The causal effect of early fertility and marriage on education and employment among young women in Kenya[*]

Phyllis Machio, PhD
University of Nairobi

Jane Kabubo-Mariara, PhD[†]
University of Nairobi and Partnership for Economic Policy

Anthony Wambugu, PhD
University of Nairobi

Abstract

Female Kenyan youths are disadvantaged in the labor market. They face higher unemployment than their male counterparts. In addition, fewer females than males attain higher levels of education. Early transition from school to child bearing and marriage can adversely affect human capital accumulation with negative consequences on labor market transition. In Kenya about one quarter of women have had a child before 18 years and still many marry before their 18th birthday. This study estimates the effect of fertility on employment status, as well as the effect of early fertility and early marriage on educational attainment of young women. Literature and theory suggests that fertility may be endogenous in employment models. Further that reverse causality may exist between early fertility, early marriage and educational attainment. Thus, instrumental variable methods are used to analyze the effect of fertility on employment status. Two-stage residual inclusion and the control function approach models are used to analyze the effect of early marriage and early fertility on education attainment. The findings indicate that fertility negatively affects young women's probability of working and that early marriage and childbearing are obstacles to young women's educational attainment. Findings also point at the importance of controlling for endogeneity of fertility; early marriage and early child birth in the labour market transition and education attainment relationships respectively. To promote girl child education and by extension ensure meaningful labor market transition, the government should put in place policies that can prevent early marriage and early child bearing.

[*] This paper is part of a multi-country research project to examine labour market transitions of young women in Burkina Faso, Ethiopia, Ghana, Kenya, Tanzania, and Uganda, funded under the auspices of the Growth and Economic Opportunities for Women (GrOW) program. The GrOW program is jointly funded by Canada's International Development Research Centre (IDRC), UK's Department for International Development (DfID), and The William and Flora Hewlett Foundation. Opinions stated in this paper are those of the authors and do not necessarily reflect the views of the GrOW program or its funding partners.

[†] Corresponding author. Email:jane.mariara@gmail.com

1. Introduction

Kenya has a substantial youthful population with the 15-35 year-olds estimated at about 30% of all Kenyans. It is further estimated that about 80% of the unemployed (actively searching for, but unable to find jobs) are youths (UNDP, 2013). While youth in Kenya face tough socio-economic characteristics, women are particularly disadvantaged in many respects, more so in terms of labor market opportunities. In many Sub-Saharan Africa (SSA) countries, women are less likely than men to be in wage employment, and those in employment are more likely to be in informal employment and non-market work (ECA, 2005; Mammen and Paxson, 2000). In Kenya, statistics show that unemployment among youth and women is higher than among adults and men respectively (Republic of Kenya, 2003, 2008). Unemployment rates are higher among young women than among young men at all age groups. For instance, in 2005/6, 14% of young women aged 15-34 years were unemployed compared to 11% of young men of the same age.

While there are many potential reasons for the employment disadvantage faced by young women, early motherhood and marriage are key predisposing factors (Chun and Oh, 2002). Adolescent (15-19 years) fertility rate in SSA in 2005 was 133.2 births per 1000 women compared to 88.2 in low income countries (World Bank, 2010). Early transition from school into early child birth adversely affects women's labor market opportunities. For example, in Latin America and the Caribbean, women labor force participation increased from 44.5% in 1995 to 52.6% in 2015 partly because of decreasing fertility (ILO, 2016).

Women are also disadvantaged in terms of education outcomes, with more young men than women attaining higher levels of education. For example, in 2014, 18.29% of women completed secondary education compared to 22.06% of men. Likewise, 11.91% of women did not undertake any formal education compared to only 5.85% of males (KNBS et al., 2015). Several reasons may explain the less favorable schooling outcomes for women: parental characteristics, including education; individual and community characteristics. Other factors include early marriage and fertility (Loughran and Zissimopoulos, 2004; Klepinger et al., 1995; Blackburn et al., 1990). Evidence shows that women in Kenya give birth relatively early with a median age at first birth estimated at about 20 years (KDHS). 25% of women aged 25 to 49 give birth by their 18^{th} birthday while 47% have given birth by age 20. The same pattern has been observed for marriage before age 18 years (Kabubo-Mariara, Wambugu and Machio, 2017). The socio-economic status of the household also affects education attainment for young women. Girls from poor households often have to combine domestic work and schooling, resulting in lower education attainment than their male siblings (Kabubo-Mariara, et al., 2017).

Literature suggests that there is a possible causal relationship between education attainment, age at first birth, age at marriage, and labour force participation (Marchetta and Sahn, 2015; Herrera and Sahn, 2015; Glick, Handy and Sahn, 2015). Specifically, early marriage and child birth

adversely affects educational attainment, while educational attainment may delay early child birth (Schultz, 1997). Results from a qualitative study in Kenya also show that teenage pregnancies force young women out of school, and at times lead to early marriages. This leads to early and often unproductive labour market transitions. Economic, cultural and religious factors condition the relationship between these outcomes (Kabubo-Mariara et al., 2017). Failure to jointly model labour market outcomes, education attainment, early fertility and marriage would lead to biased results. This paper addresses this concern and focuses on multivariate analysis of the relationship between fertility, marriage, education, and employment of young women in Kenya. First, we model the effect of fertility, (measured by the total number of children ever born) on the employment status of young women, then analyze the effect of early marriage and early fertility (before age 18) on educational attainment of young women. Instrumental variable methods are used to analyze the effect of fertility on employment status. Two-stage residual inclusion and the control function approach models are used to analyze the effect of early marriage and early fertility on education attainment. The results point at the importance of addressing reverse causality issues when analyzing the effect of endogenous covariates on employment and education attainment.

The rest of the paper is structured as follows: section 2 presents a brief review of relevant literature; section 3 presents the methodology; section 4 presents data and descriptive statistics; section 5 presents and discusses the results; section 6 concludes.

2. Relevance to the literature

The literature review presented below focus on studies that have analyzed two aspects. The first strand focuses on the effect of fertility on women's employment status. The literature suggests most studies of the effect of fertility on labor market participation (mostly from the developed world) is ambiguous, suggesting the need to instrument for fertility. The second strand focuses on the effect of early fertility and early marriage on educational attainment of young women. The review suggests reverse causality between education, childbirth and marriage.

2.1 Effect of Fertility on Employment Status

A young woman, is faced with a decision whether or not to participate in market work and if participating, the number of hours to work. The optimal labor supply is determined by the market wage rate and nonwage income (Cahuc and Zyberberg, 2004). The latter has an income effect while the former has both substitution and income effects. An individual's labor supply is also determined by social-demographic variables such as fertility.

The birth of a child is likely to affect a woman's labor supply decisions. First, part of individual or household income is spent on child commodities. The resulting income effect increases the

chance of the single mother taking up market work. For married women, the income effect could lead either or both spouses into market work (Ukil, 2015). Second, the birth of a child is accompanied by child care costs (supervision and nurturing). A working mother may increase labor supply to meet child care costs (income effect) or decide not to participate in market work to take care of the child (substitution effect).

The foregoing discussion suggests that the effect of fertility on labor market participation is ambiguous. The studies of the causal effect of fertility on labor market participation overwhelmingly focus on data from developed countries. The main problem in estimating the causal effect of fertility on labour supply is potential endogeneity of fertility. This can arise for two reasons (Connellly, DeGraff, Levison and McCall, 2006). First, the same unobservable characteristics-such as, individual preferences toward work and children may affect both fertility and labor supply. Second, women simultaneously decide to have children and to participate (or not to participate) in market work.

Researchers address the problem of endogenous fertility decisions using different instruments within instrumental variable approach. Some studies have used the occurrence of twins at first birth as an instrument for fertility. Silles (2016) found that in the U.K., an additional child among married and unmarried cohabiting women, whose children are below 13 years old, reduced labor supply. For single women, the effect of young children is only significant for births in the first parity. For all women, the study found no significant negative effect of additional children on labor supply for women whose children are over 13 years old.

Another instrumental variable approach to deal with endogeneity of fertility is to use sex composition of two previous children of a mother as an instrument for the birth of a third child. Angrist and Evans (1998) pioneered use of this instrument. The argument is that a woman with two first children of the same sex is likely to have a third child in an attempt to have children of mixed sibling-sex composition. A dummy variable for whether the sex of the second child is the same as the sex of the first child is used as an instrument for an additional child among women with at least two children. The results show that additional children reduce labor supply and the causal effect is smaller for college educated women and for women whose husbands were working.

Chun and Oh (2002) follow Angrist and Evans (1998) to study labor force participation of married women. However, the authors argued that unlike preference for balanced sex composition of children by American families, Korean families prefer sons to daughters. Therefore, the sex of first child was used as an instrument for having the second child. Results of two-stage probit estimator, suggest that additional children reduce probability of labor force participation.

