Fertility Levels, Trends and Differentials in Kenya: How Does the Own Children Method Add to Our Knowledge of the Transition?

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1. Introduction

Kenya is among the developing countries with fertility stalled in mid-transition (Bongaarts 2005). Evidence shows that fertility dropped dramatically from nearly 8 children per woman in the mid-to-late 1980s to about 5 children per woman in the late 1990s, and leveled-off thereafter (Blacker et al. 2005; Opiyo 1993; ROK 1990, 1996, 2002). Heightened interest in the Kenyan fertility dynamics begun when its transition 'delayed' despite being among the first countries in Sub-Saharan African to adopt an explicit population policy (Odile and McNicoll 1987). Some researchers described the transition as unexpected, unprecedented, and one of the most precipitous declines ever recorded for an African country (Cross, Obungu, and Kizito 1991; Kizito et al. 1991).

This study revisits the Kenyan fertility transition using the own children method of fertility analysis with a view to adding knowledge on the patterns. The study exploits the wealth of censuses and surveys data available in Kenya – 1969, 1979, 1989, and 1999 censuses, and 1989, 1993, 1998, and 2003 Demographic Health Surveys (DHS) – to generate fertility levels and trends for the period from the mid-1950s to early 2000s.

2. The own children method of fertility estimation

The own children method of fertility estimation is a reverse-survival or back-projection technique for estimating age-specific and total fertility rates for up to 15 years prior to a census or household survey. It uses population age structure with assumptions about mortality to obtain birth rates for defined periods in the past. The procedure involves matching enumerated children aged 0 to 14 years by single years of age – the *own-children* – to their mothers (also by single years of age) within each household. The resulting matches are compiled as the *mother-child matrix.* The un-matched children, referred to as the *non-own children*, tabulated by the child's age, are re-distributed to each age (group) of women according to the distribution of their own children on the assumption that the unmatched children have mothers of approximately the same ages as the matched children.

A reverse survival technique is then applied year by year, using pre-determined age-specific mortality rates, to estimate the number of births for mothers for each of the 15 years preceding the survey or census. A similar procedure is used to obtain the numbers of women by single year of age at corresponding periods (Cho, Retherford and Choe 1986). Estimates are not usually computed further back than 15 years because births would then be based on children aged 15 years or older at enumeration, a large proportion of whom may no longer reside in the same households as their mother and hence difficult to match.

Matching can be achieved through relationship to head of household (RHH), or mother's personal or line number (MPN), if available. The latter method is often considered superior. Nonetheless, in practice, they result in negligible differences in

fertility estimates, unless there is systematic bias in the distribution of non-own children by mother's age. Further refinements can often be made via simple algorithms to ensure consistency in age difference between the child and the supposed mother (Opiyo 1993; Opiyo and Levin 2007a). For a detailed discussion of the technique see Cho (1978), Cho, Retherford and Choe (1986), and Feeney (1975).

3. Applying the own children technique to Kenyan data

We apply the own children method to analyze fertility patterns in Kenya based on the 1969, 1979, 1989, and 1999 censuses, and 1989, 1993, 1998, and 2003 DHS data. Census data provide larger data sets for analysis, and so facilitate considerable differential analysis by regions, urban/rural residence, education, wealth, and other key variables. We can also compare the results with those from other African countries since the method standardizes events. Matching and production of levels and trends are facilitated by using the East-West Center's Own Children Fertility Estimates software (FERTRATE). Opiyo and Levin (2007a) discuss the application of the method in much more detail.

We first compare census and survey based estimates. Then we use DHS data to compare own child and birth history rates in order to highlight some of the advantages of the own child method over the birth history technique. The results are presented in the next sections.

4. Own children method fertility estimates

4.1 Trends in fertility

Figure 1 (and Table A.1 in the Appendix) shows the estimated total fertility rates (TFRs) over time based on the four censuses, while Figure 2 (and Table A.2 in the Appendix) shows the TFRs based on the four Demographic Health Surveys. Both data sets show that the TFR in Kenya increased from a little more than 6.0 in the 1950s and 1960s to about 8.0 during the late 1970s, and then declined to about 6.5 in the late 1980s, and further to about 5.0 at the turn of the century. Thus, the pace of decline increased from early 1990s.

