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Fertility in East Africa countries

The role of socioeconomic factors in East Africa 1998-2010

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Abstract

This paper examined and identifies the important determinants of Fertility decline in East Africa countries using a panel data set from world development indicator data base (WDI) for eight selected East African countries between 1998 and 2010. Panel regression methods were used to determine the impact of socioeconomic determinants on fertility. Fertility rate reduced in a slow pace during the period 1998 and 2010 in all selected East Africa countries. The results show that among socioeconomic factors urban population growth, women secondary school enrolments, HIV prevalence rate, adolescent fertility rate and inflation rate are the dominant significant determinants of fertility rate. However, one of the most unexpected finding in this study concerns the relationship between infant mortality rate and fertility rate. Infant mortality rate negatively related to fertility. The results found in this paper confirm the interpretation that modernization has created the improvement of socioeconomic opportunities which were important for the fertility decline. However, the magnitude of socioeconomic factors effect on fertility levels seems not strong as expected, there is a need to manipulate the socioeconomic factors operate through proximate determinants in order to have further impact of socioeconomic factors on fertility. Therefore, socioeconomic intervention policies should revise and implement to achieve further reduction of fertility in East Africa countries.

Key words: Fertility, socioeconomic determinants, East Africa.

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1. Introduction

1.1. Fertility Trends

Since the 1960's, many developing countries have experienced rapid fertility decline, the tempo of the decline appears to have been slower in Africa. Overall, the total fertility rate of the developing world dropped from 6.0 births per woman in the late 1960s to 2.9 births per women in 2000-2005 (United Nations 2007) but fertility rates still higher in sub-Saharan Africa region than other developing regions. In sub-Saharan countries an average women birth rate had 6.0 children per women until 1980s and also in East Africa countries which has higher than 6 children and the average total fertility rates in sub-Saharan Africa was still 5.1 children per women in 2009 and population grew at 2.5 percent a year in average during the 2000s (United Nations 2009). Despite these high rates, available literatures show that fertility decline has spread to most of sub-Saharan African countries over the past twenty years (Kirk and Pillet, 1998; Shapiro, 2007; Tabutin and Schoumaker, 2004). In the mid 1980s only a few sub-Saharan countries had experienced a significant decrease of its fertility, by the early 2000s, fertility had started to decline in most sub-Saharan countries at different pace (Tabutin and Schoumaker, 2004).This fertility decline is linked to modernization and although the beginning of the desire of limiting family size preference, increased the family planning and a positive progress of socioeconomic determinants are usually seen as the main driver of the fertility decline.

Kenya is the most cited example of a country in which fertility rates may have increased over this period. Historical fertility estimates for Kenya are available from the 1962 Post-Enumeration Sample Census, the 1969 Census, and the 1977 National Demographic survey. At face value, the data from these sources indicate that fertility rose dramatically from 5.3 births per woman in 1962 to 6.6 in 1969 and to 8.0 in 1977. Extensive manipulation resulted in official estimates of fertility in the earlier periods being revised to 6.8 for 1962 and 7.6 for 1969. It is now apparent, however, that the whole shape of the age-specific fertility distributions derived from both the 1962 and 1969 censuses were almost certainly biased. Despite all the official data massaging, total fertility rate estimates for 1962 and 1969 were probably still too low. Fertility probably increased in Kenya during 1962-77, probably due to a reduction in pathological sterility and shorter birth intervals because of declines in breastfeeding and postpartum abstinence, but the true extent of the increase is unknown (Cohen, 1998). In other side Kenya has started to decline fertility also recorded the rapid decline from 1977 to 1998 from 8.1 to 4.7 birth per women and this decline is due to rapid change in the behaviors about family planning and increasing contraceptive practice (Askew et al., 2009:6-7). However, evidence found in East African countries that the decline fertility are not consistence, many of those countries have experienced economic and political crises or repeated war and this unsustainable condition may have an impact on fertility decline, for example, evidence from the recent demographic health survey between the year 1998 until 2000 the border conflict between Ethiopia and Eritrea indicated that fertility decline began in both countries (Woldemicael, 2008:3) and also Uganda was experienced in civil wars that stagnant the economy and highly educated population led to fertility decline (Ntozi and Ahimbisibwe, 2001:6) and also other East Africa countries war, famine and political violence had an impact on fertility on different time.

In most countries of East Africa, population growth rates and the total fertility rate are still high. It is well known from demographic history of the world and from recent and current country experiences that levels of socioeconomic development have power full influence on

fertility change (Casterline, 2001b). Previous literatures discussed the various socioeconomic factors that served to maintain fertility at high level in Africa, especially in East Africa. As indicated earlier by the early 1980s, total fertility rate which is the key indices of fertility was beginning to fall in few Africa nations. Over the past twenty years, scholars provide evidence that the spread of fertility decline throughout sub-Saharan region including the selected countries in this study (Shapiro and Tambashe, 2003, Shapiro et al., 2003).

This paper uses the panel data set drawn from the World Bank (world development indicator and Global development finance data base) from the year 1998 through 2010 in different East African countries to explore the impact of socioeconomic variables on fertility. Socioeconomic differential in fertility arises mainly because of socioeconomic deferential in marriage, contraceptive use and postpartum infecundity (Cochran and Farid, 1990). Socioeconomic factors that have important influence in lowering fertility rates are linked to modernization such as, education attainment, labor force participation (especially for women's), rural/urban residence, health facilities and family planning service. And in Africa especially in East Africa HIV/AIDS also must be raised as one factor from many that influences fertility rates. The main aim of this study is to investigate the impact of socioeconomic factors such as, adolescent fertility rates, women's education (gross school enrolment), real GDP growth, infant mortality rate and HIV/ADS prevalence's on fertility and explain the relationship between fertility decline and these various socioeconomic factors from the result of panel regression and distinguish which of these factors are more pronounced impact for the current pattern of fertility rates and identifies the most important factors so that, it will indicates the governments should give more attention on those key sectors to further fertility decline.

1.2. Aim and Research Problem

East Africa is an important region to study in part because of fertility rate started to decline very slowly and it has lagged behind other region in terms of both economic development and in terms of fertility decline and demographic transition. The aim of this paper is to analyze the role and effects of socioeconomic determinants of fertility in selected East African countries and distinguish which of these factors are more pronounced impact for the current pattern of fertility decline during the periods 1998 to 2010 and identifies the most important factors so that, it indicates the governments should give more attention on those key sectors to develop and implement appropriate policy and strategies to further reduction of fertility rates

The main research question is: - what were the determinants of for the recent fertility decline in East Africa selected countries during the period 1998 and 2010? This paper uses data from WDI data source and other sources, for the period 1998 and 2010 to examine the recent status of fertility decline in those selected countries and although the study link modernization to fertility decline based on the Easterlin and Crimmins (1985) model that socioeconomic modernization factors affect fertility directly and indirectly through operating the proximate determinants. The Easterlin and Crimmins framework characterized by fertility decline from natural fertility to deliberate control fertility during the demographic transition period as well as characterized by from the high fertility to low level fertility (Easterlin and Crimmins, 1985). This study investigate the impact of socioeconomic variables on fertility by using panel regression analysis and to determine the impact of socioeconomic factors on fertility trend such as GDP growth, inflation, adolescent fertility, HIV prevalence, education, infant mortality and urbanization. The results will identify the important socioeconomic factors for the decline of fertility in East Africa countries from the year 1998 to 2010. The result in line

with the expectations of modernization to link fertility to GDP growth, inflation, adolescent fertility, education of women, infant mortality, urban population growth and HIV/AIDS prevalence. The study link to the previous study on different part of Africa region has found that socioeconomic variables have been crucial important factors for fertility decline.

1.3. Outline of the study

Chapter two will discuss the general background, theoretical background and previous research, explain the socioeconomic factors of fertility and discuss previous researches related to those socioeconomic factors followed by the hypothesis. The data and methodology part are presented in chapter three followed by variable description and Descriptive statistics. The fourth chapter will present the empirical analysis and discussed the empirical results in chapter five. Finally, the conclusion section will present in chapter six.

2. General Background, Theoretical Background and Previous Research

In this topic I would to discuss a very brief overview of theoretical bases of the analysis of fertility in East Africa selected countries will be outlined. Fertility can be analyzed from many various point of departure. Many different determinants that directly or indirectly influence fertility levels have been emphasized in the study and many researchers have taken the point of departure in socioeconomic, biological and demographic determinants. Many debates focused on fertility decline was associated to the proximate determinants. However, other insight may arise on the effect of various socioeconomic developments on fertility and the impacts of socioeconomic factors operate through a various proximate determinants. Various theories emphasize the role of socioeconomic characteristics of a society on fertility, of which Demand theory, wealth flow theory and the theory of diffusion are belong to the demographic transition theories.

2.1. Overview of theories

Economic, sociologic and psychological theories, plus empirical cases will now be discussed, leading towards the analytical frame that will later be employed.

The classic demographic transition theory was sketched by Thompson (1930) and Notestein (1953) (see in Kirk, 1996). According to this classical transition theory, Modernization was attributing the main cause of demographic transition that every society that undergoes modernization will have a decline in fertility (Kirk, 1996). The term modernization associated with industrializations and urbanization shift from high fertility to low fertility and high mortality to low mortality. Modernization initially led to decline mortality through improvement in health and nutrition and, subsequently, to a decline in fertility through improvement in economic and social conditions that make children costly to raise and reduce the benefits of large families. Education is often identified as one potential driving force to this fertility decline. The demographic history of several European countries consistent with the classic demographic transition theory, that from the late 18th century onward, fertility and mortality declined in response to urbanization, industrialization and improvement of economic and social conditions (Mason, 1997). Classic transition theory is more successful and scholars use this theory extensively. However, Demographic transition theory has been the subject of critical debate among demographers in recent years. Hirschman (1994), for

example, has questioned its overall utility. He has correctly observed that "over the past few decades' intensive research on demographic change in historical and contemporary societies has revealed complex patterns that do not fit neatly into earlier theoretical schema" (Hirschman, 1994). Together with this, the major weakness of demographic transition theory has the weak association of measure of modernization and fertility (Cleland and Wilson, 1987). The general concept of modernization complex and it is difficult to specify the component of modernization. I support many scholars that the characteristics of the demographic transition in developing countries, especially in Africa, differ from those of the transition in many European countries.

Caldwell theory of wealth flow (Caldwell, 1976) restated the demographic transition theory that in society of every type and stage of development, fertility characteristics is rational, and high or low fertility depends on economic benefit to individuals, parents and families in its being so. The existence of high or low fertility is as a result of social conditions, essentially by the direction of intergenerational wealth flow. At the heart of this theory the idea that in traditional society wealth flow theory associated with fertility decline because the wealth flow has been from younger to older generations, implies children of traditional society, as earlier workers, which increase family income. While in modern society, the net wealth flow is from older to younger generation, which implies parent invest more time, money and other resources to children with little expectation of returns. The main cause of for this reversal wealth flow was the socioeconomic modernization also called Westernization process, which marked by the spread of the capitalistic behaviors and mass Education. Although Westernization characterized by changing extended family toward the social, emotional and economic nucleation of smaller family (nuclear family), that are more economical, emotional and effective relative to large family (Caldwell, 1976). In conclusion, according to Caldwell wealth flow theory family nucleation (nuclearization) a key deriving force for fertility decline.

Cultural Theories of Demographic Transition

According to Diffusion theory, explanations of fertility decline as a result of innovation idea and behavioral change which spread from person to person, from group to group and from region to region (Cleland and Wilson, 1987). In other word, the theory explains diffusion of information, knowledge and new ideas about birth control. Cleland and Wilson (1987) indicated that in Africa it is difficult to associate the fertility decline and diffusion theory.
Moreover, according to the ideational theory fertility change explained by culture variables that is variation in religious beliefs, individualization and secularizations and according to this theory, fertility change is largely socially controlled. Now a days diffusion is an essential process in the explanation of fertility, but the links between culture and diffusion have yet to be clearly articulated and empirically tested (Hirschman, 1994)
From the above theories, it is indicate that socioeconomic factors (modernization) influence the fertility regulation. In line with these theories, socioeconomic development, particularly urbanization, expansion of education and improving health facilities are some of the important driving force for fertility decline. Generally during the Demographic transition period three steps are involved.
1. In the pre-industrial society modernization is characterized by high mortality rate and fertility rate.

2. At the early stage of modernization mortality begins to decline but fertility remains high.

3. Finally at end of demographic transition, in the developed society both fertility and mortality decline at low level.

Based on these theories it is noticed that socioeconomic factors play a great role in fertility regulation. According to the enthusiast of this theory, the end result of developed society is a fall in fertility rates.