Ukil (2015) followed Angrist and Evans (1998) methodology using U.K. data on sibling sex composition. However, unlike Chun and Oh (2002) or Angrist and Evans (1998), the author used the two-stage residual inclusion(2SRI) method developed by Terza et al (2008). The results suggest a negative effect of fertility on labor force participation. Just like found in other studies, the negative effect is overestimated if endogeneity of fertility is not considered.

The above strategies of estimating the causal effect of fertility on labor supply are restricted to the sample of women who have had at least one or two births. Aguero and Marks (2008, 2010) propose a new identification strategy involving use of infertility shock as the instrument for fertility. This allows the researchers to estimate the causal effect of children on labor force participation of women whether or not they have children. The study analyses Demographic and Health Surveys from 26 developing countries. Results suggest that OLS estimates are biased upward. In particular, the presence of children does not influence the probability of work or the intensity of work. Fertility only affects the type of work a woman is engaged.

The studies suggest that it is important to control for endogeneity of fertility when estimating effect of fertility on employment. This study employs instrumental variable approach to study the link between fertility and work among young women in Kenya.

2.2 Link between educational attainment, age at first birth and at marriage

As discussed in Machio et al., (2017), several studies have analyzed the correlates and/or determinants of education, marriage, and fertility as independent outcomes. In Kenya for instance, Ikamari (2005) focused on the effect of education on age at first marriage; while Ferre (2009) on the effect of education on age at first birth. There are several studies on educational attainment (e.g. Kabubo-Mariara and Mwabu, 2007), and of youth employment and unemployment (Escudero and Mourelo, 2013; Vuluku et al., 2013). Literature however suggests that analyzing the determinants of educational attainment, age at first birth, age at marriage, and employment independently can result in biased estimates because of the simultaneity of decisions (Marchetta and Sahn, 2015; Herrera and Sahn, 2015; Glick and Sahn, 2015). Marchetta and Sahn (2015) jointly modeled educational attainment, age at first birth, age at marriage, and age at entry into the labour market for young Senegalese women. They found that the relationship between education, age at first birth, and entry into the labour market depended on the relationship between educational attainment and age at marriage.

Herrera and Sahn (2015) controlled for endogeneity while modeling the relationship between education and fertility among young women in Madagascar. They found that having a child reduced the chance of completing lower secondary education and increased the risk of dropping

out of school. Glick and Sahn (2015) also jointly modeled the determinants of educational attainment, age at first birth, and age at marriage in Madagascar, addressing potential endogeneity due to simultaneity, i.e. the possible causal relationship between these outcomes.

Overall, studies showed that education delays childbirth and marriage and increases prospects for gainful employment. On the other hand, early childbirth and early marriage negatively affect the pursuit of education and often lead to early labour market transition. Failure to take this causal relationship into account will lead to erroneous policy conclusions. These studies highlight the importance of controlling for reverse causality between the decisions. Failure to control for this results in bias where some of the independent variables are also choice variables. Thus, these independent variables that are also choice variables will be correlated with the error term leading to endogeneity. This study contributes to the literature attempts to disentangle the complex relationship between early fertility and employment; early marriage and education attainment; as well as early fertility and education attainment among young women in Kenya.

3. Methodology

3.1 Effect of Fertility on Employment

In a perfect market, a young woman would be rational and make choices based on utility derived from work, children and consumption. Such a woman would choose between hours of leisure and work, as well as fertility, all which would depend on prevailing prices, and both her observable characteristics and unobservable characteristics. Assuming preferences towards fertility and leisure are separable from other prices; there would be possibility of a causal relationship between fertility and employment. In an imperfect market like Kenya, however, holding other factors constant, material needs of the household are more central to the employment/early fertility decision. The possibility of a causal relationship from fertility to employment suggests the following equation:

$$E=E(F, X, \theta) \quad (1)$$

Where X includes all variables in X_F and X_E and θ includes variables in θ_F and θ_E

To analyze the effect of fertility on employment, let y be an indicator of a woman's working status: taking value 1 if a woman was working and 0 if otherwise. This observable working status is determined by a non-observable variable (propensity of a woman to work-latent variable), y^*. The two variables are related as follows:

$$y = \begin{cases} 1, \text{if } y^* > 0 \\ 0, \text{if } y^* \leq 0 \end{cases} \quad (2)$$

The latent variable model is given as

$$y^{*} = \delta f + \boldsymbol{\beta}' \mathbf{x} + \varepsilon \quad (3)$$

Where f is fertility (number of children), δ is the coefficient of fertility, $\mathbf{x}$ is a vector of other characteristics influencing the employment decision (age bracket of the woman, her level of education, household wealth, location factors - area of residence and region, marital status and religion), $\boldsymbol{\beta}$ is a vector of coefficients to be estimated, and ε the error term. The binary model can therefore be specified as

$$y = 1[\delta f + \boldsymbol{\beta}\mathbf{x} + \varepsilon > 0] \quad (4)$$

The coefficients including δ can be estimated using probit model. However, the woman's propensity to have another child can be correlated with unobserved factors that determine the woman's working status causing a correlation between fertility and the error term. This leads to biased and inconsistent estimates of δ.

Consistent estimate can be obtained using Instrumental Variable (IV) probit model (Amemiya, 1978; Rivers and Vuong, 1988). The reduced form equation is given by:

$$f = \boldsymbol{\alpha}' \mathbf{x} + \varphi' \mathbf{z} + \upsilon \quad (5)$$

Where, $\boldsymbol{\alpha}, \varphi$, are vectors of coefficients, $\mathbf{z}$ is a vector of instrumental variables and ν is the error term. Instrumental variable probit (ivprobit) estimation involves estimating equation 5 and obtaining the predicted values as follows:

$$\hat{f} = \hat{\boldsymbol{\alpha}}' \hat{\mathbf{x}} + \hat{\varphi}' \hat{\mathbf{z}} \quad (6)$$

By construction, $\hat{f}$ is uncorrelated with υ. The second step involves including the predicted values $\hat{f}$ in equation 7 in the place of f as follows:

$$y = [\delta \hat{f} + \boldsymbol{\beta}\mathbf{x} + \varepsilon > 0] \quad (7)$$

An alternative is joint estimation of equation (3) and (5) using maximum likelihood estimation. Ivprobit estimation requires valid instrumental variables, several which have been used in the literature including twin first birth, sex composition of two previous children of a woman, sex of first child and infertility shock (Silles, 2016; Angrist and Evans, 1998; Chun and Oh,2002; Ukil, 2015; Aguero and Marks, 2008; 2010). Valid instrumental variables are those that are highly correlated with the endogenous variable (fertility) but not correlated with the structural variable (employment).

This study uses infertility shock, twin first birth and time to water source as instrumental variables for fertility. Infertility shock is expected to be highly correlated with fertility because infertile women are less likely to have children. Twin birth also increases the number of children a woman has at a single birth hence increases total children ever born. Time to water source is used to measure remoteness. It is expected that the longer it takes to get water the more remote the area is and women living in such areas would be expected to have more children. These three variables are expected to have no direct effect on employment except through fertility.

3.2. Effect of early fertility on educational attainment

The starting point of any analysis of educational attainment is the human capital theory (Mincer, 1958; Becker 1962). Education is valued for consumptive and investment purposes (Gertler and Glewwe, 1990). Parents make schooling investments decisions until the private marginal benefits of the investment is equal its private marginal costs based on the expected private gains from the human capital investment (Becker,1962,1994; Behrman and Knowles, 1999; Becker and Tomes, 1986; Leibowitz, 1974). Parents make the decision to invest in a child's education if the expected utility of the investment exceeds the utility of not taking the child to school. Assuming constant and reliable supply of schooling, the schooling investment decision depends on the factors affecting the expected utility (Gertler and Glewwe, 1990). Economic Models of household behavior further postulate that investment in schooling is expected to raise a child's human capital, at the expense of consumption of other goods and services (Strauss and Thomas 1995). Literature has shown that investment decisions are made based on a set of three factors: individual, household and community (Gertler and Glewwe, 1990; Glewwe and Jacoby, 1994; Strauss and Thomas, 1995). Individual and household factors include parents' background social characteristics including education, income and endowments, marriage stability, household composition, culture, religion etc. (Machio et al., 2017; Kabubo-Mariara and Mwabu, 2007). Marriage/childbearing at an early age can interfere with the process of human capital accumulation such as attaining secondary and/or higher levels of education because they raise the cost and possibly the return to time put into investment in such human capital (Klepinger et al., 1999). Alternative frameworks argue that investment in human capital is expected to lead to higher quality of life and that it augments economic growth through enhancing labour (Mankiw *et al.,* 1992).