Figure 1. Own children estimates of TFR: Kenya, 1969, 1979, 1989, and 1999 Censuses

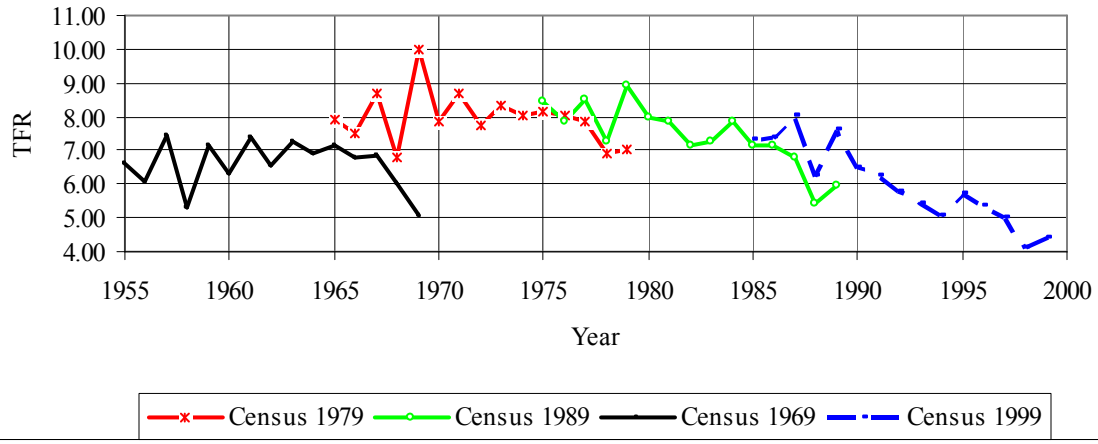
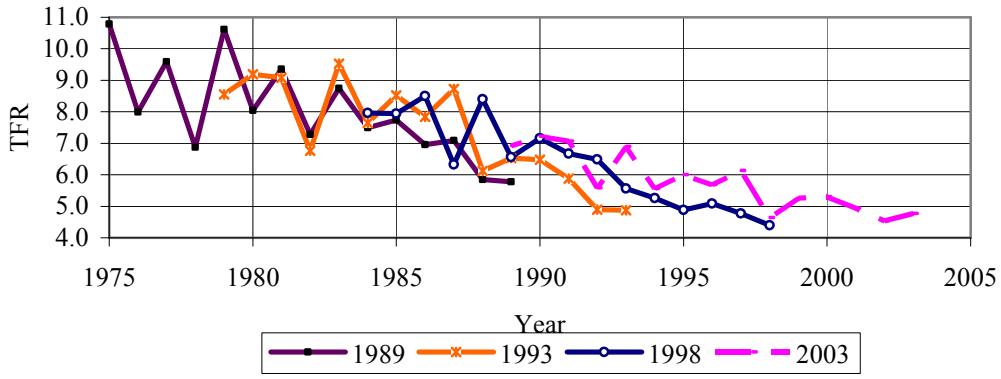
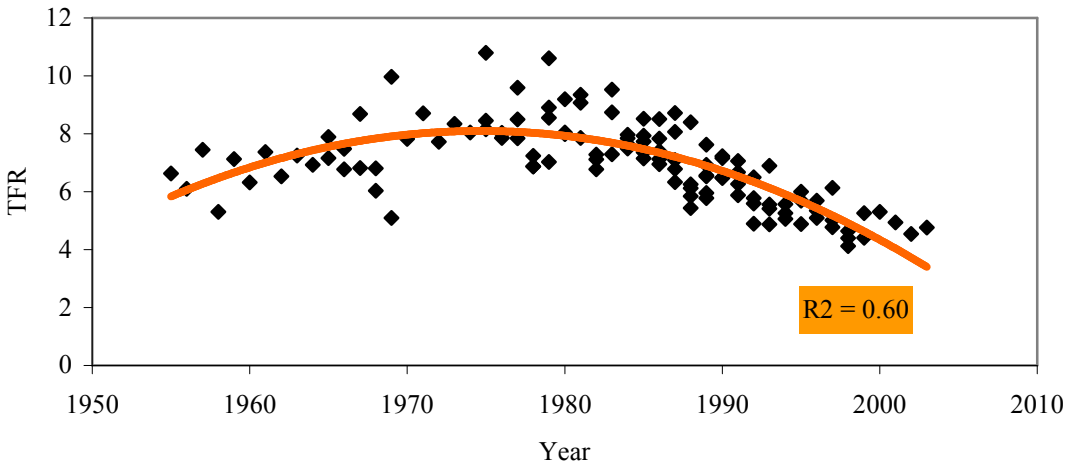


Figure 2. Own children estimates of TFR for Kenya based on the 1989, 1993, 1998, and 2003 DHSs



One great advantage of the own children method is its ability to provide long term trends. When data are available from more than one source overlapping trends can be derived that also facilitate external validity checks. Figure 3 shows a scatter plot putting together all the single-year TFR estimates for the four surveys and the four censuses. We fitted a third-degree polynomial on these point estimates. The trend line shows an arc upward until about 1980, and then a continuing downward arc after that. Since this is a straight quadratic – more or less – the trend line continues downward to the end – the most recent years – with the last 4 points all above the line. A different curve might show an upward trend at the end, but the own child method, as noted elsewhere here, tends to show a pop up in the most recent years before a census or survey because of upward age estimates of children.