Economic Theories of Fertility

The economic approach to fertility first proposed by Becker (1960) explain three key factors at the root of fertility decisions: the income of the house hold; the price of children (the relative cost of children versus other goods and services); and the preference for children versus competing form of consumption. The microeconomic theory of fertility also known as the demand theory of fertility, that Becker (1960) considering both Malthusian and Darwinian approach to population. According to Becker (1960) the demand for children considered to vary with income, child costs, knowledge, uncertainty, and testes. An increase in income and a decrease in price have typically led to an increase of the demand for children, although it is important to recognize the quantity and quality of children may also choose to maximize the number of descendants in the next generation (Becker, 1991). Becker (1960) explains the theory of the demand for consumer durables is a useful framework in analyzing the demand for children. As consumer durables, children are assumed to provide 'utility'. The utility from children is compared with that from other goods by way of a utility function or a set of indifference curves. The quality of children directly associated to the increase of the income, which should increase the amount of expenditures per child. For instance, children of traditional farm families typically work on the family farm, which increase the family's income and decreases the relative price of children. This explains why traditional farm families have been much larger than urban families. At the same time the consequence of modernization led to increase the cost for the demand of children due to the spread of new life style and require greater investment in education and health, which implies the increase of the amount of expenditures on children. On the other hand, some of the economic benefits parents may derive from children, fore example household labor, income, and old age security, falls as a result of the modernization such as industrialization and urbanization. The assumption of net cost of children rises is criticized by Cleland and Wilson (1987) because empirical evidence do not provide any correlation between changing labor utility of children and the fertility response.

2.2. Conceptual framework

In the analytical framework there is an underlying assumption that fertility are affected by exogenous (indirect) as well as endogenous (direct) factors. The exogenous factors are mainly socioeconomic character whereas the direct factors are the proximate determinants, In general, the biological and behavioral factors through which socioeconomic, cultural, and environmental variables affect fertility are called proximate determinant of fertility (Bongaarts, 1978). In the economic and sociological perspective, fertility can be considered a function of both demand and supply determinants. Davis and Blake (1956) framework is perhaps the one which emphasized the role of socioeconomic factors affecting fertility. Demand factors that influence the level of interest in or motivation for fertility control and supply factors that influence the availability of information and service for fertility control. Demand factors include the basic factors of fertility such that socioeconomic, cultural and social factors that give initiate to interest or motives to limit family size. On the other hand

supply factors include proximate determinants of fertility that is a necessary mechanism or instrument through which demand gets expressed in actual behavior (Davis and Blake, 1956).

2.2.1. Easterlin-Crimmins model

Easterlin and his colleagues developed the Supply-Demand theory to identify and measure the determinants of fertility. The main important factors in Easterlin's model are the supply of and demand for children and the cost of fertility regulation. Those factors are the base for the analysis of fertility. They have made a sophisticated effort to combine economic and sociological approach of fertility decline. The demand factors include the standard socioeconomic determinants of the fertility transition used in the modernization hypothesis. The supply factors are environmental and cultural factors that constraint natural fertility. The level of fertility is affected by direct and indirect determinants. The indirect factors mainly of the socioeconomic character whereas direct are referred to as proximate determinants. For example education has an influence on fertility through influencing directly age at marriage or use of contraception (Bongaarts, 1978). Bongaarts (1978) identifies eight proximate determinants: marriage, contraception, induced abortion, lactation, infecundability, fecund ability, spontaneous intrauterine mortality and sterility, through which socioeconomic and cultural factors affect fertility. Therefore, an adaptation of this framework is used in this study in order to identify the socioeconomic factors affecting fertility in East Africa selected countries.

The basic assumption of the analytical framework by Easterlin is that socioeconomic (modernization) and other proximate determinates are viewed as an important factors affecting reproductive outcomes by operating through the following three mediating variables.

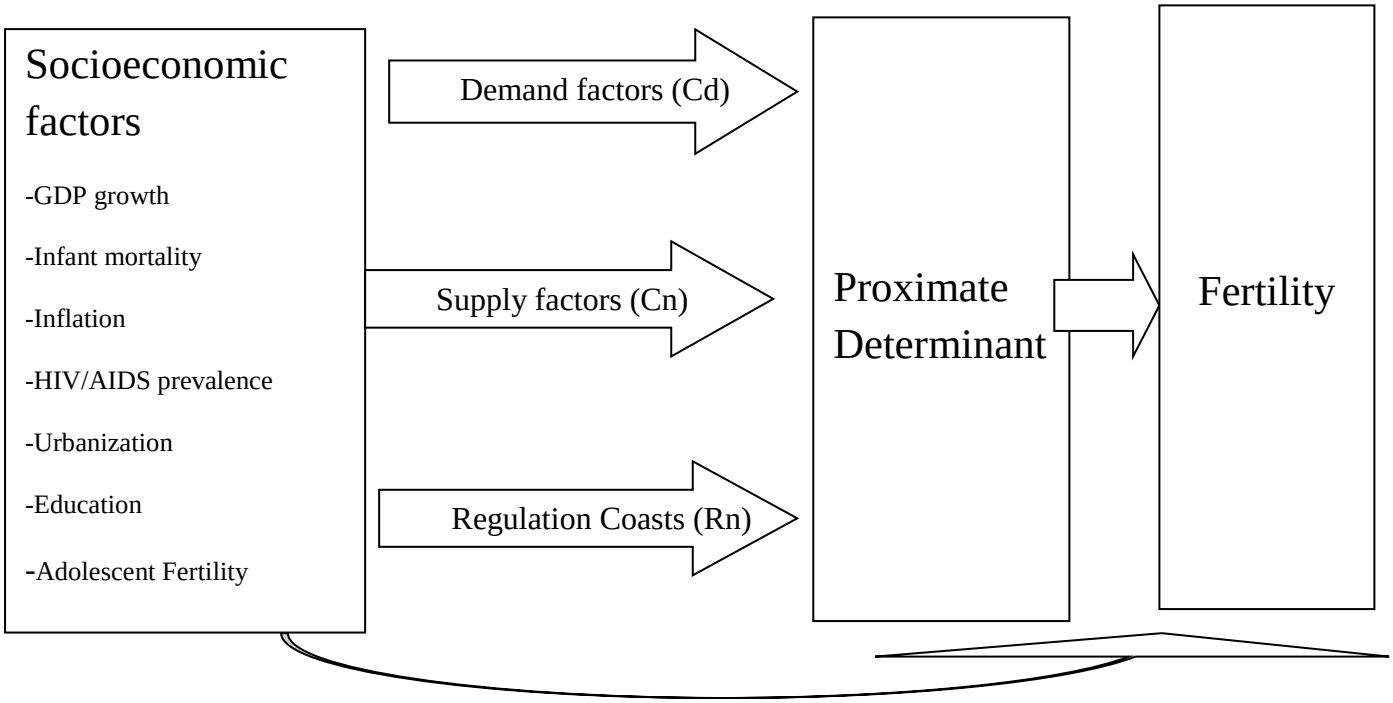
Demand for children: - the number of children parents would want if fertility regulation were costless.

The supply of children: - the number of surviving children couples would have if they did not deliberately limit fertility.

The cost of fertility regulation: - includes the economic, physical, health and social costs required to learn exercise family planning (Esterlin, 1975: 55).

Esterlin's framework shows how modernization influences fertility through intervening variables of supply, demand and cost of controlling birth.

The link between socio-economic determinants and fertility in the Easterlin-Crimmins model



Adjusted based on Easterlin-Crimmins model

The above model shows the pathway through which socioeconomic factors are likely to operate to influence fertility. Socioeconomic factors affect fertility both directly and indirectly through intermediate (proximate) variables. However, in this paper, special attention is paid to socioeconomic factors that affect fertility and identify the most crucial important variables for the decline of fertility in eight selected East6 Africa countries from 1998 to 2010. GDP growth, inflation, education, infant mortality, urbanization and adolescent fertility variables used in this paper that affect fertility directly and indirectly through proximate determinants. It is generally hypothesized that as socioeconomic development, fertility will decline. For example as education increase fertility will decline. Fertility is either curve linear or negatively related with education but the relationship between fertility and low level educations is weak (Cohen, 1993). Furthermore fertility can also indirectly affect by socioeconomic variables.

It is generally hypothesized that, the more education a woman has, the older her age at marriage. In fact, increase of women's education increase the age at which women marry, and thereby postpone the age at first birth, leading therefore to a decline in fertility, because of the reduction of childbearing span. Furthermore, education gives knowledge and information on contraceptive methods which may also lead to a decline in fertility (Bongaarts, 1978).

2.2. Literature review

The following section consist of an over view of previous research for the selected East Africa countries linked with various theories discussed above.

Previous research on fertility in East Africa countries is based on demographic transition. Transition theory is based on functionalism (parson, 1937., see in kirk, 1996). Where individual behavior is viewed as statistical group needs through group enforcement of social norm and mores (Notestein, 1949., see in kirk, 1996)). In this theory prior to modernization or economic development mortality was high and in order for a society to be viable, social norms and more involved to encourage high fertility (Jeon et al., 2008:12). Demographic transition theory indicated that mortality decline due to the increase socioeconomic factors such as industrialization, urbanization, high literacy and improved on health care. So it leads to fall in fertility. This theory indicates the causal relationship between mortality and fertility. The enthusiast of this theory argues that prior to economic development there was high death rate and birth rates. However, in the start of modernization or economic development reduce high fertility by reducing mortality. The earliest transition theories were based on the experience of developed countries in the early stage of industrialization, but evidence of transition theory were revised based on the experience of low economic countries i.e. African countries. For example Dyson and Murphy (1985) indicate that birth rate has often risen with modernization instead of remaining stagnant and high as a transition theory predicts. Caldwell (1976) also revised a transition theory for Africa indicated that fertility start rise with economic development (modernization). His theory is based on the experience of developing countries. Caldwell revision of transition theory based on family structure and fertility in Africa linked with the concept of wealth flow. According to his theory wealth flow among generation from younger to older in time of economic needs. In economic developed countries, wealth flow are downward, family based transfer occurred from where parents are expected to provide for children's economic well-being.

Based on Caldwell revision in Africa when one of the family members got a problem in economic need due to famine, work lose or other seasonal hardship, society or family members often financially support. In developed countries these wealth flow were in the form of social insurance and social security programs. Caldwell discusses the start of fertility increase indicated by Dyson and Murphy in term of wealth flow transfers that based on experience of developing countries. Caldwell contends the modernization allowed families to diversify the occupational mix, to reduce risk (Caldwell, 1976).

When modernization began in Africa, the increase of modern sector allowed extended families to reduce the risk because young adults could be employed in modern sector in a wide variety of occupation. Incomes in this modern sector are not likely highly associated with incomes in traditional agriculture and the increase of the modern sector presents opportunity for large families to reduce the risk as long as there are wealth transfers with in the extended family. Hence, the expansion of the modern sector creates an incentive for having a larger family because larger families can reduce risk by taking modern sector employment and by choosing a more diverse number of careers. Therefore, it might be expected that fertility would initially rise with modernization. This fertility rate eventually decline because the strength of the bond tying member of an extended family will begin to weaken. These bonds will weaken with time and distance. Many of the modern sector jobs will be in urban areas, which may be far from hometown and may have a different cultural environment. This economic change in urban area creates that higher wage urban job

eliminating many agricultural jobs and people move to a town to work in a factory. The strength of the bond tying with large families may be strong after moving but after time will start to weaken. Therefore, as Caldwell indicated fertility initially rise with modernization will began to decline (Jeon et al., 2008).

Wasao (2001) using multivariate analysis found that urban residence and high level of education associated with lower fertility in Cameron. In Mozambique also similarly result found that modernization led to low fertility (Wasao, 2001)

Cohen (1993) investigates the relationship between education and fertility in sub-Saharan African countries; found that education is either curve linear or negatively associated with fertility. However, the relationship between fertility and low level education is weak.

According to Martin (1995) used data from DHS survey for 26 countries to examine the relationship between education and fertility. The comparative analysis confirms that higher education is consistently associated lower fertility. Education affects fertility through age at marriage, family-size preference, and contraceptive use. However, a considerable diversity exists in the magnitude of the gap between upper and lower educational level and in the strength of the association. Martin (1995) also argues that education enables women's ability to make reproductive choice.

Imai and Sato (2008) using three rounds of NSS and NFHS Indian data over the period 1992 - 2006 investigate the relationship between women education and fertility applying econometric models. They found an evidence of mother's education significantly associated with reduction in fertility. They suggest that the influence of women's education is more pronounced on fertility decline. They conclude, promoting women's education, together with facilitating female labor force participation, would very important to reduce fertility further.