Based on these frameworks and the literature, this study starts by considering a young woman's educational attainment measured by the highest level of education attained (E). Four levels of educational attainment are considered: no formal education, primary education, secondary education and tertiary education. These observed education levels are determined by an educational attainment propensity (latent variable) which is a continuous and unobservable variable (E^*). Girls with higher educational attainment propensity will attain higher levels of education while those with lower educational attainment propensity will attain lower levels of

education. The observed educational attainment is related to the latent variable by the following equation:

$$\begin{aligned} E = 0 \quad & \text{No Formal Education} && \text{if } E^* \le \mu_0 \\ E = 1 \quad & \text{Primary Level} && \text{if } \mu_0 < E^* \le \mu_1 \\ E = 2 \quad & \text{Secondary Level} && \text{if } \mu_1 < E^* \le \mu_2 \\ E = 3 \quad & \text{Post-secondary Level} && \text{if } E^* > \mu_2 \end{aligned} \tag{8}$$

Where μ_j's are cut-off values for educational attainment.

The latent model is given by the following equation

$$E^* = \boldsymbol{\beta}\mathbf{x} + \lambda c + \theta m + \varepsilon \tag{9}$$

Where c and m are early child bearing and early marriage variables respectively and λ and θ are their coefficients; $\mathbf{x}$ is a vector of other variables influencing educational attainment (education of the head, sex of the head, household wealth, age of the woman, location factors - area of residence and region-, religion and relationship of the young woman to the household head); $\boldsymbol{\beta}$ is the vector of parameters to be estimated, and ε is the disturbance term.

The coefficients in equation (9) can be estimated using ordered probit. However, there can be unobservable factors that affect both the likelihood of having a child early and/or marrying early; and educational attainment causing c and m to be correlated with ε. For example, women with low ambition and motivation may be more likely to be early child bearers and/or to marry early as well as to attain low levels of education. Conversely, women with strong motivation may prefer small families (Glick et al., 2015). Education attainment could however delay or reduce fertility as more educated women have higher opportunity cost of not working (Becker, 1981). More educated women are also better placed to make fertility decisions and preference such as delaying and reducing births (Glick et al., 2015; see also Osili and Long, 2008; Blunch, 2007; Ferre, 2009; Angeles et al., 2005a, 2005b). Thus, education and fertility are likely to be correlated. This correlation leads to biased and inconsistent estimates. To obtain consistent estimates, this study used the two-stage residual inclusion (2SRI) (Terza et al., 2008) and the control function approach (Card, 2001; Florens et al., 2008; Petrin and Train, 2009; Diagne and Diene, 2011).

To implement the 2SRI, we first estimate the reduced form equations for early childbearing and early marriage specified as follows:

$$c = \boldsymbol{\alpha}' \mathbf{x} + \varphi' \mathbf{z} + \tau \quad (10)$$

$$m = \boldsymbol{\gamma}' \mathbf{x} + \boldsymbol{\varphi}' \mathbf{z} + \psi \quad (11)$$

Where, $\boldsymbol{\alpha}, \varphi, \gamma$, are vectors of coefficients to be estimated; $\mathbf{z}$ is a vector of instrumental variables and τ and ψ are the error terms. This study used number of unions, pregnancy termination and child before marriage as instrumental variables for early fertility and marriage. Women who have been in more unions are likely to have been married early given that this study focuses on women aged 15-25 years. Similarly having a child before marriage is likely to be associated with having a child early. Pregnancy termination may also be associated with early pregnancies and hence child bearing.

From the estimation of equations (10) and (11), we obtain respective reduced form residuals which are included in equation (9) as independent variables to obtain:

$$E^* = \boldsymbol{\beta}' \mathbf{x} + \lambda c + \theta m + \eta_1 v_1 + \eta_2 v_2 + \varepsilon \quad (12)$$

Where v_1 and v_2 are reduced form residuals for early child bearing and early marriage respectively. To test for the statistical significance of η_1 and η_2 is similar to testing for endogeneity of early childbearing and marriage. Rejecting the null hypothesis means the variable is endogenous (Bollen et al., 1995). Control function approach entails including also in equation 11 the interaction between early childbearing and its reduced form residuals as well as the interaction between early marriage and its reduced form residuals to control for unobserved heterogeneity. Equation (12) becomes:

$$E^* = \boldsymbol{\beta}' \mathbf{x} + \lambda c + \theta m + \eta_1 v_1 + \eta_2 v_2 + \sigma_1 (v_1 * c) + \sigma_2 (v_2 * m) + \varepsilon \quad (13)$$

Where $(v_1 * c)$ is the interaction of early child bearing and reduced form residuals and $(v_2 * m)$ is the interaction of early marriage and its residual and σ_1 and σ_2 are the respective the interaction coefficients.

4. Data and descriptive statistics

4.1. The Data

This study uses data drawn from the 2014 KDHS, a nationally representative survey implemented by the Kenya National Bureau of Statistics (KNBS). The survey interviewed 31,079 women aged 15-49 and 12,819 men aged 15-54. The sample points were selected from a national master sample maintained by the KNBS under the fourth National Sample Survey and

Evaluation Programme (NASSEP-IV). The sample was selected from 995 rural and 617 urban clusters. The sampling design was based on the NASSEP-V frame. The survey collected information on fertility levels, marriage, and age at first birth. It also obtained information on sexual activity, fertility preferences, awareness and use of family planning methods, breastfeeding practices, nutritional status of women and young children, childhood and maternal mortality, and maternal and child health. In addition, information was collected on schooling and educational attainment, employment status, and occupation.

This paper utilized women's dataset supplemented by the household member dataset. The focus is on women between 15 and 25 years of age and between 15 and 34 (12,753 and 22,809 women respectively). Information obtained from the household member dataset included: education level of the household head and sex of the household head. To obtain educational level of the household head, the variable relationship to household head variable was used.

In the women data set, this study used the following information: education, working status, age, religion, region, wealth quintiles, marital status, age at first birth, age at cohabitation, relationship to the head of household, whether had a pregnancy had been terminated, number of unions, marriage to first birth interval, desire for children and reasons for not using contraceptives. Table 1 presents a description of variables used in the analysis.

Table 1: Variable definition

Variable	Variable definition
Dependent variable	
Working	A binary variable that takes value 1 if a woman reported to be working and 0 if otherwise
Working in a decent job	A binary variable taking value 1 if a woman was working in a decent job (professional/technical/managerial, clerical and services) and 0 if not working in a decent job (household and domestic, agricultural self-employment, skilled manual and unskilled manual)
Educational attainment	Measured as a categorical variable: 0 if attained no formal education or had incomplete primary education, 1 if attained primary education or incomplete secondary education, 2 if attained secondary education and 3 if attained tertiary education.
Endogenous variables	
Fertility (total children ever born)	Total number of children ever born to a woman
Early fertility (child before 18)	Binary variable taking value 1 if a woman had a child before age 18 and 0 if she had a child at or after age 18.
Early marriage (married before 18)	Binary variable taking value 1 if a woman was married before age 18 and 0 if she was married at or after age 18.
Independent variables	
Education	Highest education level attained. Measure as four dummy variables: No formal education dummy, primary education dummy, secondary education dummy

	and tertiary education dummy
Age	Age in years/categories
Rural residence (area of residence)	Binary variable taking value 1 if lived in rural areas and 0 if otherwise
Religion	Measured as four dummy variables: Catholic, Protestant, Muslim and no religion.
Region	Categorical variable indicating the region a woman lived in. Eight dummy variables, 1 for each region were created: Nairobi, Coast, Central, Western, Rift Valley, Nyanza, North Eastern and Central.
Relationship to head	A categorical variable indicating the relationship between a household head and the member of the household. Five dummy variables were created to depict each potential relationship: head, wife, daughter, other relative and not related.
Marital status	Binary variable taking value 1 if a woman was married and 0 if otherwise
Instrumental variables	
Infertility shock	Binary variable taking value 1 if a woman said the reason she does not desire more children is because she is infertile and/or the reason for not using contraceptives is because she is infertile and 0 if otherwise
Twin first birth	Binary variable taking value 1 if a woman had a twin first birth and 0 otherwise
Time to water source	Time in minutes to water source
Pregnancy termination	Binary variable taking value 1 if ever terminated a pregnancy and 0 otherwise
Child before marriage	Binary variable taking value 1 if a woman had a child before marriage and 0 otherwise
Number of unions	Binary variable taking value 1 if a woman had been in more than one union and 0 if otherwise

4.2. Descriptive statistics

Table 2 presents the descriptive statistics of variables used in the model estimating effects of fertility on employment of young women aged between 15 and 35 years. The descriptive statistics indicate that 51% of the sampled women were working although only 32% of these were employed in decent jobs[‡]. The average number of children ever born to a woman was 2 and most women were aged between 20 and 29 years. About half of the women in the sample had attained primary education with only 9% attaining tertiary level education. The women were roughly equally distributed among the five wealth quintiles although the lowest quintile had a slightly higher proportion of women. Likewise, slightly more than half of the women were married and lived mostly in rural areas. Most women in the sample were from Rift Valley followed by Eastern, Nyanza and Coastal provinces. The remaining province had each less than 10% of the sampled women. Majority of the women in the sample were Protestants. About 0.2% of women reported to be infertile and 1% of the firstborns in this sample were twins. The average time to water source was 26 minutes.