Figure 3. Trends in own children fertility (TFR) estimates based on censuses and surveys: Kenya, 1950s to 2000s



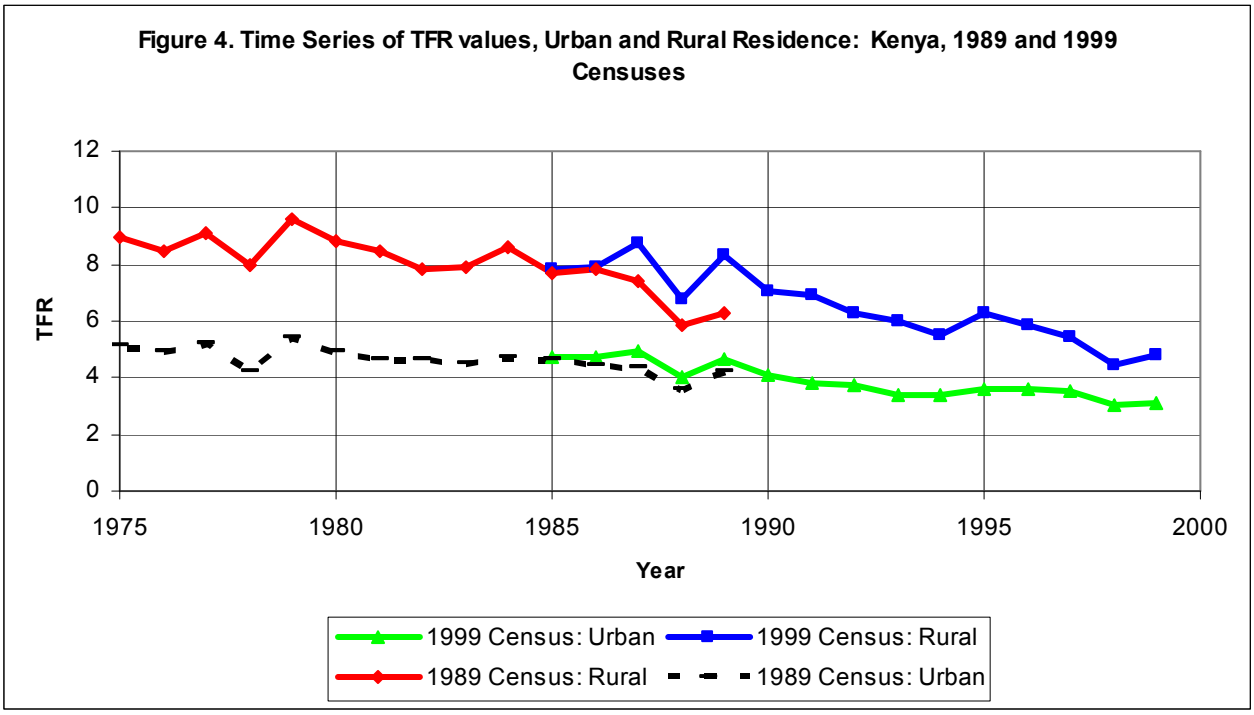
4.2 Sub-group differentials in fertility trends

The own children technique also provides a useful means of studying differential fertility over time. Here we are interested not so much on the magnitude of the differences – as that is documented in more than a dozen studies. Rather, we are interested in showing the differentials in the trends over time, and how they relate to the theories of fertility decline. We present differentials by urban/rural residence, province of residence, educational attainment, and wealth status.

Differentials by place of residence

Figure 4 presents estimated TRFs by place of residence for the period 1975 to 1999. As expected, both censuses show substantially lower fertility in urban than rural areas. Additionally, while fertility decline has continued in both urban and rural, the difference in TRF between rural and urban decreased over time from about 4 in the mid-

1970s to about 2 at the end of the 20th century, indicating that the transition in rural areas proceeded more rapidly than in urban areas. The figure, however, does not show a discernible difference in the onset of fertility decline between urban and rural areas.