Garenne and Joseph (2002) using data from DHS and WFS (world fertility survey) in 30 sub-Saharan Africa countries by using innovation approach to investigate the cause of fertility decline. The result indicate that in many countries, fertility started to decline in the late 1960s and 1970s in urban areas, and about 10 years later in rural areas. This implies urbanization play a major role in inducing fertility decline. On the other hand, they did not find any clear evidence of correlation between mother's education levels and fertility decline. For example, Ghana and Kenya had higher level of mother education level than other sub-Saharan countries in the early 1960s but still low level of fertility decline. Jejeebhoy (1995) underscores the general inverse association between education and fertility, however, such effect may be less or even reversed if socioeconomic development low enough. Rutstein (2002) used data from 1993-1995 DHS surveys in 43 countries of sub-Saharan Africa, Asia, middle east and north Africa, Latin America and the Caribbean to examine the socioeconomic factors on fertility found that women who have secondary school and above have lower fertility rate than for women with primary or no education and also urbanization positively correlated with fertility decline.

Shapiro and Gebreselassie (2008) used data from DHS to examine the status of fertility transition in sub-Saharan countries. They focus the link between socioeconomic factors and fertility decline and stalling. They found an evidence of significant negative association of education, infant and child mortality and GDP growth. They emphasize the importance of

women's education as a key factor contributing to fertility decline, in large part because of the correlation with marriage, contraceptive use and infant and child mortality. They also found that fertility decline stronger in urban areas.

Jeon et al. (2008) used panel data set for 47 Africa countries between 1962 and 2003 and applying both fixed and random effect regression method. They examined the impact of infant mortality, GDP growth, urbanization and the prevalence of HIV/AIDS. They found that all mentioned variables have a significant negative impact on fertility. However, Kalemli-Ozcan (2006) use data on 44 countries from Africa for the period 1985-2000 and employ panel regression to examine the impact of HIV/AIDS prevalence on total fertility rate. The key finding shows that HIV/AIDS positively correlated with fertility rate, implies parents who are faced high mortality rates choose to have more children. This finding inline with fertility transition theory that high demand for children in the face of uncertainty about child survival.

Lindstrom and Berhanu (1997) using the result of 1990 Ethiopian National Family and Fertility Survey investigate the short-term and long-term fertility responses to famine, political unrest and economic decline by using logestic regression method. They found an evidence of significant short-term marital conception probability decline during the year of famine and major political and economic unrest and in the long-term fertility falls in the 1980s (major economic crises occurred during 1980s) as a result of deterioration of economic conditions. The result confirms that decrease in GDP growth and high inflation rates associated low fertility rates. On the other hand, they reported increase women's education and family planning are not sufficient explanation for the decline of fertility in Ethiopia during 1980s.

2.3. Background to East African countries

East African is the poorest and least developed region in the world. Maternal mortality, infant mortality still high and HIV/AIDS highly expanded. In this region fertility has been declined but it remained high as compared to other world countries. Of course the pattern of fertility decline varied in time and also the speed of fertility decline in East Africa countries is uneven. Figure 1, Shown below present the total fertility rate for 16 countries of sub-Saharan Africa in three consecutive surveys which is conducted the first survey around 1993 to the recent survey around 2004. From the figure 1 below divide 16 countries in to three categories

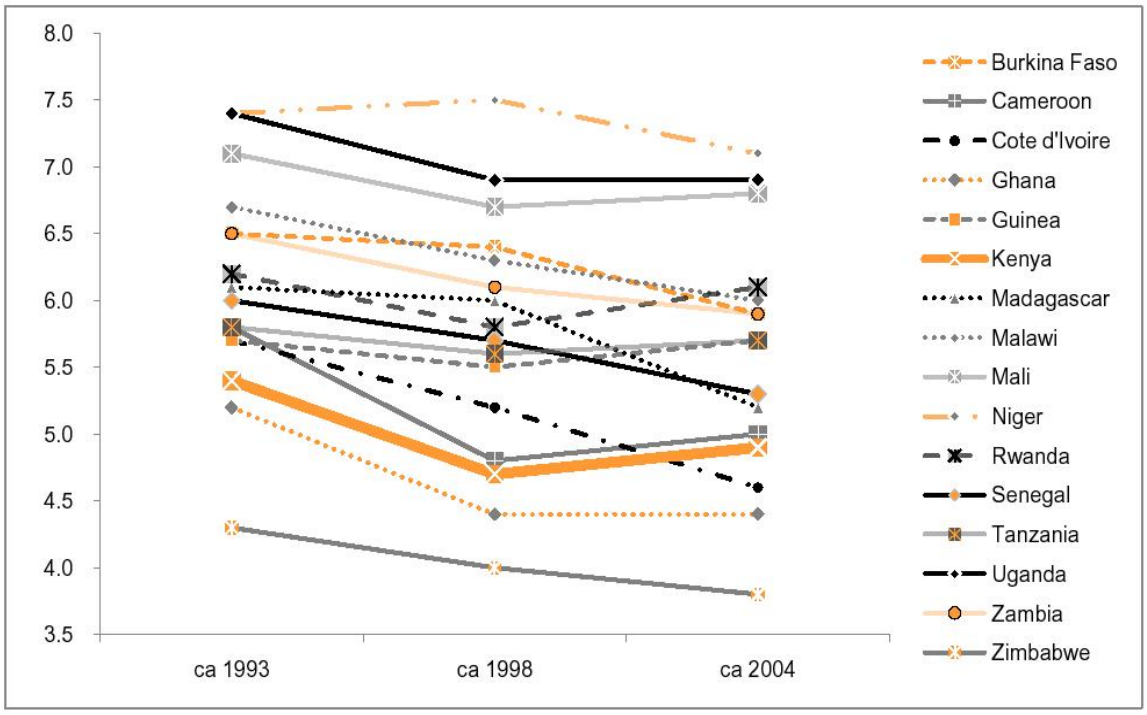
1. Stall transition: Cameron, Ghana, Guinea, Kenya, Mali, Rwanda, Tanzania and Uganda

2. Insignificant decline: Zambia and Zimbabwe

3. Significant decline: Burkina Faso, Cotdivoire, Madagasekar, Malawi, Niger and Senegal (Ian A et al 2009, P 5).

The four East Africa countries (Kenya, Rwanda, Tanzania, and Uganda) categorized stalled fertility transition and all these countries are increased total fertility rate in the last two surveys.

Figure 1: Trends in fertility of 16 sub-Saharan countries with three DHS surveys



Source: Bongaarts 2008

2.4. Fertility pattern in East Africa countries from the year 1998-2010

East Africa is an important region to study the fertility pattern because fertility is still extremely high compared to other world countries. The trend of fertility levels from the year 1998 through to 2010 in selected East Africa countries provided by the data in Figure 2, which shows the total fertility rate for each selected country. For the selected eight countries from East Africa region, all are experienced fertility decline except Kenya. According to bongaarts (2008), Kenya has been categorized as a mid-transition classification with Ghana and Cameron. In East Africa region, Kenya has experienced a rapid fertility decline. Not many years ago, the total fertility in Kenya was more than 8 children per women, among the highest in the world (Kirk and Pillet, 1998). Although, Kenya still has high total fertility rate in 2010 with 4.47 children per women.

For the selected East Africa countries included in this paper, the total fertility rate in the recent year (2010) ranges from 3.56 children per women in Djibouti to 6.01 children per women in Uganda. In Djibouti the total fertility rate steeply decreased from 5.05 children per women in 1998 to 3.56 children per women in 2010 and as shown in figure 2 below, Djibouti has an experience of lower fertility trend compared to other East Africa countries and rose in GDP growth from -0.75 % in 1998 to 2.32 % while HIV prevalence slightly decreased from 4.0 in 2000 to 3.80 in 2007 and then 3.4 in 2010 and in other side Uganda experienced quit higher fertility rate it has been an average consistently above six children per women between 1998 and 2002. Uganda's total fertility rates slightly decreased between 1998 and 2010 from 6.94 to 6.01 children per women which is among the highest total fertility rate in Africa.

Many surveys have found evidence that fertility in urban areas lower than from the rural area all over the world. For example Egypt's total fertility rate in urban areas is 3 children per

women and in rural areas 3.8 children per women, in Ethiopia 3.3 children per women in urban areas and 6.4 children per women in rural areas, likely in Uganda it is 4 children per women in urban areas and 7.4 children per women which is the highest from other countries in rural areas (Moses and Kayizzi, 2007:2). In general, the decrease of total fertility rates lower in urban areas than in rural areas. In Uganda the GDP growth rate rose from 4.905 in 1998 to 7.24 in 2009 and decline to 5.18 in 2010. However, there is a significant increase in GDP from 6.33 in 2005 to 10.78 in 2006 and inflation also rose from 3.76 in 2000 to 9.40 in 2010 while HIV prevalence of adult population fall from 11.90 in 1998 to 5.80 in 2010.

Ethiopia is among one of the least developing countries from East Africa with highly populated and ranked the 2nd populated nation from sub-Saharan and experienced high fertility rates. The total fertility rate still high only small decline from 6.41 in 1998 to 4.12 in 2010 and Ethiopia recorded high GDP growth, increased from 6.07 in 2000 to 10.13 in 2010 and also on the other side HIV prevalence of adult improved; it decreased from 2.8 in 198 to 2.3 in 2010. As mentioned above there is a clear difference in fertility level between urban and rural areas and also between regions due to different in socioeconomic factors and the impact of poverty on fertility decline in major town of Ethiopia is significant (Eshetu and Mace, 2008).

In Rwanda over a million people died in the 1994 genocide and at the same time population increased due to the return of over million people at the end of the war that are former refugees in abroad countries. Many researchers had found evidence that fertility rates decline during the period of genocide crises. Rwanda demographic health survey in 2005 indicated that the total fertility fall from 8.5 in 1983 to 6.2 in 1992, then a very small decline of total fertility rate 6.1 in 2005, this small decline that fertility rate decline by 0.1 children per women from the year 1992 until 2005 because of the return of genocide in 1994, it slow down the fertility transition (Chandrasekhar et al., 2007:2). From the source of world development indicator data base total fertility rates in Rwanda slightly decline from 5.91 in 1998 to 5.16 in 2010. While the GDP growth fluctuate in the interval between the year 1998 to 2010 from 8.10 % to 7.94% but in 2002 GDP growth by 11% and 0.30% in 2003 and HIV prevalence decreased from 6.2 in 1998 to 3.0 in 2010. Like other countries, in Rwanda also the urban area fertility rates lower than the rural fertility. From the three consecutive demographic health survey the total fertility rate decline from 6.3 in 1992 to 5.9 in 2000 and then increased in 2005 to 6.3 in rural areas and in urban areas total fertility rates increased from 4.5 in 1992 to 5.8 in 2000 then again decreased to 4.9 in 2005.

In Tanzania the fertility rate decline from 5.74 in 1998 to 5.37 in 2010 while GDP growth from 3.71 in 1998 to 7.00 in 2010 and like other sub-Saharan countries HIV/AIDS infection level is high, during the year interval between 1998 to 2010, However, it decreased from 7.8 to 5.8 during these period.