[‡] In this paper, we adopt a working definition for decent employment to include professional/technical/managerial positions, clerical jobs, service sector jobs, and skilled manual work. This definition does not necessarily correspond to the ILO definition of decent employment as it is rather difficult to disentangle the services sector in the DHS.

Table 2: Descriptive statistics for women aged 15-35 years

Variable	Observations	Mean	Standard deviation
Dependent variable			
Employment (1 if employed)	10809	0.51	0.50
Decent work (1 if employed in a decent job)	5468	0.32	0.47
Independent variables			
Total children ever born	22809	1.84	1.91
Age brackets			
Age 15-16 years	22809	0.12	0.32
Age 17-19 years	22809	0.15	0.36
Age 20-24 years	22809	0.24	0.43
Age 25-29 years	22809	0.26	0.44
Age 30-34 years	22809	0.20	0.40
Age 35 years	22809	0.04	0.20
Education level			
No education	22809	0.12	0.33
Primary education	22809	0.49	0.50
Secondary education	22809	0.30	0.46
Tertiary education	22809	0.09	0.29
Wealth quintiles			
Lowest quintile	22809	0.23	0.42
Lower quintile	22809	0.19	0.39
Middle quintile	22809	0.19	0.39
Richer quintile	22809	0.19	0.39
Richest quintile	22809	0.20	0.40
Married dummy (1 if married)	22809	0.56	0.50
Rural residence	22809	0.61	0.49
Region			
Nairobi	22809	0.04	0.19
Nyanza	22809	0.14	0.35
Western	22809	0.09	0.29
Rift Valley	22809	0.30	0.46
Central	22809	0.09	0.29
Eastern	22809	0.17	0.37
North Eastern	22809	0.06	0.23
Coastal	22809	0.13	0.33
Religion			
Catholic	22778	0.20	0.40
Protestant	22778	0.64	0.48
Muslim	22778	0.14	0.35
No religion	22778	0.02	0.13
Instrumental variables			
Infertility shock	22809	0.002	0.04
Twin first birth	15138	0.019	0.09
Time to water source	21970	25.99	44.63

Table 3 presents descriptive statistics of variables to be used in the model of the effect of early fertility and early marriage on educational attainment of woman aged between 15 and 25 years. The descriptive statistics indicate that about 43% of the young women who had had children had them before age 18. Similarly, about half (47%) of those married were married before they were 18 years old. The average educational attainment was primary education. Most household head had attained primary education with only a few attaining tertiary education. Distribution of women by religion, region and wealth quintiles are same as in the above section. Most of the women in the sample were daughters and wives. About 4% of the respondents had had a pregnancy terminated, 4% had been in more than one union and 23% had been married with a child.

Table 3: Descriptive statistics for women aged 15-25 years

Variable	Observations	Mean	Standard deviation
Dependent variable			
Educational attainment	12753	0.88	0.88
Independent variables			
1 if had a child before 18	5650	0.43	0.50
1 if married before 18	5395	0.47	0.50
Age	12753	19.84	3.24
Education level of the household head			
No education	12710	0.20	0.40
Primary education	12710	0.47	0.50
Secondary education	12710	0.22	0.42
Tertiary education	12710	0.11	0.32
Wealth quintiles			
Lowest quintile	12753	0.24	0.43
Lower quintile	12753	0.20	0.40
Middle quintile	12753	0.19	0.40
Richer quintile	12753	0.19	0.39
Richest quintile	12753	0.18	0.38
Rural residence	12753	0.63	0.48
Region			
Nairobi	12753	0.3	0.18
Nyanza	12753	0.14	0.35
Western	12753	0.10	0.30
Rift Valley	12753	0.30	0.46
Central	12753	0.08	0.27
Eastern	12753	0.16	0.37
North Eastern	12753	0.06	0.23
Coastal	12753	0.13	0.33
Religion			
Catholic	12739	0.20	0.40
Protestant	12739	0.64	0.48

Muslim	12739	0.15	0.35
No religion	12739	0.02	0.12
Relationship to the household head			
Head	12753	0.09	0.29
Wife	12753	0.28	0.45
Daughter	12753	0.41	0.49
Other relative	12753	0.18	0.38
Not related	12753	0.04	0.20
Instrumental variables			
1 if ever had pregnancy terminated	6032	0.04	0.19
Number of unions (1 if more than 1 0otherwise	5321	0.04	0.19
1 if married with a child	4701	0.23	0.42

5.0. Results

5.1. Effect of fertility on employment among young women

This section presents the econometric results of the effect of fertility on employment among young women in Kenya. First, estimates of a simple probit model are reported. However due to potential endogeneity of fertility in the employment equation, instrumental variable probit estimates are also reported. Infertility shock, twin first birth and time to water source are used as instrumental variables for fertility (Silles, 2016; Angrist and Evans, 1998; Chun and Oh,2002; Ukil, 2015; Aguero and Marks, 2008; 2010).

Table 4 column 1 presents the first-stage regression results and shows that infertility shock, twin first birth and time to water source are all strongly correlated with the total number of children ever born to a woman. As expected, there is a negative relationship between infertility and total children ever born. On average, infertile women have 0.72 fewer children than fertile women. Having a twin first birth increases the number of children ever born to a woman by 0.84. As the time to water source increases (a proxy for remoteness), it increases total children ever born to a woman by 0.001. Women in remote areas are expected to be more likely to have more children due to limited access to and lack of knowledge about contraceptives and beliefs and cultures that may promote more children.

Table 4 columns 2, 3, 4 and 5 reports the estimates of two employment equations. The dependent variable in the first equation is whether or not a young woman was working. In the second equation, the dependent variable is whether or not a young woman was employed in a decent job. The marginal effects of the probability of employment and the standard errors are reported in the table. A negative and statistically significant marginal effect of a given independent variable implies that the variable reduces the probability of employment. Conversely, a positive and

statistically significant marginal effect indicates that the variable increases the probability of employment.

The simple probit estimates suggest a positive and significant effect of fertility on the probability of working. On average, one additional child increases the probability of a woman working by 0.7 percentage points. However, probit estimates may be biased because of endogeneity of the variable total children ever born so that the error term in the employment equation is correlated with total children ever born. To address potential endogeneity this study used ivprobit. The ivprobit results indicate a negative and significant marginal effect of total children ever born on the probability of working. Fertility therefore negatively affects probability of working among young women. One additional child reduces the probability of working among young women by 9 percentage points holding other factors constant. The findings suggest that failure to control for endogeneity not only biases downwards the effect of fertility on probability of working but may also give a wrong sign.

According to labor supply theory, birth of a child can affect a woman's labor supply decisions. In this case we find that birth of a child brings about substitution effect where a woman substitutes market work with child care. The findings in this study contradict Escudero and Mourelo (2013) who found that having children increased the likelihood of employment among youths aged 15-34 years, but the reverse for age 15-24 years in Kenya. This study however did not control for endogeneity of fertility. In line with this study, Spierings et al. (2008) also found that having small children reduced women's likelihood of employment. This finding is supported by results of a qualitative survey from Kenya which suggests that fertility affects labour market transitions for young women, often forcing them into domestic activities or informal jobs (Kabubo-Mariara et al., 2017). Early marriage, which is associated with high fertility has also been shown to have a negative effect on the probability of young women being employed (Marchetta and Sahn, 2015; Kahraman, 2011; and Spierings et al. 2008).

Table 4 column 4 and 5 present the effect of fertility on probability of being employed in a decent job. Probit estimates show a negative and significant effect of fertility on probability of working in a decent job. One additional child reduces a woman's chance of working in a decent job by 1 percentage points. Results from qualitative research show that teenage pregnancies bar youths from securing meaningful jobs and at times such young mothers miss out on opportunities for any form of work as they cannot afford child care. The literature also suggests that young mothers are likely to transition to the labour market more slowly than their counterparts without children (Mills & Präg, 2014).

Another factor that significantly affects the probability of a woman working and working in a decent job is education especially tertiary education. Women with tertiary education are for instance 15 percentage points more likely to be working and 30 percentage points more likely to

be employed in a decent job. Tertiary education therefore has higher effect on probability of being employed in a decent job than being employed. This finding is supported by results of focus group discussions and key informant interview which indicate that inadequate education limits job opportunities available to youths, often leading to a vicious cycle of poverty. Findings on labour market transition literature show that higher levels of education increase the likelihood of transitioning into a first job (Mills & Präg, 2014). Other control factors such as region, area of residence, wealth status and religion are also significant determinants of women's employment (Marchetta and Sahn, 2015).

