortative Mating on Fertility in Cameroon

The aim of this subsection is to evaluate the effects of educational assortative mating on fertility among women in Cameroon while controlling for other correlates. Table 3 displays estimates of the Poisson regression and negative binomial regression of the fertility generating function under different assumptions. Column 1 hosts the estimates of the Poisson regression, while Column 2 harbors the estimates of endogeneity-corrected Poisson regression. The estimates Negative Binomial regression and endogeneity-corrected Negative Binomial regression are hosted in Column 3 and Column 4, respectively. We employed both Poisson and Negative Binomial models for the analysis, ultimately selecting the model that best suits our data. The reason for using both models was to choose the Negative Binomial model, specifically in case our data exhibits over-dispersion. Our regression results (Table 3) indicate a significant alpha coefficient, providing evidence of over-dispersion in the data. Consequently, the Negative Binomial model is preferred over the Poisson model.

Column 4 of Table 3 presenting the endogeneity-corrected Negative Binomial regression results reveals a statistically significant effect of positive educational assortative mating on predicting couples' fertility behavior. Specifically, the results indicate that positive educational assortative mating is negatively associated with fertility rates. The results show that a percentage increase in educational assortative mating decreases fertility among women by 11.3%. The decline fertility among couples with positive educational assortative mating can be linked to delayed family formation due to prioritized career development, influenced by higher education. Greater awareness of family planning methods, coupled with economic considerations and evolving gender roles, results in a conscious choice for smaller family sizes. Societal norms emphasizing individual fulfillment and economic prudence further contribute to this trend, illustrating the intricate interplay of educational, economic, and cultural factors shaping fertility decisions. The year dummy variable, D2011, serves to capture the intertemporal change in fertility rates between 2004 and 2011, elucidating a noteworthy decline of 2.8% during this period. Likewise, a similar trend is observed between 2004 and 2018, wherein fertility rates exhibit a substantial decrease of 5.7%. This information underscores a consistent pattern of declining fertility over the specified time intervals.

Table 3: Effects of Educational Assortative Mating Patterns on Fertility in Cameroon: Poisson Regression/Negative Binomial regression

VARIABLES	(1) Poisson	(2) Poisson_IV	(3) nbreg	(4) nbreg_IV
Positive assortative mating	-0.084***	-0.115***	-0.084***	-0.113***
	(0.001)	(0.009)	(0.001)	(0.009)
Urban residency	-0.053***	-0.023**	-0.054***	-0.024**
	(0.003)	(0.009)	(0.003)	(0.010)
Christian	0.009	0.023***	0.008	0.022***
	(0.005)	(0.007)	(0.006)	(0.007)
Muslim	-0.028***	-0.042***	-0.028***	-0.042***
	(0.006)	(0.007)	(0.006)	(0.007)
Male headed	0.006	0.000	0.006	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
High savannah	-0.028***	-0.011	-0.028***	-0.012
	(0.005)	(0.007)	(0.006)	(0.008)
highlands	0.051***	0.107***	0.051***	0.104***
	(0.005)	(0.016)	(0.005)	(0.017)
Mono rainforest	-0.005	0.057***	-0.005	0.054***
	(0.005)	(0.018)	(0.006)	(0.019)
Bimodal rainforest	0.042***	0.104***	0.042***	0.102***
	(0.005)	(0.018)	(0.005)	(0.019)
Age at first birth	-0.025***	-0.025***	-0.025***	-0.025***
	(0.000)	(0.000)	(0.000)	(0.000)
D2011	-0.027***	-0.028***	-0.028***	-0.028***
	(0.003)	(0.003)	(0.004)	(0.004)
D2018	-0.055***	-0.056***	-0.056***	-0.057***
	(0.004)	(0.004)	(0.004)	(0.004)
Residual		0.031***		0.030***
		(0.009)		(0.009)
Constant	2.204***	2.151***	2.206***	2.155***
	(0.010)	(0.018)	(0.011)	(0.019)
lnalpha			-3.714***	-3.716***
			(0.039)	(0.039)
Likelihood-ratio test of alpha=0			783.20 [0.000]	780.73 [0.000]

Observations	91,444	91,444	91,444	91,444

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The inclusion of additional variables demonstrates that the influence of educational assortative mating characteristics does not act in isolation. Regarding the variable of urban residency, we observed urban-rural differentials in fertility. Specifically, the average number of children ever born to a rural woman is 2.4% higher than the number for an urban woman. The observed urban-rural differentials in fertility, with rural women having, on average, 2.4% more children than their urban counterparts, may be economically explained by factors such as access to resources, employment opportunities, and education. Urban areas often provide greater access to family planning resources, educational facilities, and employment options, enabling individuals to make more informed decisions about family size. Additionally, urban environments may encourage smaller family sizes due to the associated costs of living and the pursuit of individual career and educational goals. In contrast, rural areas may experience different economic realities, potentially leading to larger family sizes due to factors like agricultural livelihoods and different cultural norms regarding family planning. The findings corroborate those of Mutungi (2018).