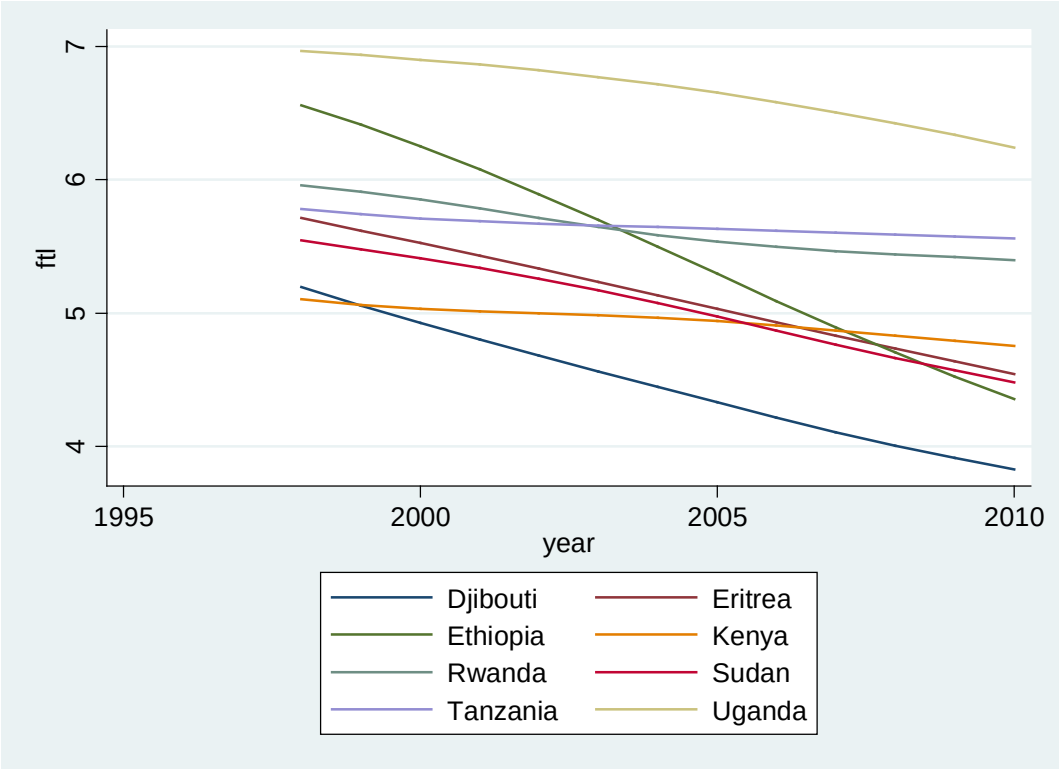
HIV prevalence decreased in Sudan and Eritrea from 2.1 and 2.4 in 1998 to 21.85 and 1.75 in 2010, respectively and fertility also decline in both countries and in both although political unrest have contributed an impact for fertility decline and like other countries the urban rural fertility differential exist.

From the world development indicator (WDI) fertility has fallen across all selected East Africa countries in the year between 1998 to2010. Despite in compared to other countries a higher total fertility rates decline has been recorded in Djibouti followed by Ethiopia, Eritrea and Sudan, where fertility has fallen by 2.5, 2.3, 1.3 and 1.25 children per women during the

study periods, respectively. In Keya and Uganda also there has been decline of 0.9 children per women in the study period. In Rwanda and Tanzania also a slight decline of fertility rate recorded, where there has been a decline of 0.74 and 0.40 children per women during the study periods.

In general, Fertility trend discussed above confirmed many researchers' arguments that East African countries like other sub-Saharan countries are still at early and pre-transition fertility levels with slow pace of fertility decline. And this slow pace of fertility decline pattern has been explained across the countries and within the period largely as a resulting from socioeconomic differences among countries and socioeconomic variables suspected to play a key role on fertility decline further.

Figure 2. Trends of total fertility rate in eight East African countries from 1998 -2010.



2.5. Factors that influence the pattern of Fertility

In this section I explain several factors contributing to the differences in fertility pattern and behavior. I look the impact of these factors from the year 1998 to 2010 from the World Bank data base in each selected East Africa countries.

Education and Fertility

Women education is one the most important socioeconomic factors that mostly used by demographers that influencing fertility control behavior and educations, gives for every women the opportunities, the knowledge, the ability and decision making and the potential to manipulate and control her environment, basically marriage, work, fertility and so on. The

length of schooling is highly related with the beginning of women reproductively (fertility) and mortality.

"Caldwell (1980) hypothesized that the fertility decline in developing countries would link with the achievement of mass formal schooling by which he mean near–universal enrollments of children in primary or basic school" (Lloyd et al., 2000:483).
In most least developing countries, especially in Africa education system is owned by privately or publically (UNDP, 2003), however, due to the quality of the education most people prefer private institution rather than public but in developing countries most children learn in public school because of economic hardship. Nevertheless, the united nation's human development report in 2003 indicates that many parents prefer to keep their male children in school and dropout their female children because of social belief that male children are future asset for family. This has thus created a great knowledge inequality between the male and female children belonging to the same household or cohorts. However, the female education improvement has contributed equally and similar socioeconomic implication and positive impact toward any countries especially, in developing countries (UNDP, 2003). Many scholars indicated that girls education as to be influencial and having a positive impact compared to boys education in term of social development in societies. For instance, Cross sectional evidences, summarized by Jejeebhoy (1995) indicated that age at first marriage and first birth among women are strongly related to length of schooling in nearly all low and medium income countries.

Women educations have an impact on women social status and dominate behavior of women, for example contraceptive use and women education status has positive relationship. With few exception women education level increased contraceptive use, knowledge of women also rise monotonically and also when women education level increased and women age at first marriage and women age at first birth also increased. This behavior has an impact on fertility of women. Education has an impact directly on the demand for children, the supply and the regulatory cost of fertility (Easterlies and Crimmins, 1995; Cleland and Hobcraft, 1987). It indicate the dominant behavior of fertility transition postponed child bearing decision and decreases the demand of children, in response to the social changes, including education the main influential force of fertility changes. In developing countries especially in sub-Saharan countries assure to this perspective. And falling demand for children in the last two-three decades because of the increase in the use of contraception. Therefore, education obviously has an impact on fertility of couple by providing information about preventing pregnancy and child birth.

Infant Mortality

Demographic transition theory assumes that a fall in infant mortality should lead to a decrease fertility rate. The theory indicates that infant mortality decrease over time, fertility rate reduced with a potential long lag. And evidence of previous work of scholars indicate that the reason for the fall of infant mortality are industrialization, urbanization, improvement in living standard and better health facilities may also lead to a fall in fertility. On the other hand according to Easterlin (1975) infant mortality play a major impact on fertility decline via the impact on the supply of children and ultimately on the motivation for fertility control. Evidence indicated that Africa countries follow a classic pattern of demographic transition in which fertility decline is correlated with that fall in infant mortality, which is linked with modernization (socioeconomic development and improvement health facilities). On the evidence of earlier literatures, a decrease in infant mortality is expected to decrease the

fertility rate, a small number of infant mortality decreases the demand for children and decrease infant mortality also decrease the riskiness and increase the expected return of investment in child quality, which may lead to further decline.

Economic aspect of Fertility (GDP growth and Inflation)

The current economic situations in Africa countries likely to have a serious impact on education, employment opportunities and standard of living which linked to the modernization that led to fertility transitions. Many literatures and historical records indicated that there is a fertility decline seen in response to economic crises. It is crises led transition. Boserup indicated that the Africa economic crises are seriously shaking in the post independence aspiration and that growing economic constraints may have a considerable effect on the individual calculus (Boserup, 1995: 391).

In Africa especially in East Africa urban areas educated young women and men delay child bearing to get job because of job opportunity and salary difference by education seems very narrow because of economic fluctuation. This makes sense in developing countries especially in urban areas that economic fluctuations affect the standard of living, which in turn delayed the birth rate or terminate child bearing. Many developing countries were experienced high rate of population growth. This population growth uses many countries as a power for rapid economic development in the exception of Africa. Economic development induces the fall in fertility. The fertility decline in the Africa countries began later than elsewhere, the main causes of the delay of fertility transition in Africa are obvious, that the first stage of demographic transition that is mortality decline began recently, before two or three decades and economic development also not much successfully in Africa. Fertility decline in other developing countries has been the result of economic development, accompanying by increasing industrialization. In this situation the increased population engaged by different occupation that eventually induced lower fertility.

In most African countries, especially in East Africa countries which were the poorest region that modernization and urbanization still low, the status of women also low in those less economic developing countries, their roles mostly is to be obedient and giving birth and the responsibility for the families' consumption. This indicate East African women has low economic position and unable to support themselves. This economic hardship for women indicated an impact on fertility. Earlier works suggest that GDP per capital and inflation rates, indicators of economic development, are an important variable that associated to fertility. Higher GDP per capital implies improvement in income lead to higher fertility. This positive relation ship between income and fertility is a key component of Malthusian theories (Davis & Blake, 1956). However, according to the classic theories the positive association between income and fertility exist in the short run and it could be negative in the long run. Therefore the improvement of economic development implies higher GDP per capital, which tend to increase the return to invest to child quality may led to decrease the current demand for children. However, in Friedlander and Silver (1967) study, the effect of income on fertility varies at different stage of economic development. Easterlin (1975) indicated income of the generation have a great influence for fertility change. He assumed there is extended families in natural fertility regimes and also assumed in developing countries have poor health and nutrition, so as he said poor health and nutrition cause for the desire of house hold to reduce family size and fall fertility rate. On the other side improvement of health and nutrition might increased fertility, at fertility transition onset. "Eventually the parental testes for large families is assumed to be an inverse function of the parents per capital income and as per capital

income increases more and more families restrict fertility, eventually setting in motion the down ward trend in fertility''(Donaldson, 1991:13). In this study the GDP growth rate are used as a proxy for income. On the evidence of earlier literatures, it is difficult to predict the association of fertility rate and GDP growth. However, given higher economic development and the rising opportunity of cost of time, we expect a negative association between GDP growth and fertility rate.

On the other hand, on the bases developed countries experience those economic crises played a major role in their fertility decline. Since the fluctuation of inflated price may led to a lower standard of living, which may depressed the demand for children and likely to increase the relative cost of having children. And also high unstable economy (fluctuation of inflation) may increase uncertainty about the future, which might also deter family expansion. In this study, we expect a negative correlation between inflation and fertility.

Urbanization and Fertility

Urbanization Explain women lived in urban area have access to inter to formal school and getting a chance of participating in labor market and having the ability to decide about her and have a better knowledge of smaller family size and modern contraceptive use. East Africa countries still the last by the level of urbanization (the proportion of population that lived in urban areas) from the world and also recorded as the highest growth in urban area (the percentage increase in urban population per annum). Up through the late 1980s, sub-Saharan countries was the only major region in which fertility transition had not started (Lesthaeghe, 1989) but during the past two-three decades those countries entered in to fertility transition and a few countries have strong evidence of fall in fertility. Even prior to the emergence of fertility decline at the national level, there were clear signs of fertility decline in urban areas (Jolly and Gribble, 1993), with fertility being especially low in capital cities as compared to other urban and rural areas (Cohen, 1993). This prior emergence of fertility decline in urban also shared by East Africa countries which is part of sub-Saharan region and this evidence of fertility decline supported by the theoretical framework, that is the benefit of parents having large number of children diminished in urban than in rural areas. Alternatively, onset of fertility transition in urban areas is integral to innovation-diffusion theories emphasizing urban settings as places of innovation in fertility behavior (Reed et al., 1999). Schooling enrollments are higher in urban area than in rural area, which implies increasing the cost of children to parents who live in urban area and bringing into play quality-quantity tradeoffs. So from the evidence of many literature urbanization have a negative impact on fertility transition.

HIV/AIDS and Fertility

HIV/AIDS spread faster worldwide, for example in 2008 people living with HIV/AIDS were estimated about 32 million and from those more than 90 percent of the infected people living in developing countries and from those more than two-third of infected people from the world total living in Africa (Juhn et al., 2008:2).

In developing countries, especially in sub-Saharan Africa high level of young mortality has increased rapidly because of the expansion of HIV/AIDS epidemic and although life expectancy in those countries decrease rapidly. It seems that AIDS will fall the population growth rate in Eastern Africa by increasing mortality rates. Although HIV/AIDS has an impact on the reproductive decision of infected women and men and it will affect fertility.

HIV epidemics have become a significant influence on fertility and it badly affected areas of sub-Saharan Africa. Population based survey in south western Uganda (Gray et al., 1998) and analyses of data from antenatal clinics in a number of other countries shows that 25-40 percent of lower fertility in women with HIV (Gregson, 1999b), while some of this sub–fertility prior disposition to other sexually transmitted infections (STIs) among HIV incident cases, about half result directly from the infection itself (Gregson et al., 199b:104). The relationship between HIV and fertility rates are associated with demographic factors, such as HIV slowdown the population growth by increasing mortality (Gregson, et al., 1999b:104).

Using household data from South Africa and relying on between cohort variation in country levels HIV infection and fertility, he estimates a large negative effect of HIV prevalence on fertility (Juhn et al., 2008:2). In Kenya and Lesto, that recorded high HIV prevalence, the effect of community HIV prevalence on fertility of non effected women actually positive and significant (Juhn et al., 2008:3), From the results of their analysis HIV infection more in urban areas with a highly educated population and for those with higher economic activities. Many researches found evidence that HIV positive women reduce fertility by about 40 percent in most of African countries. In Uganda a cross sectional analysis indicated that HIV reduced pregnancy rate by about 55 percent (Gray et al., 1998) and Carpenter et al., (1997) and Hunter et al (2003), in their cohort studies in Uganda and Tanzania indicated that HIV reduced probability of becoming a pregnant by about 30 to 40 percent. Fecundity is decreased by HIV infection because of discouraging still birth and high rate of co-infection with other sexual transmitted infection, which may cause secondary infertility (Juhn et al., 2008:9).