Table 4: The effect of fertility on employment among young women

Variables	Coefficients	Marginal effects			
Dependent variable	Total children ever born	1 if working		1 if working in a decent job	
	First stage estimates	Probit	ivprobit	Probit	ivprobit
Total children ever born		0.007**	-0.086*	-0.010**	0.045
		[0.004]	[0.044]	[0.005]	[0.055]
Age (Reference: age15-16 years)					
Age 17-19	0.167	0.190***	0.174***	0.093**	0.161
	[0.141]	[0.019]	[0.067]	[0.047]	[0.158]
Age 20-24	0.821***	0.421***	0.342***	0.107**	0.138
	[0.135]	[0.018]	[0.066]	[0.044]	[0.165]
Age 25-29	1.790***	0.557***	0.537***	0.128***	0.105
	[0.135]	[0.018]	[0.080]	[0.045]	[0.190]
Age 30-34	2.870***	0.605***	0.695***	0.085*	0.01
	[0.135]	[0.020]	[0.112]	[0.046]	[0.228]
Woman's education (Reference: No formal education)					
Primary	-0.335***	0.191***	0.153***	-0.070**	-0.062*
	[0.039]	[0.016]	[0.032]	[0.027]	[0.035]
Secondary	-0.848***	0.155***	0.098*	0.018	0.05
	[0.045]	[0.018]	[0.054]	[0.030]	[0.058]
Tertiary	-1.402***	0.223***	0.155*	0.301***	0.338***
	[0.056]	[0.022]	[0.088]	[0.033]	[0.074]
Rural residence	0.066**	-0.014	0.007	-0.041***	-0.050***
	[0.026]	[0.010]	[0.013]	[0.014]	[0.015]
Wealth quintiles (Reference: lowest quintile)					
Lower	-0.192***	0.052***	0.058***	0.054**	0.075***
	[0.035]	[0.014]	[0.022]	[0.022]	[0.027]
Middle	-0.449***	0.031**	0.015	0.104***	0.126***
	[0.036]	[0.014]	[0.028]	[0.022]	[0.033]
Richer	-0.658***	0.035**	-0.02	0.144***	0.183***
	[0.038]	[0.015]	[0.036]	[0.022]	[0.044]

Richest	-0.881***	0.041**	-0.05	0.189***	0.253***
	[0.044]	[0.017]	[0.048]	[0.024]	[0.057]
Marital status (1 if married)	0.510***	-0.017	-0.046	-0.040***	-0.065**
	[0.026]	[0.010]	[0.032]	[0.013]	[0.030]
Region (Reference: Nairobi)					
Nyanza	0.475***	-0.002	0.092***	0.003	-0.029
	[0.064]	[0.025]	[0.035]	[0.031]	[0.045]
Western	0.435***	-0.050*	0.026	0.075**	0.053
	[0.069]	[0.026]	[0.038]	[0.033]	[0.047]
Rift valley	0.162***	-0.012	0.016	0.025	0.019
	[0.061]	[0.023]	[0.030]	[0.029]	[0.034]
Central	-0.325***	0.084***	0.071*	0.012	0.017
	[0.067]	[0.026]	[0.042]	[0.031]	[0.041]
Eastern	-0.278***	-0.026	-0.018	0.02	0.019
	[0.064]	[0.024]	[0.034]	[0.031]	[0.040]
North Eastern	0.128	-0.211***	-0.185***	0.153***	0.172**
	[0.085]	[0.034]	[0.046]	[0.056]	[0.070]
Coastal	-0.101	-0.016	-0.009	0.071**	0.043
	[0.067]	[0.025]	[0.033]	[0.032]	[0.038]
Religion					
Protestant	0.048*	0.021**	0.032**	-0.022	-0.038**
	[0.027]	[0.010]	[0.013]	[0.014]	[0.015]
Muslim	0.478***	-0.126***	-0.071*	0.046	0.024
	[0.050]	[0.019]	[0.040]	[0.030]	[0.041]
No religion	0.329***	0.04	0.078**	-0.025	-0.074
	[0.075]	[0.030]	[0.035]	[0.044]	[0.048]
Instrumental variables					
Infertility shock	-0.724***				
	[0.274]				
Time to water source	0.001***				
	[0.000]				
Twin first birth	0.840***				
	[0.111]				
Constant	1.180***				
	[0.152]				
Observations	14,606	10,807	6,960	5,467	4,395
R-squared	0.466				
Standard errors in brackets		*** p<0.01, ** p<0.05, * p<0.1			

5.2. The effect of early fertility and early marriage on educational attainment of young women.

This section presents the results of the effect of early fertility and early marriage on educational attainment of young women in Kenya. To estimate this effect, first ordered probit model is used. These results are presented in column 2 of table 6. The ordered probit estimates show that early fertility reduces the probability of young women attaining higher levels of education but it increases the probability of them attaining no formal education. Having a child before 18 years reduces a woman's chance of attaining primary, secondary and tertiary education levels by 4, 4and 2 percentage points respectively but it increases their chance of attaining no formal education by 10 percentage points. Similarly, being married before18 increases a young woman's chance of attaining no formal education by 10 percentage points but it reduces her chance of attaining primary, secondary and tertiary levels of education by 5,5 and 3 percentage points respectively

These results may however be biased by endogeneity and heterogeneity. Therefore, in addition we estimate the two-stage residual inclusion and the control function approach models. Table 5 presents the reduced form model results of early childbearing and early marriage. The statistically significant coefficients of the instrumental variables show that t having terminated a pregnancy, having had a child before marriage and having been married more than once are valid instrumental variables for fertility.

Findings indicate that young women who have ever had a pregnancy terminated are 10 and 7 percentage points respectively more likely to marry early and have early child bearing than their counterparts who have never terminated pregnancy. Similarly, being married with a child and having been married more than once increased a woman's chance of early childbearing by 17 and 20 percentage points. More than one union also increased chance of early marriage by 24 percentage points.

Education reduces chances of young women marrying early and being involved in early child bearing. Young girls with tertiary education are 31 and 29 percentage points more likely to delay marriage and childbearing compared to those with no formal education. Probability to delay marriage and childbearing increases significantly with the level of education.

The results also show that wealth is inversely correlated with the likelihood of early marriage and child bearing. Young women from richest wealth quintiles are 10 and 17 percentage points less likely to have children early and to be married early compared to those from lowest wealth quintile. These findings supported findings by Glick et al., (2015). These findings are also supported by findings of qualitative analysis which show a correlation between socio-economic status and the likelihood of young women dropping out of school, early marriage and fertility (Kabubo-Mariara et al., 2017)

In addition to the ordered probit model results, Table 6 also presents the two-stage residual inclusion and control function approach estimates. Presence of endogeneity is indicated by a significant coefficient of the reduced form residuals, while presence of heterogeneity is indicated by a significant coefficient of interaction term between the variable and its reduced form residuals. The significant coefficient of the reduced form residuals for the two variables suggest presence of endogeneity of both early fertility and early marriage. The coefficients for the interaction terms of both early marriage and early fertility with their respective residuals are insignificant, suggesting that unobserved heterogeneity may not be a problem in the relationships under investigation. The interpretation of the results is therefore based on the two stage residual inclusion estimates. The results indicate that having a child before 18 years reduces a young woman's chance of attaining primary, secondary and tertiary education by 10, 10 and 9 percentage points while it increases their chance of attaining no formal education by 26 percentage points. Further that young women who get married before 18 years are 31 percentage points more likely to attain no formal education but are 12, 12 and 7 percentage points less likely to attain primary, secondary and tertiary education respectively. Failure to control for endogeneity biases downwards the effects of early fertility and marriage on educational attainment

Most girls drop out of school once they fall pregnant. The few who go back have to struggle with both physically taking care of the children and providing for their needs all of which compete with schooling. Teenage marriages also lead to a disruption of girls' education. At about 18 years, youths are just completing their high school education and preparing for college. Marriage comes with responsibility of having children and taking care of them all which compete with schooling. Statistics show that 68% of those who marry before 18 years also have children before 18 years.

Other previous studies also find similar results. Moore and Waite (1977); McElroy (1996); and Klepinger et al. (1995) find that early childbearing hinder young women's educational attainment. After childbearing, young mothers are never able to catch up with their former, childless, classmates. Our findings support Field and Ambrus (2008), who found early marriage to negatively affect educational attainment, and that that delaying marriage by one year resulted in 0.22 additional years of schooling. Webbink et al., (2009) also found teenage motherhood to affect educational attainment although only marginally. McElroy, (1996) also found a negative correlation between early marriage and education.

The findings also indicate that girls who came from households with educated household heads were more likely to attain higher levels of education compared to those who came from households whose head had no formal education. These results support findings by Marchetta and Sahn, (2015) and Glick et al., (2015) on the effect of parental education on young women's education. Further, the results show that Catholic and Protestant girls are more likely to attain higher levels of education compared to those with no religion. North Eastern girls are also

disadvantaged in the sense that they are less likely to attain higher levels of education compared to those living in Nairobi. In addition, girls coming from wealthier households are more likely to attain higher levels of education but are less likely to attain lower levels of education.