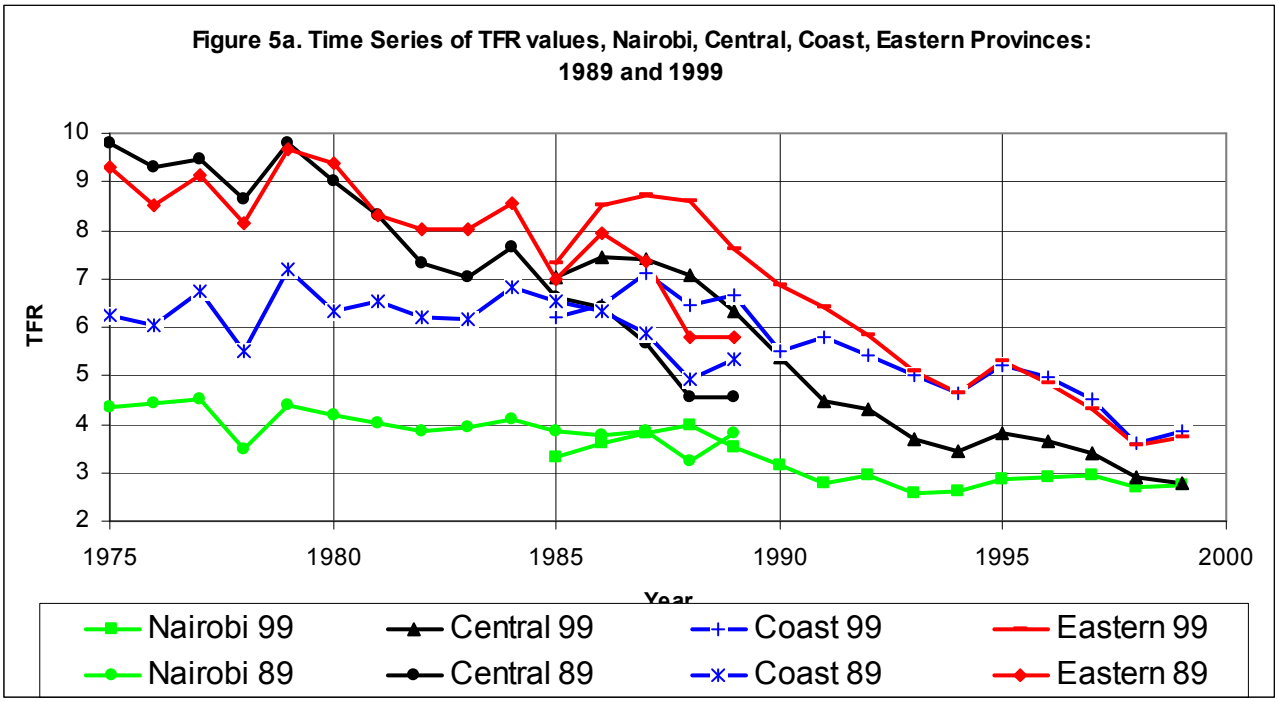
Differentials by Province of residence

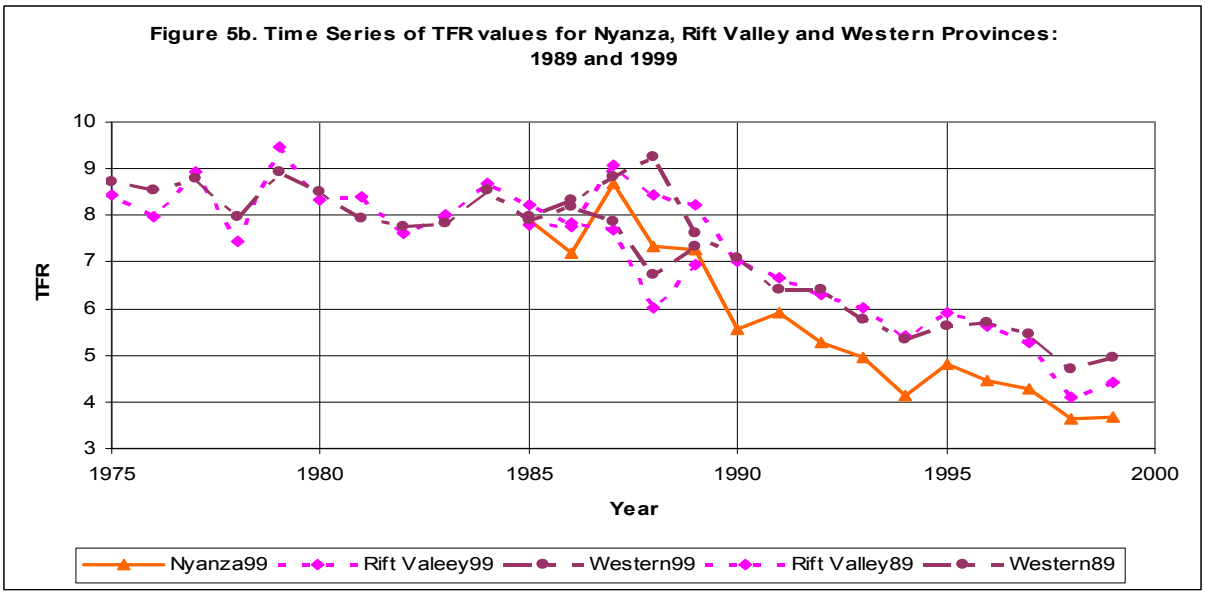
Figures 5a and 5b present own children estimates of fertility differentials by Province, based on the 1989 and 1999 censuses. Here we are looking to elucidate the view that the onset of fertility transition in Kenya varied by regions. Evidence from these figures supports this view, showing that the transition started earlier – in the late 1970s – in Central Kenya (Central and Eastern provinces) and around mid-1980s in the western (Nyanza, Rift Valley, and Western provinces) and coastal Kenya. The pace, however, varied considerably, with the transition proceeding faster among the latter provinces.