HIV/AIDS is transmitted sexually disease, it is reduced largely by changing sexual behavior. In Africa many literature found that small change or no change in sexual behavior. Oster (2005) suggest that the relative little response in sexual behavior may be in part explained by low level of knowledge about the disease. Data from DHS survey show that the percentage of female population that request an HIV tests, gets tested and received results is very small, the mean being 5.7 percent across ten African countries with an average level of compressive knowledge about the disease is only 30 percent. There is little evidence that countries with higher prevalence have better knowledge (Juhn et al., 2008:10). However, knowledge alone may not account for the change but in East Africa life expectancy and income of individual are very low, may have an influence for the behavioral change of sexual activities.

Young found that strong evidence of the limit in willingness to engage in unprotected sex is a major component of the overall fertility response to HIV/AIDS (Young, 2005). On the other hand a women who are infected by HIV/ADS and women who have knowledge about mother–child transmission want to limit fertility. Allen find an evidence that using cohort data from Rwanda, Kigali HIV positive women and HIV positive women with no children more likely to become pregnant and 45 percent of HIV positive women wants to have children (Allen et al., 1993). HIV/AIDS response to fertility may decrease, first direct biological and physiological impact on effected women, secondly through change in sexual behavior and the last one is by reducing in willingness to engage in unprotected sex (Juhn et al., 2008:11).

2.6. Hypothesis Testing

Among Africa countries, the selected East Africa countries are experiencing substantial reduction of fertility rate. Thus, this reduction of fertility rate depends up on the socioeconomic factors. Based on the previous researches and theories the following hypothesis will be exploring and this will indicates which factors are more associated with fertility decline in the selected East Africa countries and seeks plausible answers for the research questions.

The hypothesis to be tested in this analysis

1. Economic factors such as GDP growth and inflation rates have negative effect on fertility. Based on the theories and previous research for both economic variables, we assume that GDP growth and inflation will have a significant effect on fertility, I would expect that an increase in GDP growth and inflation rates would be negatively associated with fertility, as high in GDP growth and high inflation rates are expected to decrease the fertility levels.
2. The higher the adolescent child bearing is likely to have high levels of fertility. Adolescent fertility would be a positive effect on fertility levels.
3. The high enrollment of women in schooling have a negative impact on fertility, as increase enrollment of women in schooling expected to coincides lower fertility rates; this is true other exogenous factors are constant.
4. A decrease in infant mortality is expected a negative effect on fertility rate.
5. HIV prevalence rate expected lower fertility; I would expect that increase HIV prevalence would be a negative effect on fertility.
6. The increase of urbanization has a negative effect on fertility.

3. Data

In order to test my hypothesis and to estimate fertility trends and to examine which socioeconomic factors affect fertility across the eight selected countries from East Africa region, I used the aggregate level panel data maintained by the world development indicator data base (WDI) from the year 1998 through 2010 and for the missed data in WDI, I used data from http://www.economywatch.com/economic-statistics/ website and UN data base for the missed data for each country to balance the panel data.

The WDI data base a primary world bank data base which is reliable data base provide full of access of 209 countries and the data set provided in structured table and reports in different topic of social and economic indicators for each country of the world starting from the year around 1970s. This data base contains several aggregate East Africa socioeconomic indicators. However, WDI missing some data from the year 1998 to 2010 and I used UN data base and http://www.economywatch.com/economic-statistics/ websites for each selected East African countries for those missed data and also due to the potential data problem few missing date were imputed using linear interpolation.

3.1. Methodology and Model

This study focus the impact of socioeconomic factors on total fertility (represent the number of children that would be born to a women if she were live to the end of her child bearing year and bear a children in accordance with current age specific fertility rate (world bank)) in eight

selected countries of East Africa: Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. The panel data are drawn from WDI data base from the year 1998 to 2010. The empirical analysis will use total fertility rate as dependent variable and independent variables are GDP growth (annual percentage growth rate of GDP at market price based on local currency (world bank)), Inflation (represent the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at a specific interval, such as yearly (world bank)), adolescent fertility rate (represent birth per 1,000 women aged 15-19 (world bank)), prevalence of HIV (represent a percentage of people who are infected with HIV (world bank), urban population growth (represent percentage of people living in urban and rural areas (world bank)), gross school enrollment primary and secondary (gross enrollment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown (world bank)).

The changes of socioeconomic characteristics are key predictor for the fertility decline for this study. The analysis is limited to Eights selected East African countries from 1998 to 2010. In this paper two panel data econometric methodology were employed , the fixed effect and random effect models in order to investigate the effect of socioeconomic determinants on fertility over time and across the selected East Africa countries. The important benefit of Panel data is that it allows not only to look the relationship between fertility and its socioeconomic determinants across the selected East Africa countries but it allows to study those relationship over time and with in countries, though it allows to control for variable that can not be observe or measure such as culture factors. The ordinal least square method is not appropriate methods since it ignore unobserved heterogeneity and it assumes that all countries have similar estimates for all time periods this may lead to omitted variable bias. Therefore I will perform either the fixed effect model or the random effect model using the aggregate panel data for eight selected countries from 1998 to 2010, since the assumption is that all selected countries have different estimates.

In this study the panel data contain both cross-sectional (countries) time series panel data on eight countries from 1998 to 2010. The general benefit of panel data analysis are more informative (more variability, less co linearity, more degree of freedom and estimation are more efficient), enables to look individual dynamics and the most important one is that it accounts unobserved heterogeneity, which means that the dependent variable will vary across countries due to unmeasured country level factors and the disadvantage of OLS regression method, that ignoring this unobserved individual heterogeneity, this may led to omitted variable biases (Verbeek, 2008). As indicated above to analyze the panel data two models are used, fixed effect models and random effect model. The fixed effect model is a simple regression model in which the variables vary over time and the constant term vary over the countries, not over time. In other word fixed effect estimation not suitable for the parameter estimates that do not vary over time. The random effects model is that, unlike the fixed effects model, the variation across countries is assumed to be random and uncorrelated with the dependent or independent variables included in the model. In the random effect model the constant terms are independent of the explanatory variables.

The fixed effect model looked like as follow

$$y_{it} = \alpha_i + \beta_1 x_{1it} + \beta_2 x_{2it} + ... + \beta_k x_{kit} + \varepsilon_{it}$$

Where

– y_{it} is the dependent variable where i = country and t = time.

– x_{kit} represents independent variables (IV).

– β_k is the coefficient for the the independent variables,

– ε_{it} is the error term

– α_i is the unobserved country heterogeneity which correlated with one or more explanatory variables known as fixed (country) effect.

To eliminate the unobserved countries heterogeneity first calculate or perform sequentially the between and within regression. Finally, the OLS estimator of the parameters (β_k) obtained from this within regression called with in estimator or fixed effect estimator (Verbeek, 2004). In Stata, the within estimator is computed by using the xtreg command with the fe option.
The usual standard errors of the fixed effect estimators assume that after controlling for α_i, the error ε_{it} is independent and identically distributed (i.i.d). The standard error of fixed effect estimator usually recognized in the presence of serial correlation and the presence of serial correlation in the panel data makes the estimator less efficient. Therefore, it is advisable to use cluster-robust standard error to solve the problem of existing correlation in the with-fixed effect regression. On the other hand if the assumption of homoskedasticity of the ε_{it} (idiosyncratic error term) with the same variance across countries and time is violated, implies the usual fixed effect estimator are understand in the presence of Heteroskedasticity, then we should use robust standard error to correct the standard error of fixed effect estimators.

The random effect model

$$y_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + ... + \beta_k x_{kit} + (\alpha_i - \alpha) + \varepsilon_{it}$$

Where $\alpha_i - \alpha = v_i$
v_i is a part of the errors and thus should not be correlated to any explanatory variables; otherwise, the OLS assumption is violated and the OLS estimator to be inefficient. While in fixed effect model v_i is part of the intercept. The fundamental difference between fixeds effects and random effects models is that, in the fixed effect model, the αi possibly to be correlated with the explanatory variable $x_{kit,}$ While continuing to assume that x_{kit} is uncorrelated with ε_{it}. In the random effect model, it is assumed that α_i is purely random; the strong assumption implies that α_i is unrelated to $x_{kit.}$

The efficiency of fixed effects and random effects are tested by a Hausman specification test. In the panel models, the FE estimator is consistent in both the RE model and in the FE model. In the FE model it is even efficient, while in the RE model it has good asymptotic properties. By contrast, the RE–GLS estimator cannot be used in the FE model; while it is efficient by construction in the RE model (Verbeek, 2004). The hausman test can be applied to all hypotheses, in which two different estimators are available. The null hypothesis of Hausman test is that if the country effects are independent of the explanatory variables in the model and if we fail to reject this null hypothesis then the random effect estimate is efficient. Otherwise we chose fixed effect. In other word, Hausman test basically compare random effect and fixed effect that the null hypothesis is that the appropriate model is random effect verses the

alternative one of fixed effect. Therefore, according to the Hausman test in this study the null hypothesis is rejected, so that the fixed effect model is selected which implies that the country level effects are modeled by fixed effects estimation. However, I perform both fixed effect and random effect model for comparison purpose. Before the Hausman test, I perform a test for the inclusion of time dummies in our analysis, a test for joint significance confirm that it is not necessary to include time dummies in the model. The Wooldridge test for autocorrelation in panel data, to examine if error terms at time t are correlated with error terms in at time t-1 or t+1, is also run before the Hausman test. The Wooldridge test indicates that the null hypothesis of no first order correlation is rejected. Consequences of autocorrelation are similar to Heteroskedasticity which is common in cross-country panel data, and therefore robust estimators are used in the regressions to compensate for such problem (Verbeek, 2004).

3.2. Variable description

Dependent variable

Total Fertility rates is the dependent variable for the study which measure the number of children that a women will have in her life time given that she survives until her fiftieth birth day by summing the age specific fertility rate (ASFR) for a women, usually aged 15 to 49 (Weeks, 2008).
As shown in the appendix from figure 3 and 4 total fertility rate trend slightly decline from the year 1998-2010 across eight selected countries, and I discussed these trend in the background section of this paper. As this variable does not under go strong yearly fluctuation, the missing data were imputed using linear interpolation.

Explanatory variables

GDP growth

GDP growth is a measure of annual percentage growth of a country. The GDP growth highly fluctuated due to many reasons like war, political violence and economic crises. The scatter plot of GDP growth, Figure 5 in the Appendix, indicates that GDP growth fluctuated over time. Generally as shown in table 2 GDP growth exhibit 19.22 percent positively correlated with total fertility rate and GDP growth seems to good predictor of total fertility rate during the year 1998-2010.

Inflation

In this new millennium our world exposed to an economic crises, East Africa region highly affected by this inflation crises, inflation measure a rise in the general level of prices goods and services in an economy over a period of time that decreases the purchasing power of the money. The scatter plot of Inflation, Figure 6 in the Appendix, indicate that inflation rate are somewhat fluctuated over time and also the degree of fluctuation varies across countries. From the trend of total fertility and inflation rate relationship, it does not have a significant uniformity. Table 2 shows the correlation is negative; indicating the correlation between total fertility rate and inflation rate is about 26 percent.

HIV prevalence

HIV/AIDS are widely spread across the East African region, this wide spread also largely increased in the eight countries selected for this study. HIV prevalence measures the number of infected people, living with HIV. The scatter plot of HIV prevalence, Figure 7 in the Appendix, indicate that HIV prevalence steadily decline over time. The general decrease HIV prevalence might be due to the correlation of other variable such as education and family planning project across the selected East African countries. The overall correlation between total fertility rate and HIV prevalence is 41.21 percent, indicating a positive association between these two variables.

Urban population growth

Urban population growth rate measure the annual growth of people living in urban areas, in contrast rural population growth rate refers the annual growth of people living in rural areas. As discussed in the background section in many literature urbanization and lower fertility have a positive relationship. The scatter plot of urban population growth rate as shown in Figure 8, indicate that urban population growth rate increase slightly from 1998-2005, and then slightly decrease after 2005. The overall correlation between urban population growth rate and total fertility rate is 23.68 percent. It seems good predictor of total fertility rates that have a positive correlation during the year 1998 to 2010.