6. Conclusion

This study sought to estimate the effect of fertility, early marriage and early childbearing on employment and educational attainment of women aged 15-35 years in Kenya using the 2014 KDHS data. The study is based on the premise that labour market transition of youths are affected by education, fertility and marriage outcomes. Girls who get pregnant or get married during their teenage years, most often drop out of school and this lowers their likelihood of getting an opportunity for gainful employment. Education on the other hand delays childbirth and marriage and increases prospects for gainful employment. While disentangling the relationship between early fertility, early marriage, educational attainment and employment is complex, failure to take this causal relationship into account will lead to erroneous policy conclusions. To address this concern, first the study uses instrumental variable methods to investigate the effect of the total number of children ever born (fertility) on the employment status of young women. We use infertility shock, twin first birth and time to water source as instrumental variables for fertility.

The results show that infertile women have 0.72 fewer children than fertile women, while having a twin first birth increases the number of children ever born to a woman by 0.84. Time to water source (remoteness) marginally increases total children ever born to a woman by. The findings indicate that fertility is endogenous and that failure to take this into account biases downwards the effect of fertility on probability of working, may lead to unexpected effects and may also lead to wrong policy conclusions. The ivprobit estimates show that fertility negatively affects the probability that young women will work. One additional child reduces the probability of a young woman working by 9 percentage points. The results further show that an additional child reduces a woman's chance of working in a decent job by 1 percentage points. Teenage pregnancies bar youths from securing meaningful jobs and at times such young mothers miss out on opportunities for any form of work due to lack of child care. The results further show that education raises the probability of women working and also having a decent job. Furthermore, tertiary education has a higher effect on probability of being employed in a decent job than being employed. Inadequate education limits job opportunities available to youths, often leading to a vicious cycle of poverty.

Second, the study explores the effect of early marriage and early childbearing on educational attainment of young women. The literature suggests that educational attainment affect early fertility and early child bearing, but early childbearing and fertility also affect educational attainment suggesting. Failure to take into account this simultaneity biases the estimates. Thus, this study adopts the two-stage residual inclusion (2SRI) and the control function approach to

deal with this problem of simultaneity bias/endogeneity. Ever having terminated a pregnancy, having had a child before marriage and having been married more than once are used as instrumental variables to identify early childbearing and early marriage in the education attainment model. The findings indicate that early childbearing and marriage reduces the likelihood of young women attaining higher levels of education.

The results also show that young women who have ever had a pregnancy terminated have a higher probability of getting into early marriage and to give birth early than their counterparts who have never terminated pregnancy. Further, being married with a child and having been married more than once are associated with higher chances of early childbearing, while more than one union is associated with early marriage.

The results for education attainment indicate that having a child before 18 years reduces a young woman's chance of attaining primary, secondary and tertiary education by 10, 10 and 9 percentage points. Marriage before 18 years reduces the likelihood of attaining primary, secondary and tertiary education by 12, 12 and 7 percentage points respectively. Failure to control for endogeneity biases downwards the effects of early fertility and marriage on educational attainment. The results also show that education of the household heads, household wealth, religion and area of residence affect education attainment of young women.

Findings in this study point to the need for the government to put up mechanisms to deal with early fertility and marriage among young girls. This would give young women an opportunity to concentrate on their education which is a significant determinant of their labor market entry and earning potential. The government for example should prosecute heavily parents who marry their daughters off early and also men who marry young girls respectively. Given the reverse causality between education, early fertility and marriage, policies that keep girls in school are important in cushioning young women against early drop out from school and consequent early transition into child bearing, marriage and unproductive labour market outcomes. Secondary school fees should for instance be subsidized to prevent school drop outs that push girls to marry early and/or be involved in early child bearing. There is also need for awareness creation on the negative consequences of pre-marital sex to the young women.

Table 5: Determinants of early fertility and early marriage

Variables	Linear probability model	
	1 if had a child before 18	1 if married before 18
Education of household head (No formal education is the reference)		
Primary	-0.1190***	-0.0846***
	[0.031]	[0.030]
Secondary	-0.2087***	-0.2048***
	[0.037]	[0.037]
Tertiary	-0.3120***	-0.2900***
	[0.051]	[0.050]
Male headed household	-0.0032	-0.0088
	[0.044]	[0.043]
Age	-0.0570***	-0.0585***
	[0.005]	[0.004]
Wealth quintiles (Lowest is the reference)		
Lower	-0.0073	-0.038
	[0.030]	[0.030]
Middle	-0.0395	-0.0777**
	[0.033]	[0.032]
Richer	-0.1059***	-0.1457***
	[0.036]	[0.035]
Richest	-0.1041**	-0.1680***
	[0.043]	[0.042]
Rural residence	-0.0516**	-0.0156
	[0.025]	[0.024]
Religion (No religion is the reference)		
Catholic	-0.0776	-0.0444
	[0.059]	[0.058]
Protestant	-0.1034*	-0.0542
	[0.056]	[0.055]
Muslim	-0.0465	0.0549
	[0.064]	[0.063]
Region (Nairobi is the reference)		
Nyanza	0.2053***	0.1146*
	[0.064]	[0.063]
Western	0.0598	0.0229
	[0.068]	[0.067]
Rift valley	0.0286	0.0236
	[0.061]	[0.060]
Central	-0.0085	-0.0547
	[0.069]	[0.068]
Eastern	0.0166	-0.0387

	[0.065]	[0.063]
North Eastern	-0.0573	-0.0918
	[0.081]	[0.079]
Coastal	-0.0177	-0.0391
	[0.068]	[0.066]
Relationship to household head (Reference: Head)		
Wife	-0.025	0.0146
	[0.052]	[0.051]
Daughter	-0.1268***	-0.0744
	[0.047]	[0.046]
Other relative	-0.1619***	-0.1298***
	[0.045]	[0.044]
Not related	0.2330***	0.2459***
	[0.088]	[0.086]
Instrumental variables		
1 if ever had pregnancy terminated	0.0720**	0.1013***
	[0.037]	[0.036]
1 if had a child before marriage	0.1505***	-0.2079***
	[0.020]	[0.020]
1 if married more than once	0.2022***	0.2368***
	[0.045]	[0.044]
Constant	1.9019***	2.0903***
	[0.135]	[0.132]
Observations	2,229	2,229
R-squared	0.163	0.217
Standard errors in brackets	*** p<0.01, ** p<0.05, * p<0.1	

Table 6: The effect of early fertility on educational attainment

Variables	**ordered probit model**				**Two-stage residual inclusion**				**Control function approach**			
	No formal education	Primary education	Secondary education	Tertiary education	No formal education	Primary education	Secondary education	Tertiary education	No formal education	Primary education	Secondary education	Tertiary education
Married before 18	0.134***	-0.052***	-0.052***	-0.030***	0.306***	-0.121***	-0.120***	-0.065***	0.303***	-0.122***	-0.118***	-0.064***
	[0.011]	[0.005]	[0.005]	[0.003]	[0.067]	[0.027]	[0.027]	[0.015]	[0.067]	[0.027]	[0.027]	[0.015]
Child before 18	0.103***	-0.040***	-0.040***	-0.023***	0.360***	-0.142***	-0.142***	-0.076***	0.349***	-0.140***	-0.136***	-0.073***
	[0.012]	[0.005]	[0.005]	[0.003]	[0.090]	[0.036]	[0.036]	[0.020]	[0.092]	[0.038]	[0.036]	[0.020]
Married before 18 residuals					-0.163**	0.064**	0.064**	0.035**	-0.205***	0.082***	0.079***	0.043***
					[0.069]	[0.027]	[0.028]	[0.015]	[0.076]	[0.031]	[0.030]	[0.016]
Child before 18 residuals					-0.257***	0.102***	0.101***	0.055***	-0.293***	0.118***	0.114***	0.061***
					[0.092]	[0.037]	[0.037]	[0.020]	[0.097]	[0.040]	[0.038]	[0.021]
Interaction of married before 18 and residuals									0.085	-0.034	-0.033	-0.018
									[0.072]	[0.029]	[0.028]	[0.015]
Interaction of child before 18 and residuals									0.084	-0.034	-0.033	-0.018
									[0.082]	[0.033]	[0.032]	[0.017]
Education of household head (No formal education is the reference)												
Primary	-0.168***	0.065***	0.065***	0.037***	-0.122***	0.048***	0.048***	0.026***	-0.121***	0.049***	0.047***	0.025***
	[0.017]	[0.007]	[0.007]	[0.004]	[0.028]	[0.011]	[0.012]	[0.006]	[0.028]	[0.011]	[0.012]	[0.006]
Secondary	-0.313***	0.121***	0.122***	0.070***	-0.204***	0.081***	0.080***	0.043***	-0.202***	0.081***	0.078***	0.042***
	[0.019]	[0.008]	[0.009]	[0.006]	[0.039]	[0.016]	[0.016]	[0.009]	[0.039]	[0.016]	[0.016]	[0.009]
Tertiary	-0.531***	0.206***	0.206***	0.118***	-0.340***	0.134***	0.134***	0.072***	-0.331***	0.133***	0.129***	0.070***
	[0.024]	[0.013]	[0.011]	[0.008]	[0.055]	[0.024]	[0.022]	[0.013]	[0.055]	[0.024]	[0.022]	[0.013]
Male headed household	0.024	-0.009	-0.009	-0.005	0.045	-0.018	-0.018	-0.01	0.045	-0.018	-0.018	-0.009
	[0.021]	[0.008]	[0.008]	[0.005]	[0.030]	[0.012]	[0.012]	[0.006]	[0.030]	[0.012]	[0.012]	[0.006]
Age	-0.000**	0.0001***	0.0001***	0.0001***	0.027***	-0.011***	-0.011***	-0.006***	0.027***	-0.011***	-0.011***	-0.006***
	[0.002]	[0.001]	[0.001]	[0.001]	[0.008]	[0.003]	[0.003]	[0.002]	[0.008]	[0.003]	[0.003]	[0.002]
Wealth quintiles (Lowest is the reference)												