Additionally, we observe from the findings that the age at first birth has a significant effect on the number of children ever born by a couple. Specifically, these results indicate that the number of children ever born by a woman decreases as the age at first birth increases. The relationship between the age at first birth and the number of children ever born by a couple can be economically explained by human capital considerations. Delaying the age at first birth is often associated with higher education and career development, leading individuals to prioritize smaller family sizes to optimize resource allocation for each child. The opportunity cost of early childbirth, in terms of career and income potential, may influence individuals to delay starting a family, resulting in a decrease in the number of children ever born as the age at first birth increases.

6.2 Contribution of Educational Assortative Mating to Changes in Fertility over the period 2004-2018

In this section, we present the results of the multivariate decomposition based on Negative Binomial Regression, examining the changes in fertility rates between 2011 and 2018. We first provide a summary of the decomposition, followed by a presentation of the detailed decomposition.

6.2.1 Summary Decomposition of changes in Fertility Between the 2011 and 2018

The table presents a summary of the multivariate Negative Binomial decomposition of changes in fertility rates over the period 2004-2018, with further breakdowns for the sub-periods 2011-2018 and 2004-2011. The results indicate that the mean fertility rate per woman stood at 5.882 in 2004, declined to 5.671 in 2011, and further reduced to 5.497 in 2018. This signifies a noteworthy structural decline in fertility over the period 2004-2018, amounting to a 3.9% decrease. These observations align with economic theories predicting demographic shifts influenced by socio-economic factors, highlighting the intricate interplay between economic conditions and fertility dynamics in Cameroon. Decomposing the decline in fertility over the period 2004-2018 into the endowment effect and returns to endowment effect, our analysis reveals that both components significantly contribute to the reduction in fertility. While both the endowment effect and returns to endowment effect contribute to the decline in fertility over the period 2004-2018, they exhibit differing magnitudes. Specifically, the endowment effect makes a substantial contribution of 0.028 points, constituting 7.3% of the overall decline.

Table 4: Summary of Multivariate Negative Binomial decomposition of Changes in Fertility over period 2004-2018

Components	(1) 2004-2018	(2) 2011-2018	(3) 2004-2011
Mean fertility for T_1	5.497 (0.016)	5.497 (0.016)	5.671 (0.014)
Mean fertility for T_0	5.882 (0.018)	5.671 (0.014)	5.882 (0.018)
Change in Fertility	**-0.385***** **(0.019)**	**-0.174***** **(0.016)**	**-0.211***** **(0.019)**
Endowment Effect	-0.028*** (0.009)	-0.031*** (0.004)	-0.078*** (0.003)
Returns to endowments effect	-0.357*** (0.022)	-0.143*** (0.016)	-0.133*** (0.019)

Source: Computed by authors using Stata 14, DHS 2004, DHS 2011, and DHS 2018.
Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1
Notes:

In contrast, the returns to the endowment effect play a predominant role, contributing a noteworthy 0.357 points, which accounts for 92.7% of the observed decline in fertility. These divergent contributions highlight the varying impacts of these endowment-related factors on the overall fertility dynamics over 2004-2018. This result aligns with that delivered by Canning (2011), suggesting that social norms have a greater role in changes in fertility behavior than changes in individual characteristics. The same trend is observed for the subperiods 2004-2011 and 2011-2018. In both intervals, a consistent pattern is discerned, indicating a decline in the phenomenon under consideration. This trend aligns with the overarching 2004-2018 period, reinforcing the notion that the observed decline is persistent and extends across multiple timeframes. The uniformity of this trend across subperiods underscores the robustness and stability of the observed pattern over the specified time intervals.

6.2.2 Detail Decomposition: Contribution of changes in Educational Assortative Mating to the changes in Fertility

Table 5 presents the detailed decomposition results, indicating the contributions of different variables to changes in fertility in terms of both endowments and returns to endowments. The findings reveal that positive educational assortative mating has a mitigating effect on changes in fertility, in terms of the endowment effect contributing in the order of 0.023 points. While in terms of returns to endowment, positive educational assortative mating marginally contributed to increased fertility. Regarding other variables, in the context of endowments, the variable that contributes to mitigating fertility is the Bimodal rainforest, whereas those enhancing fertility include urban residency, Muslims, male-headed households, Western highlands, Monomodal rainforest, and Age at first birth.