Women gross school enrolment (primary and secondary)

Education is one of the power full determinants to lower fertility and influencing reproductive behaviors of women. In many literatures discussed educations have a negative impact on fertility and female education play a strong role. “Formal education increases the supply of children by improvements the health conditions, by diffusing knowledge, for instance about personal hygiene, food care, vaccination and by reduction in the length of breast feeding and post–partum assistance” (Ceccato, 2000:4). Ceccato (2000) get an evident that education is the factor that mostly affect fertility trend and affect the supply, demand and the regulation cost of fertility but as he said education play a role for other determinants of fertility by providing information. In this study, I will use the gross primary and secondary school enrolment ratio only for women as in independent variables in addition to others. Gross enrollment ratio measure the total enrollment regardless of age, to the population of the age group. From the scatter plot figure 9, both primary and secondary gross school enrollment rates of women steadily and rapidly increased over time. However, the trend and pattern of secondary gross school enrollment ratio is not higher as compared to primary school enrollment. It is generally belief that low fertility rate associated to high educational level.

Generally as shown in table 2, the overall correlation between secondary school enrollment ratio and total fertility rate is about 45.03 percent. There exists a negative relationship between the two variables. However, the overall correlation between primary school enrollment ratio and total fertility rate is about 50.86 percent, indicating a positive association between these variables.

Infant mortality rate

Infant mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year. Infant mortality play an important role for the reduction of fertility, since declining child mortality increases the supply of children, which gives incentives to families to limit fertility. Figure 10 shows that infant mortality steadily decreases over time. As this variable does not under go yearly fluctuation, the missing data were imputed using linear interpolation. Table 2 shows the overall correlation between these two variables is 32.16 percent and has positive association.

3.3. Descriptive statistics and correlation

As shown in the descriptive statistics of table 1, the total number of observation is 104, n=8 (countries) and t= 13 (years) and by working one lag of the independent variables, the observation are reduced to further to 12 years. As we can see from the table1 all the socioeconomic variables have a big gap between their min and max values, which means that there are a variation in the selected East Africa countries in socioeconomic perspectives. And also we observe that from table1, all the variables included in this study have a within variation, implies unobserved heterogeneity exist, the socioeconomic variables varies with in country level and it confirms that the fixed effect estimation of the panel data model is more preferable and suitable method for the parameter estimation. The descriptive statistics of all the explanatory variables which are included in the analysis are summarized below in table 1 and table 2. Although the scatter plots, presented in Figures 10 to 18 in the Appendix, shows the relationships between total fertility rates and the explanatory variables included in the study. And also we can see from table 2, the correlation between regresses' from the correlation matrix.

Table 1. Descriptive statistics of dependent and explanatory variables.

Variable		Mean	Std. Dev.	Min	Max	Observations	
Country	overall	4.5	2.3024	1	8	N =	104
	between		2.4495	1	8	n =	8
	within		0	4.5	4.5	T =	13
Year	overall	2004	3.7598	1998	2010	N =	104
	between		0	2004	2004	n =	8
	within		3.7598	1998	2010	T =	13
ln_total fertility rate	overall	1.6735	0.1328	1.3421	1.9412	N =	104
	between		0.1198	1.4920	1.8973	n =	8
	within		0.0704	1.4514	1.8619	T =	13
lag_GDP growth rate	overall	5.0415	4.3178	-13.1204	13.5724	N =	96
	between		2.7670	-0.2945	7.7450	n =	8
	within		3.4457	-7.7844	14.2135	T =	12
lag_infant mortality rate	overall	72.8198	13.7239	43.7	117.8	N =	96
	between		10.8376	53.65	88.225	n =	8
	within		9.1919	45.3948	102.3948	T =	12
lag_urban population growth rate	overall	4.2919	0.9237	2.3403	6.5692	N =	96
	between		0.8211	2.8976	5.3211	n =	8
	within		0.5069	2.6084	5.7010	T =	12
lag_gross primary school enrollment rate	overall	80.4635	34.8477	27.45044	154.292	N =	96
	between		34.0286	36.4713	125.0586	n =	8
	within		13.8021	50.5310	113.7391	T =	12
lag_secondary school enrollement rate	overall	21.3686	11.3796	5.49435	56.4641	N =	96
	between		10.6702	10.8331	44.3176	n =	8
	within		5.3688	9.9510	34.6232	T =	12
lag_HIV prevalence rate	overall	4.8063	2.8779	1.6	12	N =	96
	between		2.8876	1.8625	9.1858	n =	8
	within		.9536	2.7547	8.6447	T =	12
lag_adolescent fertility rate	overall	88.2518	43.3245	21.5586	187.3194	N =	96
	between		45.0298	26.5673	165.0201	n =	8
	within		9.1713	62.9409	110.5511	T =	12
lag_inflation rate	overall	8.5440	7.0608	-7.224	36.399	N =	96
	between		4.2578	3.0552	17.4028	n =	8
	within		5.8159	-8.8816	34.7414	T =	12

Table 2.The Correlation Matrix

	ln_total fertility rate	lag_GDP growth rate	lag_infant mortality rate	lag_urban population growth rate	lag_gross primary school enrollment rate	lag_gross secondary school enrollment rate	lag_HIV prevalence rate	lag_adolescent fertility rate	lag_inflation rate
ln_total fertility rate	1.0000								
lag_GDP growth rate	0.1922	1.0000							
lag_infant mortality rate	0.3216	0.2812	1.0000						
lag_urban population growth rate	0.2368	0.1465	0.4432	1.0000					
lag_gross primary school enrollments rate	0.5086	0.4020	0.0787	0.1502	1.0000				
lag_gross secondary school enrollments rate	-0.4503	-0.0945	-0.5211	-0.2140	0.0978	1.0000			
lag_HIV prevalence rate	0.4121	0.0736	0.1054	-0.0839	0.5607	0.1258	1.0000		
lag_adolescent fertility rate	0.7496	0.1075	-0,0932	-0.1690	0.4548	-0.0737	0.6241	1.0000	
lag_inflation rate	-0.2610	-0.2327	-0.5438	-0.0253	-0.0063	0.2899	-0.3290	-0.0957	1.0000

4. Empirical analysis and results

This section presents the statistical result of the fixed effects and random effects regression models which were analyzed using STATA. Both fixed effects and random effects equations are estimated to observe the impact of socioeconomic variables on fertility. As mention above the fixed effect model is the preferable model for this analysis, however, I perform random effect models for comparison. For both regressions, I use robust standard errors to correct for any Heteroskedasticity and Autocorrelations that may exist. Table 3 displays both fixed and random effects models.

The first step of the analysis is to test poolability of the data, which enables to know whether pooling the data is necessary. The null hypothesis of the poolability test is OLS model verse the alternative one fixed effect model. In other word it is a test for the presence of individual (country) effects. As shown in the table3, in the fixed effect model, the probability is 0.000, implies that to reject the null hypothesis of all county effect intercepts equal to zero. In other word the poolability test confirms the presence of country specific effect, which implies OLS estimator is biased and inconsistent.

Now turn to select whether the appropriate model is fixed effect or random effect by using the hausman test. As shown in table 5, the probability is 0.000, which is less 0.05. This indicates to reject the null hypothesis of country specific effects are random. In other word, fixed effects are suitable for parameter estimates and provide consistent estimates. However, as mentioned earlier I used both model for comparison.

Looking the 3rd column of table 3, we see that the random effect model regression results which consider the country-specific effect are random. In the random effect model, the over all R-square is 0.877, suggest that the socioeconomic factors used in the model explain more than 87 percent of the variation in total fertility across countries.

The coefficient of GDP growth, infant mortality rate, women gross secondary school enrollments, HIV prevalence and inflation rates variables show a negative relationship with total fertility rate and significant, either at 1%, 5% or 10% levels. By contrast urban population growth rates, women gross primary school enrollment and adolescent fertility rates variables shows a positive relationship with total fertility rates and all variables are significant at 1 percent level.

Next we turn to fixed effect model, which measure the cross sectional panel data and the country effect are taken as fixed. As shown from the table 3 in fixed effect model, the estimated standard deviation of α_i (sigma_u) is 0.38 much larger than 0.017, which is the standard deviation of ε_{it} (sigma_e). Indicate that the country-specific component of the error is much more important than the idiosyncratic error. All the socioeconomic variables except GDP growth , women gross primary school enrollment and inflation rates were a negative correlation with total fertility rates and significant a 5 percent level but urban population growth and adolescent fertility rates shows a positive correlation with total fertility rates and the coefficient are significant.

Table 3 Fixed and Random effects regression result.

Variable(1)	Fixed(2)	Random(3)
lag_GDP growth rate	-0.0006	-0.0042**
	(0.0006)	(0.0014)
lag_infant mortality rate	-0.0178***	-0.0010*
	(0.0018)	-0.0005
lag_urban population growth rate	0.0025*	0.0121***
	(0.0012)	(0.0021)
lag_gross primary school enrollments rate	-0.0004	0.0017***
	(0.0002)	(0.0002)
lag_gross secondary school enrollments rate	-0.0030***	-0.0040***
	(0.0007)	(0.0006)
lag_HIV prevalence rate	-0.0129***	-0.0127***
	(0.0031)	(0.0032)
lag_adolescent fertility rate	0.0030***	0.0024***
	(0.0004)	(0.0002)
lag_inflation rate	-0.0001	-0.0039***
	(0.0004)	(0.0009)
_cons	2.7678***	1.5313***
	(0.1375)	(0.0322)
N	96.0000	96.0000
r2	0.9439	
r2_a	0.9334	0.8775
rmse	0.0171	0.0485
sigma_u	0.3801	0.0000
sigma_e	0.0171	0.0171
rho	0.9980	0.0000
F Test that all u_i=0	F (7,80) P>F=0.0000	

***significant at 1%, **significant at 5%, *significant at 10%. Robust Standard Errors in parenthesis.

Differences across country (country effects)

The results presented in table 4, indicates the country specific effects of fertility. The result shows the coefficient of the country dummy, which is continuation of table 3 column 2. For obvious reason the country dummy were estimated by using least square dummy variable methods, the unobserved effect is brought explicitly into the model instead of the with in fixed effect approach(fixed effect). However, for both LSDV and the within approach of fixed effect methods yield the same coefficient estimates of the explanatory variables but the only difference between them is in the number of degree of freedom.

Now turn to the results, the coefficient of country-specific dummy variable are statistically significant at 1 percent for all countries except Eritrea, this confirms country specific effect have a strong impact on fertility. Fertility in Rwanda, Tanzania, Uganda, Kenya and Ethiopia are higher than the reference country (Djibouti), by about 0.69, 0.47, 0.43, 0.42 and 0.30 children per women, respectively. On the other hand, fertility in Sudan is lower than the reference country (djibutie), by about 0.50 children per women. However, fertility rates in Eritrea fairly similar to the reference country Djibouti and the inclusion of this dummy variable have no effect on the estimate of the other independent variable included in the model.

Table 4

Variables	LSDV
Other variables as in:	table 3(2)
Eritrea	-0.0396
Ethiopia	0.3011***
Kenya	0.4254***
Rwanda	0.6942***
Sudan	-0.5012***
Tanzania	0.4783***
Uganda	0.4325***

***significant at 1%, **significant at 5%, *significant at 10%.

5. Variable discussion

Economic Variables (GDP growth and inflation rates)

The result from random effect analysis shows that GDP growth rate has negatively associated with fertility and statistically significant, which is inline with my hypothesis and most of the transition theories and previous researches. However, results from fixed effect analysis, GDP growth rate negatively associated with total fertility rate and statistically insignificant.

Under the random effects estimation, inflation rates display a negative coefficient and statistically significant, which shows that an increase with one percent of inflation rates lead to about 0.4 percent fertility decrease. This result is inline with the proposed hypothesis of a negative correlation between inflation rate and total fertility rates. And also the result is similar to what was found by Lindestrom and Berehanu (19997) that the economic crises led to fertility decline in Ethiopia. However, in the fixed effect model, inflation rates were negatively correlated with total fertility rate. This is inline with both the proposed hypothesis and the previous researches but it is not statistically significant.

HIV prevalence

The HIV variable is significantly correlated with lowering fertility in both fixed effects and random effects models. In both model the magnitude of the impact of HIV variable on fertility almost equivalent and the effect of HIV on fertility is small, which shows that a 1 percent increase in HIV prevalence lead to 0.0128 fertility decline, while in the random effects model, a 1 percent increase in HIV prevalence leads to 0.0127 decline of fertility. Therefore, this result support the hypothesis of this paper and Similar result is showed in western Uganda population based survey that HIV epidemic badly influence fertility and analyze the data from antenatal clinics in number of sub-Saharan countries 25 to 40 percent lower fertility in women with HIV, in South Africa using house hold data a similar evidence that large negative effect of HIV prevalence on fertility between country variation (as I mentioned in the theory section). However, other researchers found a contradicted and ambiguous or small negative effect on fertility, for example, Lorentzen et al. (2005) found that adult mortality is positively correlated with total fertility rat, and therefore, this could mean that the increase of HIV/AIDS led to increase fertility. As discussed in the previous research Kalemli-Ozcan (2006), also found that a positive relationship between HIV/AIDS and fertility by using regional data and fixed effect methods implies high HIV prevalence associated to high fertility rates. And also Magadi and Agwanda (2007) found that HIV prevalence have no effect on fertility in Kenya, but indicators of HIV/AIDS awareness seems negatively correlated to overall fertility.