Lower	-0.117***	0.045***	0.045***	0.026***	-0.132***	0.052***	0.052***	0.028***	-0.133***	0.054***	0.052***	0.028***
	[0.014]	[0.006]	[0.006]	[0.004]	[0.021]	[0.008]	[0.009]	[0.005]	[0.021]	[0.009]	[0.009]	[0.005]
Middle	-0.178***	0.069***	0.069***	0.040***	-0.163***	0.065***	0.064***	0.035***	-0.165***	0.066***	0.064***	0.035***
	[0.015]	[0.006]	[0.006]	[0.004]	[0.023]	[0.009]	[0.010]	[0.006]	[0.023]	[0.009]	[0.010]	[0.006]
Richer	-0.226***	0.088***	0.088***	0.050***	-0.205***	0.081***	0.081***	0.043***	-0.204***	0.082***	0.079***	0.043***
	[0.016]	[0.007]	[0.007]	[0.005]	[0.028]	[0.012]	[0.012]	[0.007]	[0.029]	[0.012]	[0.012]	[0.007]
Richest	-0.289***	0.112***	0.112***	0.064***	-0.288***	0.114***	0.113***	0.061***	-0.286***	0.115***	0.111***	0.060***
	[0.019]	[0.008]	[0.008]	[0.005]	[0.033]	[0.015]	[0.014]	[0.009]	[0.033]	[0.015]	[0.014]	[0.009]
Rural residence	0.011	-0.004	-0.004	-0.002	0.01	-0.004	-0.004	-0.002	0.011	-0.004	-0.004	-0.002
	[0.011]	[0.004]	[0.004]	[0.003]	[0.017]	[0.007]	[0.007]	[0.004]	[0.017]	[0.007]	[0.007]	[0.004]
Religion (No religion is the reference)												
Catholic	-0.188***	0.073***	0.073***	0.042***	-0.160***	0.063***	0.063***	0.034***	-0.161***	0.065***	0.062***	0.034***
	[0.040]	[0.016]	[0.016]	[0.009]	[0.054]	[0.021]	[0.022]	[0.012]	[0.054]	[0.022]	[0.021]	[0.012]
Protestant	-0.184***	0.071***	0.071***	0.041***	-0.135**	0.053**	0.053**	0.029**	-0.136**	0.055**	0.053**	0.028**
	[0.039]	[0.015]	[0.015]	[0.009]	[0.053]	[0.021]	[0.021]	[0.012]	[0.053]	[0.021]	[0.021]	[0.011]
Muslim	-0.074*	0.029*	0.029*	0.017*	-0.054	0.021	0.021	0.011	-0.057	0.023	0.022	0.012
	[0.043]	[0.017]	[0.017]	[0.010]	[0.058]	[0.023]	[0.023]	[0.012]	[0.058]	[0.023]	[0.022]	[0.012]
Region (Nairobi is the reference)												
Nyanza	-0.001	0.0001	0.0001	0.0001	-0.101**	0.040**	0.040**	0.021**	-0.101**	0.041**	0.039**	0.021**
	[0.027]	[0.010]	[0.010]	[0.006]	[0.045]	[0.018]	[0.018]	[0.010]	[0.045]	[0.018]	[0.018]	[0.010]
Western	0.068**	-0.026**	-0.026**	-0.015**	0.016	-0.006	-0.006	-0.003	0.015	-0.006	-0.006	-0.003
	[0.029]	[0.011]	[0.011]	[0.006]	[0.043]	[0.017]	[0.017]	[0.009]	[0.043]	[0.017]	[0.017]	[0.009]
Rift valley	0.046*	-0.018*	-0.018*	-0.010*	0.023	-0.009	-0.009	-0.005	0.021	-0.008	-0.008	-0.004
	[0.026]	[0.010]	[0.010]	[0.006]	[0.038]	[0.015]	[0.015]	[0.008]	[0.038]	[0.015]	[0.015]	[0.008]
Central	-0.032	0.013	0.013	0.007	-0.033	0.013	0.013	0.007	-0.031	0.012	0.012	0.007
	[0.029]	[0.011]	[0.011]	[0.006]	[0.043]	[0.017]	[0.017]	[0.009]	[0.043]	[0.017]	[0.017]	[0.009]
Eastern	0.057**	-0.022**	-0.022**	-0.013**	0.045	-0.018	-0.018	-0.01	0.047	-0.019	-0.018	-0.01
	[0.027]	[0.011]	[0.011]	[0.006]	[0.040]	[0.016]	[0.016]	[0.009]	[0.041]	[0.016]	[0.016]	[0.009]
North Eastern	0.207***	-0.081***	-0.081***	-0.046***	0.193***	-0.076***	-0.076***	-0.041***	0.196***	-0.079***	-0.076***	-0.041***
	[0.043]	[0.017]	[0.017]	[0.010]	[0.063]	[0.025]	[0.025]	[0.014]	[0.063]	[0.026]	[0.025]	[0.014]
Coastal	0.073**	-0.029**	-0.029**	-0.016**	0.084*	-0.033*	-0.033*	-0.018*	0.085**	-0.034*	-0.033*	-0.018*

	[0.029]	[0.011]	[0.011]	[0.006]	[0.043]	[0.017]	[0.017]	[0.009]	[0.043]	[0.018]	[0.017]	[0.009]
Relationship to household head (Reference: Head)												
Wife	0.009	-0.003	-0.003	-0.002	-0.017	0.007	0.007	0.004	-0.018	0.007	0.007	0.004
	[0.025]	[0.010]	[0.010]	[0.006]	[0.036]	[0.014]	[0.014]	[0.008]	[0.036]	[0.014]	[0.014]	[0.008]
Daughter	-0.067***	0.026***	0.026***	0.015***	-0.026	0.01	0.01	0.005	-0.026	0.01	0.01	0.005
	[0.024]	[0.009]	[0.009]	[0.005]	[0.036]	[0.014]	[0.014]	[0.008]	[0.036]	[0.015]	[0.014]	[0.008]
Other relative	-0.059***	0.023***	0.023***	0.013***	0.021	-0.008	-0.008	-0.004	0.024	-0.01	-0.009	-0.005
	[0.022]	[0.009]	[0.009]	[0.005]	[0.037]	[0.015]	[0.015]	[0.008]	[0.037]	[0.015]	[0.015]	[0.008]
Not related	0.225***	-0.087***	-0.088***	-0.050***	0.166**	-0.065**	-0.065**	-0.035**	0.159**	-0.064**	-0.062**	-0.033**
	[0.041]	[0.017]	[0.016]	[0.009]	[0.068]	[0.028]	[0.027]	[0.015]	[0.069]	[0.028]	[0.027]	[0.015]
Observations	4,687	4,687	4,687	4,687	2,229	2,229	2,229	2,229	2,229	2,229	2,229	2,229
Standard errors in brackets		*** p<0.01, ** p<0.05, * p<0.1										

References

Aguero, J.M. and Marks M.S. (2008), Motherhood and Female Labor Force Participation: Evidence from Infertility Shocks, *American Economic Review: Papers & Proceedings* 98(2), 500–504

_____(2011), Motherhood and Female Labor Supply in the Developing World: Evidence from Infertility Shocks, *Journal of Human Resources,* 46(4): 800-826

Amemiya, T. (1978), The estimation of a simultaneous equation generalized probit model. *Econometrica* 46(5):1193–1205

Angrist, J.D., and William N. E. (1998), Children and their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size. *American Economic Review,* 88(3): 450–77.