Accordingly, the wide disparities in levels at the onset of the transition substantially narrowed over time, thereby putting the TFRs on a path of convergence after the mid-1990s.

Further evidence shows that fertility has been substantially lower in Nairobi, which is entirely urban. Coast Province also exhibited lower fertility before mid-1980s, but Central and Eastern provinces have since caught up. Fertility was, however, much higher in western Kenya (Nyanza, Rift Valley, and Western provinces), but the decline proceeded faster compared to central Kenya.

Figure 5a. Time Series of TFR values, Nairobi, Central, Coast, Eastern Provinces: 1989 and 1999



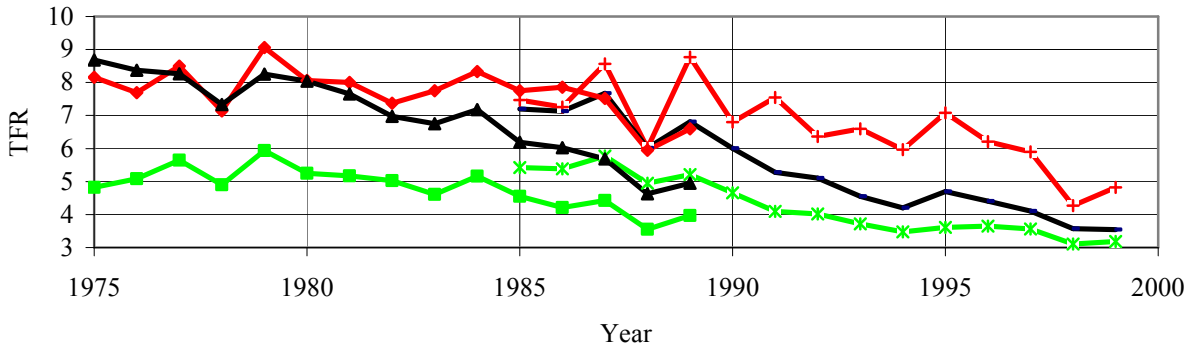


Differentials by educational attainment

The influence of education on fertility is the most studied socio-economic differential (Cochrane 1979; Caldwell and Caldwell 1987; UN 1987). Education exerts its influence on fertility by encouraging innovative behavior such as contraceptive use, or through introduction of socio-economic alternatives to child bearing and rearing.

Kenya has continued to exhibit substantial differentials in fertility by educational attainment. Figure 6 affirms the inverse relationship between fertility and educational attainment, showing lowest fertility among the most educated and much highest fertility among the uneducated. But of more interest to us are the trends in the differentials over time. To this end Figure 6 highlights three points. First, all subgroups showed appreciable fertility decline beginning around 1980. Second, while there is no clear difference in the onset of decline, it proceeded faster among the sub-group with partial secondary education (Form 1-3). Last, the sub-group differentials have continued to narrow over time.