Education

Women education is an important determinate via other socioeconomic factor influencing the fertility decline. And as I mentioned in the theory section of this paper education strongly related to fertility. And women education has highly influence the women status and educated women motivate to delay child bearing to reducing the desired number of children to more effective control of fertility and increase age at first marriage, this led to decline of fertility rate as indicated in developed countries.

Women gross primary school enrollments variable negatively correlated with total fertility rate, that an increase of gross primary school enrollment lead to fall in fertility but not statistically significant in the fixed effect model. Unexpectedly, in the random effect model women gross primary school enrolment has a positive coefficient, that as women gross primary school enrollment increase, the total fertility rate increase and significant at 1 percent level. This unexpected result not inline with the proposed hypothesis in this paper and contradicted with the Caldwell hypothesis that the strong relationship between education and fertility and fertility decline due to the expansion of mass schooling in sub-Saharan countries (Lloyd et al., 2000:511). Similar result obtained from DHS reports only women with primary schooling in Burundi, Cameron, Liberia and Madagascar and women with incomplete primary education in Kenya and Nigeria are found that high fertility than women with no education (Kirk and Pillet, 1998: 10).

On the other hand, the variable women gross secondary school enrollment yield negatively associated with total fertility rate in both fixed effects and random effects models. In both fixed effect and random effect model shows that a 1 percent increase of women gross secondary school enrollment with in a country leads to reduced total fertility rate by 0.003 and 0.004 percent, respectively. This result inline with the proposed hypothesis of a strong negative association of women gross secondary school enrollment with total fertility rate and also supports the conclusion of Shapiro and Tambashe (2003) that women's education is an

important factor for the fall of total fertility rate in sub-Saharan Africa. Similar results also obtained in sub-Saharan Africa, Asia, middle east and north Africa, Latin America and the Caribbean that women with education were forced to delay birth and age at first marriage, lead to fertility decline (Rutstein, 2002). And Kirk and Pillet (1998) indicated that by using DHS national report most of the total fertility decline exhibit women with secondary education and they suggested a strong effect of education on total fertility rate and evidence from united nation report using multivariate analysis of individual data took first round DHS survey for each of the countries in sub-Saharan Africa a significant effect obtained between secondary and higher education and fertility by controlling other socioeconomic variables.

Infant mortality rate

Both the fixed effects and random effects model regression not confirm the proposed hypothesis that infant mortality significantly reduced total fertility rates. The result indicate that a 1 percent increase of infant mortality rates, the total fertility rate decrease by 0.02 and 0.001 children per women for fixed effects and random effects, respectively. This result contradicts the finding of many scholars, that there is a less consistent positive correlation of infant mortality and total fertility rates. The possible explanation for this inconsistent relation ship is that in developing countries is because of the endoginiety of infant mortality, it is not clear to identify the strength and causality of the correlation between infant mortality and fertility. However, the finding of this paper is not inline with the previous researches that decline in lagged infant mortality rate are significantly correlated with fertility decline (Shapiro and Gebreselassie, 2008 and Jeon et al., 2008)

Urban population growth rate

Urban population growth rates variable prove a positive correlation with fertility in both fixed effects and random effects models and significant impact on fertility, which is support the proposed hypothesis of this paper and also inline with the previous research that Caldwell (1993) hypothesis of the population growth rate and fertility are expected to be positively related but percent of urban population is expected negatively correlated to fertility (this variable not included in this paper).

Adolescent fertility rates

Adolescent fertility rate variable shows a positive relationship with total fertility rate and have a significant effect on total fertility rates in both fixed effects and random effects models. When a 1 percent increase of adolescent fertility responsible for a 0.3 percent (in fixed effects model) and 0.2 percent (in random effects model) reduction of the total fertility rates. Therefore, such evidence is support my hypothesis and the theoretical motivation.

6. Conclusion

The study has empirically investigated and identified the socioeconomic determinants of fertility decline in eight East Africa countries from 1998 to 2010 using panel regression method. Its aim is to find the effect of different socioeconomic factors on fertility in eight selected East African countries. From the theory section of this paper and previous research different socioeconomic factor identified that affect fertility in East Africa. The research question of this paper aimed which social and economic factors that was most important for the decline of fertility in those countries during 1998 to 2010. The results of the panel regression reveal interesting insight have substantial impact of socioeconomic determinants on decline of fertility. However, the result shows that the magnitudes of the coefficients of socioeconomic factors of fertility are weak.

We find support for several hypotheses and overall the empirical results displayed the expected result according to the previous researches.
In both fixed effects and random effects model urban population growth, women secondary school enrolments, HIV prevalence rate, adolescent fertility rate and inflation rate are the dominant significant socioeconomic determinants of fertility rate. However, one of the most unexpected finding in this study concerns the relationship between infant mortality rate and fertility rate. Infant mortality rate negatively related to fertility. This may be as a result of infant mortality rate correlated with other independent variables. This result does not support the hypothesis and not inline with both theories and the previous researches that a decrease in infant mortality rate will decrease fertility and these needs further research to understand the relationship.

In general modernization affect selected East Africa countries fertility level during the study period mainly through the improvement of urban population growth, HIV prevalence, inflation rate, adolescent fertility and women secondary school enrollment which were associated with lower fertility and although unexpectedly low infant mortality rate were associated with high fertility rate. The overall results stress the importance of modernization associated with fertility decline such that increase level of industrializations, urbanization, expansion of education and although this change had a significant effect on demand and supply of children and lower fertility regulation cost lead to fertility decline.

Hence, the results found in this paper support the interpretation that modernization has created the improvement of socioeconomic opportunities which were important for the fertility decline. However, the magnitude of socioeconomic factors effect on fertility levels seems not strong as expected, there is a need to manipulate the socioeconomic factors operate through proximate determinants in order to have further impact of socioeconomic factors on fertility. The result also show that the socioeconomic development variation between countries does have a significant impact on fertility decline and this confirm that fertility widely varied between countries in East Africa due to unequal level of industrialization , urbanization and unequal socioeconomic development and improvement of living standard. Because of this it seems reasonable to suggest that this type of analysis should be conducted on country level data.

In conclusion, governments and different organizations policy should be focus on the above important determinants of fertility and socioeconomic intervention policies should revise and implement to achieve further reduction of fertility in East Africa countries.

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Appendix

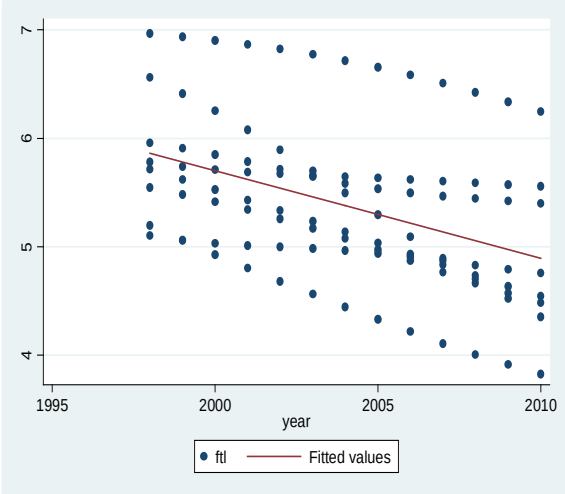


Figure 3 Fertility over time

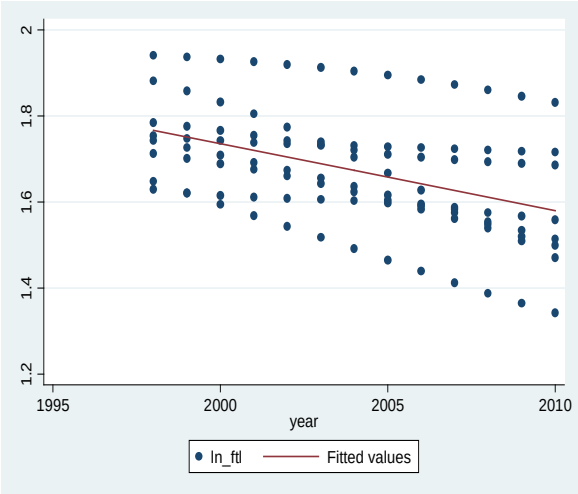


Figure 4 ln_Fertility over time

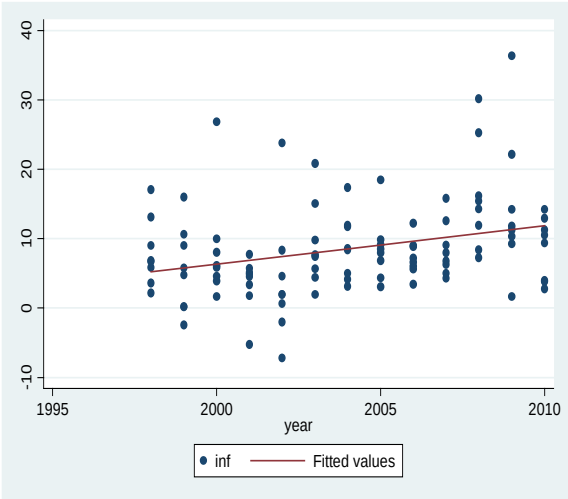


Figure 5 Inflation over time

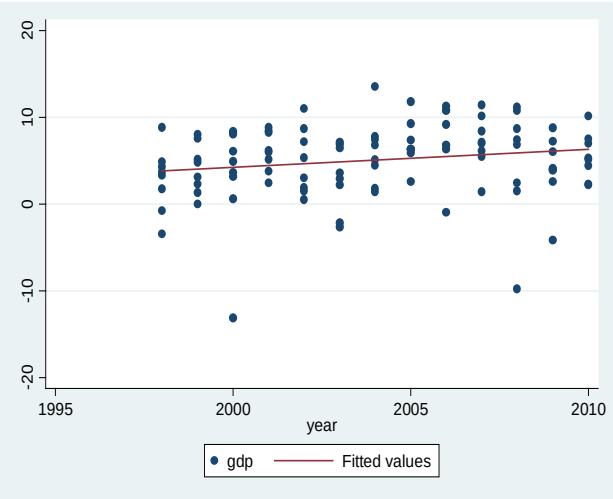
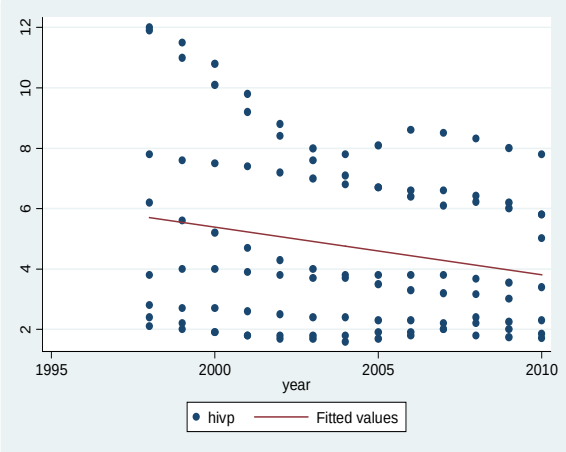