Table 5: Detailed Multivariate nbreg decomposition over period 2004-2018

	(1)	(2)	(3)
Components	2004-2018	2011-2018	2004-2011
Endowment effect attributable to:			
Positive Assortative mating (PAM)	-0.023***	-0.024***	0.001***
	(0.001)	(0.002)	(0.000)
Urban residency	0.003***	0.004***	0.000***
	(0.001)	(0.000)	(0.000)

Christians	-0.000	0.003*	0.002
	(0.000)	(0.002)	(0.001)
Muslims	0.017***	0.023***	0.005***
	(0.005)	(0.004)	(0.001)
Male headed	0.015***	-0.004**	0.001***
	(0.003)	(0.002)	(0.000)
High savannah	0.000	-0.001**	0.000
	(0.001)	(0.000)	(0.001)
Western highlands	0.009***	0.003***	-0.001***
	(0.001)	(0.001)	(0.000)
Monomodal rainforest	0.025***	-0.015***	0.005***
	(0.004)	(0.003)	(0.001)
Bimodal rainforest	-0.033***	0.006*	0.021***
	(0.002)	(0.003)	(0.001)
Age at first birth	0.081***	0.036***	0.044***
	(0.003)	(0.002)	(0.001)
Returns to endowment effect attributable:			
Positive Assortative mating (PAM)	0.004***	0.003***	0.000
	(0.001)	(0.001)	(0.000)
Urban residency	0.086***	0.056***	0.028*
	(0.019)	(0.017)	(0.016)
Christians	-0.120**	-0.029	-0.094**
	(0.056)	(0.055)	(0.044)
Muslims	-0.103***	-0.147***	0.034**
	(0.028)	(0.027)	(0.016)
Male headed	-0.530***	-0.296***	-0.208***
	(0.053)	(0.048)	(0.039)
High savannah	0.024***	0.016***	0.008
	(0.007)	(0.006)	(0.007)
Western highlands	-0.010	-0.051***	0.047***
	(0.011)	(0.010)	(0.011)
Monomodal rainforest	0.055***	-0.017*	0.104***
	(0.010)	(0.009)	(0.013)
Bimodal rainforest	0.195***	-0.071***	0.205***
	(0.023)	(0.020)	(0.018)
Age at first birth	0.406***	0.599***	-0.190*
	(0.116)	(0.095)	(0.111)
Constant	0.285*	0.080	0.199
	(0.156)	(0.142)	(0.133)

Source: Computed by authors using Stata 14, DHS 2004 DHS 2011 and DHS 2018. Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1
Notes:

Regarding the contribution of individual variables in terms of returns to endowment, factors that act to reduce fertility include the Christian dummy, Muslim dummy, and male-headed households. Conversely, variables augmenting fertility encompass urban residency, High savannah, Monomodal rainforest, Bimodal rainforest, and Age at first birth.

7. Conclusion and Policy Implication

This chapter attempts investigate the contribution of educational assortative mating to changes fertility in Cameroon. The specific objectives of the study were to investigate the effect of educational assortative mating on fertility in Cameroon, to analyze the role of educational assortative mating on changes in fertility rates in Cameroon over the period 2004-2018. To achieve these objectives, the study made use of the poison Regression and Negative Binomial regression to examine the effects of educational assortative mating patterns on fertility rates in Cameroon. We also made use of the Multivariate Negative Binomial Regression decomposition to measure the contribution of educational assortative mating on changes in fertility rates over the period 2004-2018.

The findings reveal significant differences in fertility behavior between couples based on assortative mating characteristics. The results show that positive educational assortative mating is associated with decreased fertility rates in Cameroon. Additionally, the returns to endowment significantly contribute to mitigating the decline in fertility from 2004-2018. Furthermore, positive educational assortative mating plays a contributory role in terms of endowment, mitigating fertility.

These findings can help policymakers understand the factors that influence fertility rates and family planning decision-making and develop interventions that promote greater access to family planning services and information. This can include increasing availability and affordability of contraceptives, improving education and awareness about family planning options, and addressing cultural and social barriers to contraceptive use. These results also recommend that, pprograms and policies aimed at controlling fertility should incorporate strategies that focus on the characteristics of couples in marriage. For instance, hypergamous couples in education have a greater tendency to have a higher birth rate. So that the policy implications that can be applied are by adding hypergamous couples into one of the priority targets in programs related to birth control such as; communication, information and education.

These finding can also inform policies that support reproductive health and rights for individuals and communities. This can include policies that promote safe and legal access to abortion services, support maternal and child health, and address reproductive health disparities across population subgroups. These findings can equally help policymakers understand the economic and social factors that influence fertility rates, and develop policies that support economic stability, educational attainment, and gender equality. This can include policies that address income inequality, promote access to education and job opportunities, and support work-family balance and caregiving responsibilities.

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