Figure 6. Time Series of TFRs by education level: Kenya, 1989 and 1999 Censuses

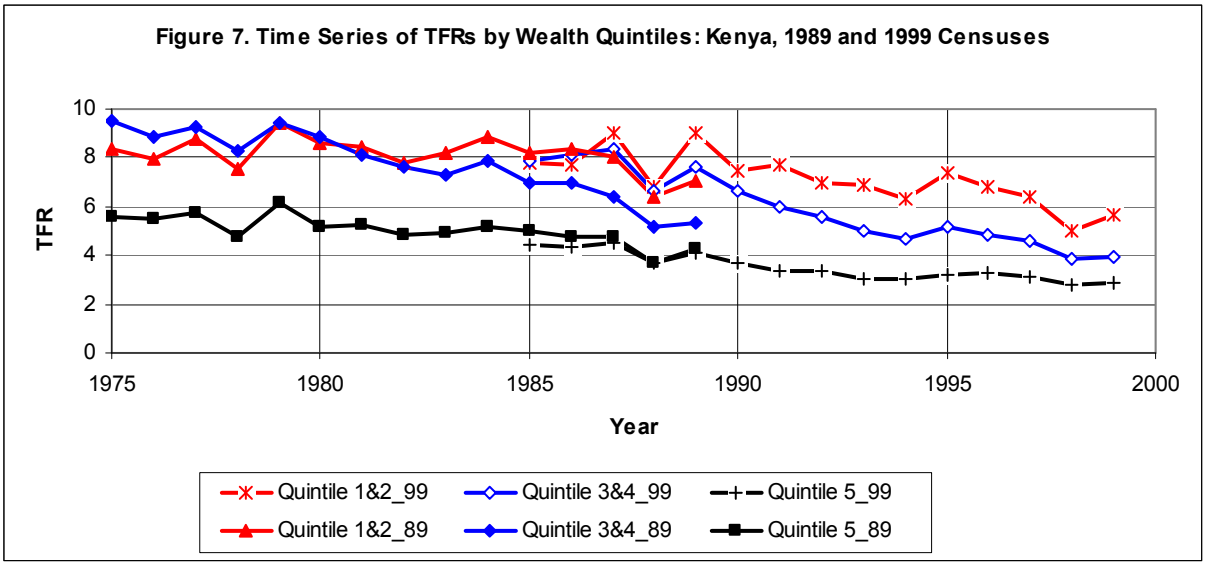


Differentials by poverty status

That demographic and poverty indicators are intertwined is not a new phenomenon among researchers and policy makers. However, recently researchers are showing renewed interest in the linkages, particularly owing to the presumed association between welfare deterioration and the unfavorable demographic outcomes observed in most Sub-Saharan African countries in recent times. Thus, we also sought to examine fertility differentials by poverty status. We created a composite wealth index based on census data to proxy household poverty – via principal components analysis (PCA) – which we duly grouped into quintiles. Opiyo and Levin (2007b) provide details of this procedure.

We have collapsed the quintiles into 1 and 2, 3 and 4, and 5 in order to clearly discern the trends in the differentials. Figure 7 shows that fertility decline started between early and mid-1980s among all sub-groups. However, the decline proceeded faster among

the middle-wealth category where fertility was highest in the pre-transition period. As expected, fertility has remained lowest among the wealthiest category.

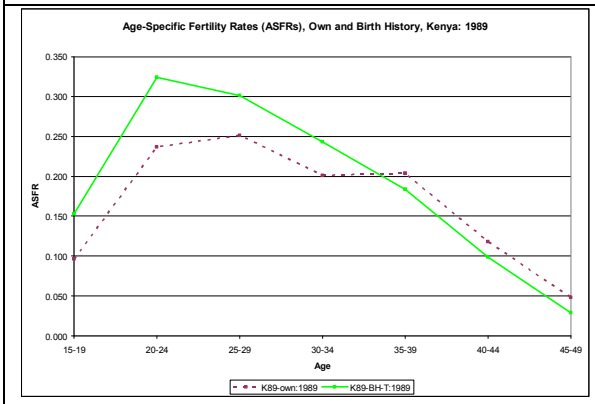


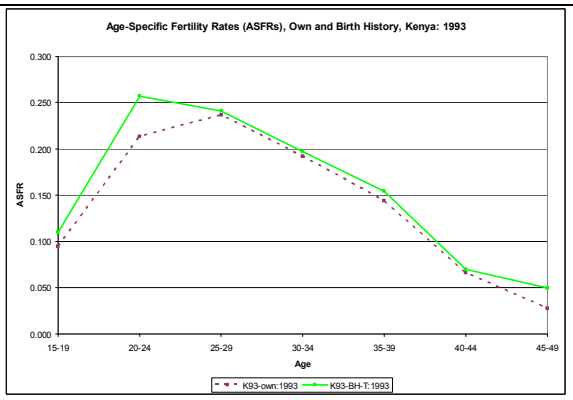
4.3 Age pattern of fertility: Own children versus birth history fertility estimates