Figure 6 GDP growth over time



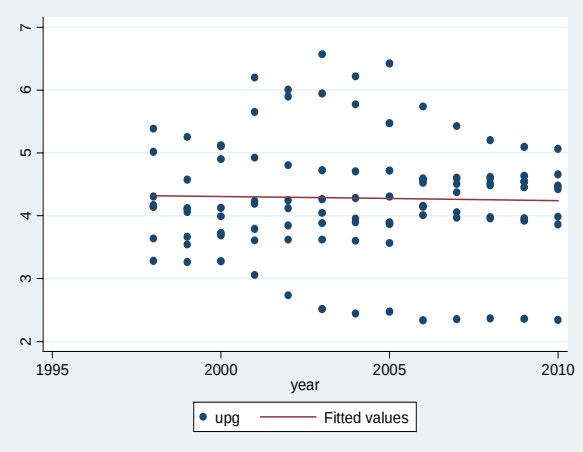
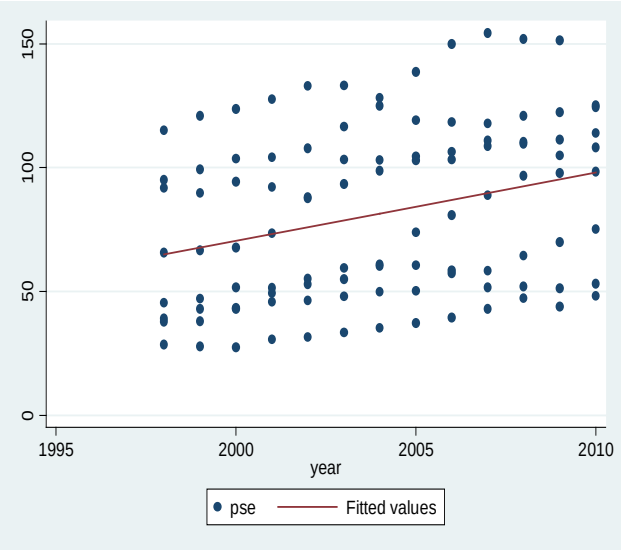


Figure 7 HIV Prevalence over time **Figure 8 Urban Population Growth over time**



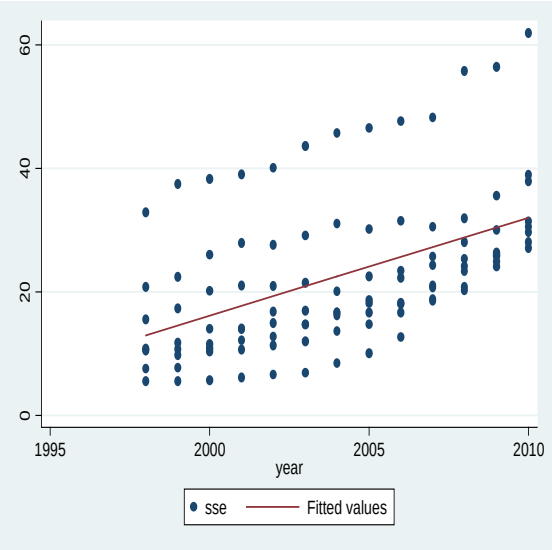


Figure 9 Primary and Secondary School enrollments over time

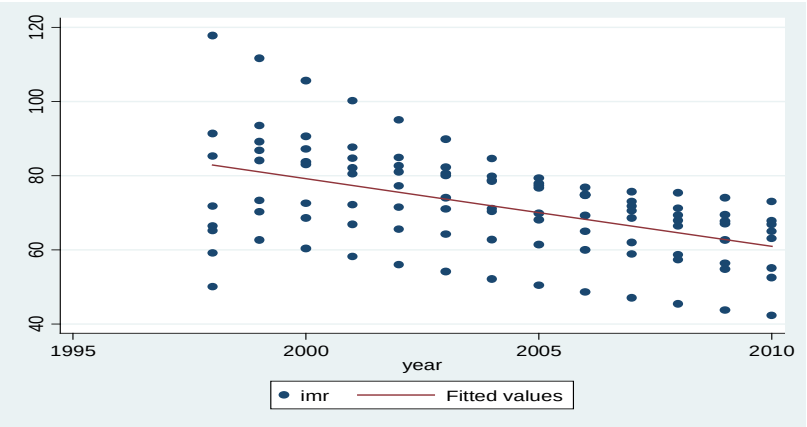


Figure 10 Infant Mortality over time

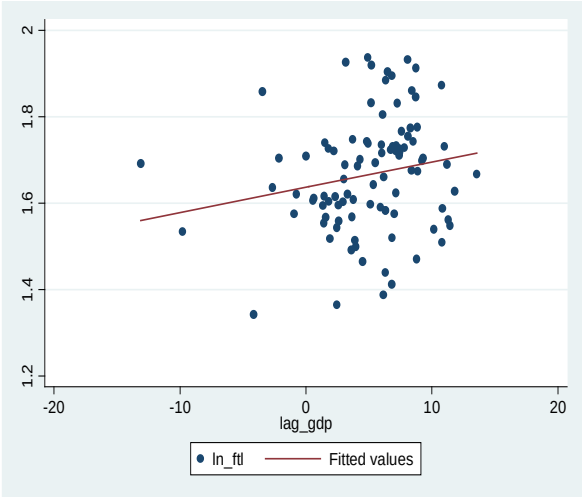


Figure 11 Lag_GDP growth and ln_fertility

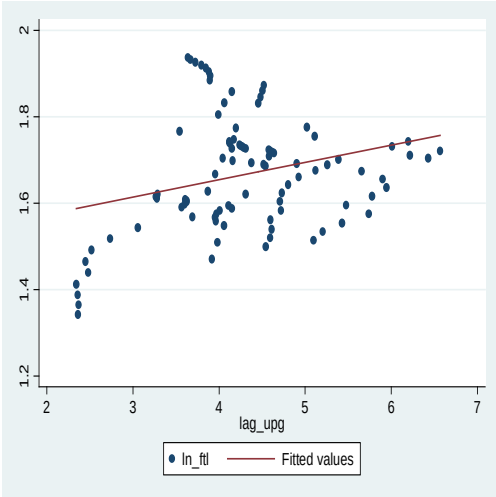


Figure 12 Lag_urban population growth and ln_fertility

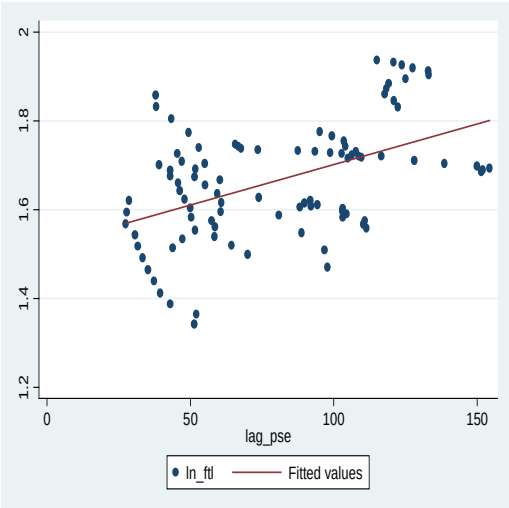


Figure 13 Lag_primary school enrollment and ln_fertility

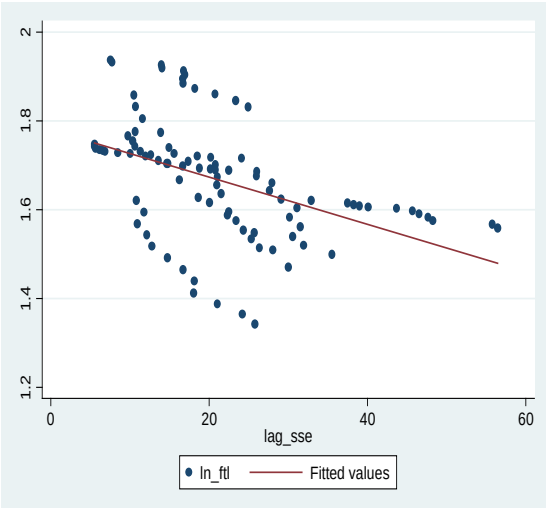


Figure 14 Lag_secondary school enrollment and ln_fertility

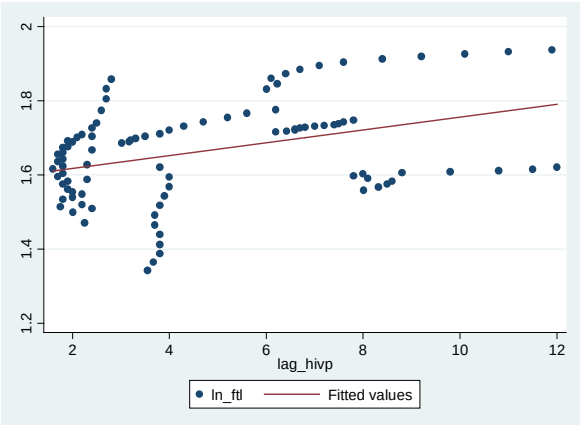


Figure 55 Lag_HIV prevalence and ln_fertility

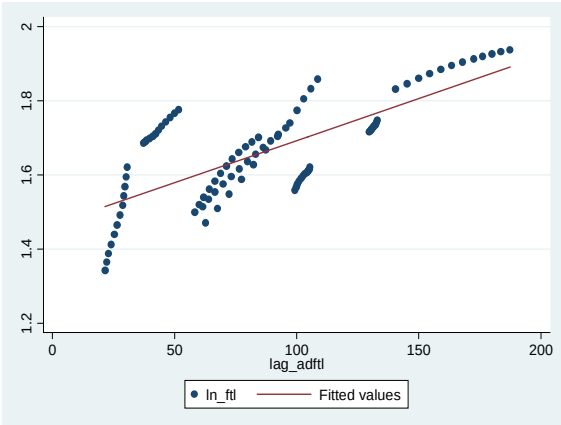
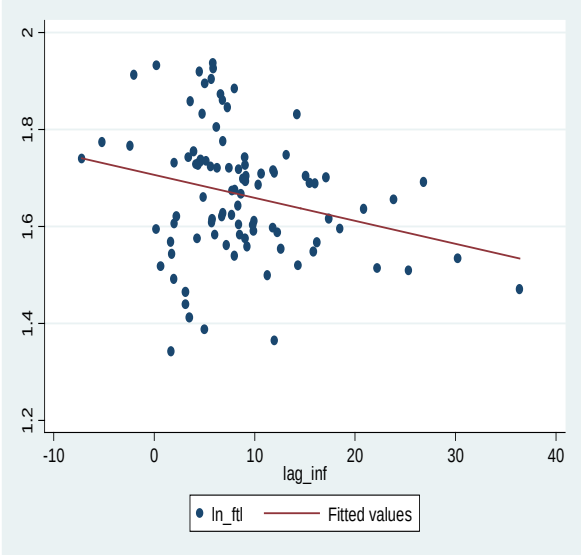


Figure 16 Lag_adolecent fertility and ln_fertility



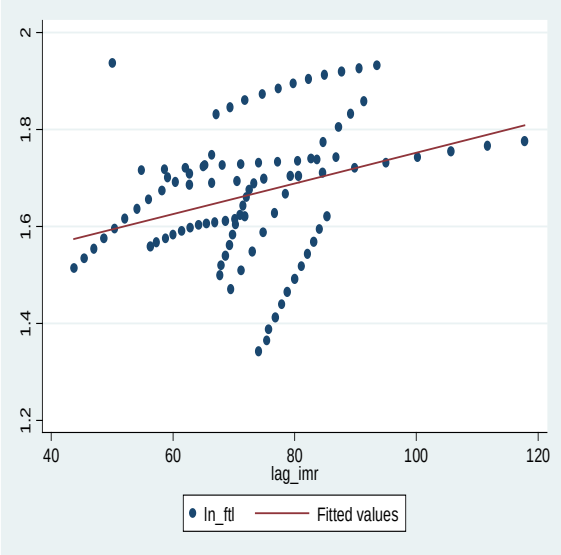


Figure 17 Lag_inflation and ln_fertility **Figure 18 Lag_infant mortality and ln_fertility**

Table 5 Hausman Test.

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
     lag_gdp |  -.0006031    -.0041551         .003552               .
     lag_imr |  -.0177578    -.0010297       -.0167281        .0017683
     lag_upg |   .0025354     .0121302       -.0095948               .
     lag_pse |  -.0003892     .0017221       -.0021113               .
     lag_sse |  -.0029517    -.0040356        .0010839        .0004089
    lag_hivp |  -.0128899    -.0127123       -.0001776               .
   lag_adftl |   .0029999      .002395        .0006049         .000347
     lag_inf |  -.0000713    -.0039466        .0038753               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =     1317.88
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Table 6 Test for joint significance

```
. testparm y1 y2 y3 y4 y5 y6 y7 y8 y9 y10 y11 y12 y13

 ( 1)  y1 = 0
 ( 2)  y2 = 0
 ( 3)  y3 = 0
 ( 4)  y4 = 0
 ( 5)  y5 = 0
 ( 6)  y6 = 0
 ( 7)  y7 = 0
 ( 8)  y8 = 0
 ( 9)  y9 = 0
 (10)  y10 = 0
 (11)  y11 = 0
 (12)  y12 = 0
 (13)  y13 = 0
       Constraint 1 dropped
       Constraint 2 dropped

       F( 11,    68) =    1.22
            Prob > F =    0.2887
```