Becker, G. (1994). Human Capital Revisited. *In* Becker, G.S (ed). 1964. *Human Capital: A Theoretical and Empirical Analysis with Special. Reference to Education*. Chicago: University of Chicago Press. *Human Capital*. Chicago: University of Chicago Press. http://www.nber.org/chapters/c11229.pdf.

Becker, G.S. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy*, 70(5): 9-49.

Becker, G S., & N. Tomes (1986). Human Capital and the Rise and Fall of Families. *Journal of Labour Economics,* 4 (3, Part2): S1-39.

Blackburn, M., D. Bloom, and D. Neumark (1990). Fertility Timing, Wages, and Human Capital. *NBER Working Paper 3422.* Cambridge, MA: National Bureau of Economic Research.

Bollen K.A., D.K. Guilkey and T.A. Mroz. 1995. "Binary outcomes and endogenous explanatory variables: Test and solutions with an application to the demand for contraceptive use in Tunisia". *Demography,* 32(1): 111–31.

Cahuc, P., and Zylberberg, A. (2004). *Labor Economics*. Cambridge, Mass.: MIT Press.

Card, D. 2001. "Estimating returns to schooling: Progress on some econometrics problems". *Econometrica,* 69: 1127–160.

Chun, H., and Oh, J. (2002). An instrumental variable estimate of the effect of fertility on the labour force participation of married women. *Applied Economics Letters*, 9(10), 631–34.

Connelly, R., DeGraff, D., Levison, D. and McCall, B. (2006), Tackling Endogeneity: Alternatives for Analysis of Women's Employment and Child Care in Brazil, *Feminist Economics*, 12(4): 561-597

Diagne, A. and B. Diene. 2011. "Estimating returns to higher education: A survey of models, methods and empirical evidence". *Journal of African Economies,* 20: iii80–iii132.

Escudero, V., & L.E. Mourelo (2013). *Understanding the drivers of the youth labour market in Kenya*. ILO Research Paper Series No. 8. Geneva: ILO.

Ferre, C. (2009). Age at First Child: Does Education Delay Fertility Timing? The Case of Kenya. *WB working paper*.

Field, E. & A. Ambrus (2008). Early marriage, age of menarche, and female schooling attainment in Bangladesh. *Journal of Political Economy*, 116(5): 881-930.

Florens, J.P., J.J. Heckman, C. Meghir and E. Vytlacil. 2008. "Identification of treatment effects using control functions in models with continuous, endogenous treatment and heterogeneous effects". *Econometrica*, 76: 1191–206.

Behrman J.R. & J.C. Knowles 1999. Household Income and Child Schooling in Vietnam. *World Bank Economic Review*13(2):211-56

Economic Commission for Africa (2005). Meeting the Challenges of Unemployment and Poverty in Africa. *Economic Report on Africa 2005*. Addis Ababa, Ethiopia.

Gertler P. & P. Glewwe. 1990. The Willingness to Pay for Education in Developing Countries. *Journal of public Economics* 42:251-275.

Glewwe P. & H. Jacoby. 1994, Student Achievement and Schooling in Low Income Countries: Evidence from Ghana. *The Journal of Human Resources* XXIX (3): 843-864

Glick P. C. Handy & D. E. Sahn (2015). Schooling, Marriage and Age at First Birth in Madagascar. *Population Studies*, 69 (2): 219-236.

Herrera C. & D. E. Sahn (2015). The Impact of Early Childbearing on Schooling and Cognitive Skills among Young Women in Madagascar. Cornell Food and Nutrition Food Policy Programme Working Paper.

Ikamari, L. (2005). The effect of education on the timing of marriage in Kenya. *Demographic Research,* 12 (1): 1-28.

ILO, (2016), Women at Work: Trends 2016 International Labour Office – Geneva: ILO

Kabubo-Mariara J., M. Kamui, Machio P. & A. Wambugu (2017). The Link between Education, Ferility, Marriage and Labour Market Transitions among youth in Kenya. Evidence from Qualitative data. ELMTP/GrOW, Working Paper No. x.

Kabubo-Mariara, J & D.K. Mwabu (2007). Determinants of School Enrolment and Education Attainment: Empirical Evidence from Kenya. *South African Journal of Economics*, 75 (3): 572-593

Kahraman, B. (2011). Youth Employment and Unemployment in Developing Countries: Macro Challenges with Micro Perspectives. *Graduate Doctoral Dissertations. Paper 36*

Kenya National Bureau of Statistics and ICF International. (2015). Kenya Demographic and Health Survey 2014. Rockville, Maryland, USA: KNBS and ICF International.

Klepinger D.H., Lundberg, S., & R.D. Plotnick (1995). Adolescent Fertility and Educational Attainment of Young Women. *Family Planning Perspectives* volume, 27: 23-28.

Klepinger, D., S. Lundberg & R. Plotnick (1999). "How Does Adolescent Fertility Affect the Human Capital and Wages of Young Women?" *Journal of Human Resources* 34(3): 421-48.

Leibowitz, A. (1974). Home investment in children. *Journal of Political Economy,* Volume 82: 2, Part2 (S111-S131

Loughran, D.S., & J.M. Zissimopoulos (2004). Are there Gains in Delaying Marriage? Effects of Age at first Marriage on Career Development and Wages. Rand working paper WR-207. Santa Monica, CA: RAND

Machio P, Kabubo-Mariara J., & A. Wambugu (2017b). Educational attainment, marriage, age at first birth, and employment among young men and women in Kenya. ELMTP/GrOW, Working Paper No. x.

Mammen, K. & C. Paxson (2000). Women's Work and Economic Development. *Journal of Economic Perspectives*, 14 (4): 141-164.

Marchetta F. & D. E. Sahn (2015). The role of education and family background in marriage, childbearing and labor market participation in Senegal. IZA DP No. 8876

Mankiw, N. G., Romer, D. & Weil, D. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107(2): 407-437.

McElroy, S. (1996), 'Early Childbearing, High School Completion, and College Enrolment: Evidence from 1980 High School Sophomores. *Economics of Education Review*, 15: 303-324

Mills, M. & P. Präg (2014) Gender inequalities in the school-to-work transition in Europe. *Short Statistical Report No. 4*. European Commission.

Mincer, J. (1958). Investment in human capital and personal income distribution. *The Journal of Political Economy*, 66(4): 281-302.

Moore, K.A. & L.J. Waite (1977) Early Childbearing and Educational Attainment, *Family Planning Perspectives,* 9(5): 220-225.

Petrin, A. and K. Train. 2009. “A control function approach to endogeneity in consumer choice models”. *Journal of Marketing Research*, 47: 3–13.

Republic of Kenya (2003), “Report of the 1998/99 Labour Force Survey”. Nairobi: CBS.

Republic of Kenya (2008). *Labour Force Analytical Report – Based on the Kenya Integrated Household Budget Survey (2005/2006)*, Kenya National Bureau of Statistics (2008). Nairobi: Government Printer, Nairobi, Kenya.

Rivers, D., and Vuong, Q.H. (1988) Limited information estimators and exogeneity tests for simultaneous probit models. J Econ 39(3):347–366

Schultz, T. P. (1997). Demand for Children in Low Income Countries, in M. R. Rosenzweig and O. Stark (eds.), *Handbook of Population and Family Economics*. Amsterdam: Elsevier Press, pp. 349–429.

Silles, M.A. (2016), The impact of children on women’s labour supply and earnings in the UK: evidence using twin births, *Oxford Economic Papers*, 68(1): 197–216

Spierings, N., Smits, J., & M. Verloo (2008). Micro and Macro-Level Determinants of Women’s Employment in Six MENA Countries. *NiCE Working Paper 08-104*. Nijmegen: Nijmegen Center for Economics.

Strauss J. and D. Thomas, 1995. “Human Resources: Empirical modeling of household and family decisions” In J. Behrman and T.N. Srinivasan, eds., *Handbook of Development Economics*, Vol. 3. Amsterdam; North-Holland.

Terza, J.V., Basu, A., and Rathouz, P.J. (2008). Two-stage residual inclusion estimation: Addressing endogeneity in health econometric modeling. *Journal of Health Economics*, 27(3), 531–43.

Ukil, P.(2015), Effect of Fertility on Female Labour Force Participation in the United Kingdom, *The Journal of Applied Economic Research* 9(2): 109–132

United Nations Development Programme (2013). *Kenya’s youth employment challenge.* Discussion paper. New York.

Vuluku, G., Wambugu, A. & E Moyi (2013). Unemployment and underemployment in Kenya: A gender gap analysis. *Economics, 2* (2): 7-16.

Webbink, D., N.G. Martin & P.M. Visscher (2009). Does Teenage Childbearing on Years of Education

World Bank (2010). 2010 World Development Indicators. Washington, DC: World Bank