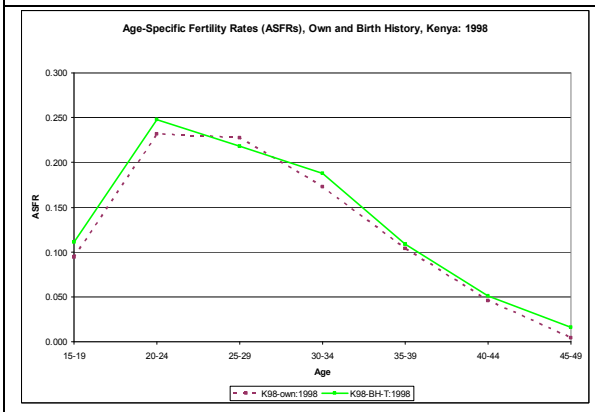
We have chosen to concentrate on total fertility rates for this paper. Nonetheless, the own child method provides estimates for age specific rates as well. A detailed analysis of age-specific fertility trends for Kenya is available in Opiyo and Levin (2007a). In this section, however, we focus on how the age patterns of fertility from the own children method compare with similar estimates from birth history data, following work with more than 50 DHS data sets for Sub-Saharan Africa (Levin 2007). It is an interesting comparison, given that the own children is child-based while the birth history technique is women-oriented. We have re-produced some of the results for Kenya in Figure 8.

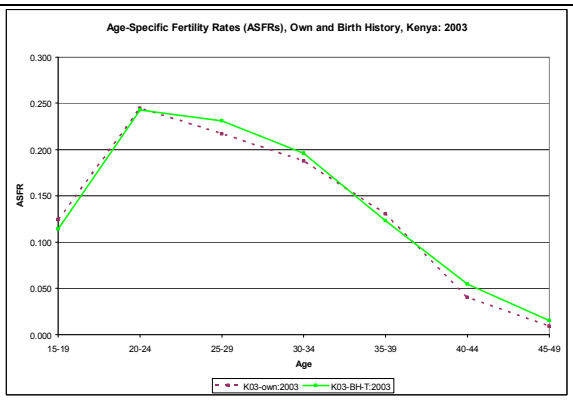
The estimates for 1989 show significant differences between the two methods. The own children birth rates were substantially lower among women aged under 35 and higher for older women, compared to birth history estimates. The rates from the more recent DHSs – 1993, 1998, and 2003 – show remarkably similar results for the two methods over the entire reproductive life span, save for women aged below 30 in the 1993 DHS for whom the own children rates were somewhat lower. In addition, the birth history rates consistently show early fertility, peaking at 20-24. The own children estimates show a similar pattern with 1998 and 2003 DHS. However, they show a broad-peaked fertility at age 20-29 with 1989 DHS and a late peak at age 25-29 with 1993 DHS. Thus, the pattern depicted by the own children method is inconsistent, and could be the result of assigning more children to older women at the expense of younger ones, as noted later in this paper. This is a regular feature of the own children method, so these results are satisfying.

Figure 8. Age specific fertility rates based on own children fertility estimates and birth histories: Kenya DHSs, 1989 to 2003

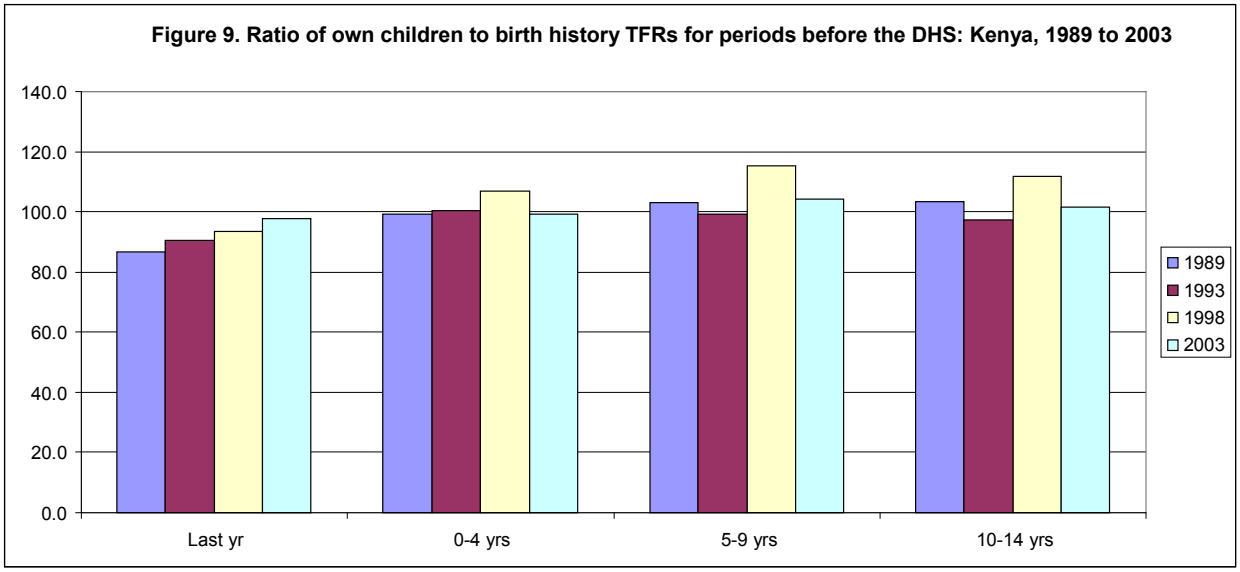








In Figure 9 we show the ratios of the own children (numerator) to birth history (denominator) TFRs for the year before the survey, and the 0-4, 5- 9, and 10-14 years before the survey. A "score" of 100 would indicate that the TFRs were the same using both methods. The own children rates are lower for the year before the survey for all four surveys. However, the rates are more or less the same for the periods 0-4, 5-9, and 10-14 years, save for the 1998 survey where the own children rates are slightly higher, most likely because of over-matching to older mothers in the own child method.



5. Discussion

This study revisited the Kenyan fertility transition based on insights from the own children technique. In particular, it reviewed features of the fertility transition that could not be teased out with conventional methods. Kenya is an obvious choice of study because of the heightened interest that the delay in the onset of the transition generated among researchers and policy makers. Further, Kenya has a wealth of regularly collected census and demographic survey data, which augurs well for the application of the own children method. Rather than focus on a full explanation of the observed patterns, we sought to dwell on the aspects that would encourage the use and further development of the own children method.

The study corroborates findings from previous studies using conventional methods that fertility in Kenya increased from a little more than 6.0 in the 1950s and 1960s to about 8.0 during the late 1970s, before declining to about 6.5 in the late 1980s, and further to about 5.0 by the end of the 20th century. Although the decline, first

observed during the 1989 KDHS, was celebrated as the most precipitous ever recorded (Brass and Jolly 1993; Cross et al. 1991; Kizito et al. 1991), our findings indicate that the pace of decline accelerated from the early 1990s. Generally, good agreement exists between census and survey estimates where they overlap. The superior matching in surveys seems offset by the strength of number in censuses.

The single year estimates are characterized by fluctuations, mainly reflecting misreporting of children's ages, especially in censuses. Theoretically, misreporting of women's ages should introduce less error in the own children fertility estimates, especially if grouped data are used (Cho, Retherford and Choe 1986). In practice, however, some biases do occur, particularly if the pattern of age misreporting in children is systematically and positively correlated with that of their respective mothers, which might result in spurious trends (Retherford and Mirza 1982).

The census estimates decrease much more rapidly close to the census date, giving a rather false impression of a faster decline during that period. This phenomenon is most noticeable 1999 Census where the TFR estimated for the 0-4 years before the census is implausibly low. Kenya's censuses have perennial under-enumeration of young children (ROK 2002 1996), but the under-reporting is a less serious source of error than age misreporting (Cho, Retherford and Choe 1986).

The own children method does not show significant changes in the fertility schedule among Kenyan women. The birth history technique is more consistent in this regard, showing that the onset of childbearing is still fairly early. One may, therefore, argue that the Kenyan fertility transition is driven by the "stopping behavior" rather than "delayed onset of reproduction".

This study also shows that the transition is universal among differential sub-groups. However, it also highlights differences with regard to the onset and pace of transition. First, a clear difference in the onset of the transition is only discernible among the regions – it was earlier in central Kenya compared to western Kenya and the coast. No clear cut differences in onset are observed by place of residence, education, and wealth. Secondly, the pace of decline was faster in western Kenya, among rural residents and women with some secondary education, and among households in the middle wealth category, compared to their complements. Lastly, the sub-group differentials narrowed remarkably over time.

These patterns are consistent with fertility theories. Fertility transitions all over the world are often initiated by the more modern sub-groups, and then spreads, through 'leads and lags', to the less modern sub-groups where it normally proceeds faster (Bongaarts and Watkins 1986; Coale 1973). Thus, once initiated, transitions tend to proceed faster in areas where fertility was high hitherto. We can then argue that urban, educated, and wealthy women already had low fertility and, therefore, had not much incentive to limit their fertility at this early stage of the transition. However, once the ideational changes in family formation take root among the populace, Coale's (1973) three prerequisites for fertility decline (able, willing and ready) are largely satisfied, leading to more effective practice of family size limitation.

Finally, recent studies suggest a stall in the Kenyan fertility decline at about 5 children per woman (ROK, 2004, 2002; Bongaarts 2005; Blacker *et al* 2005). Although our analysis tends to confirm the stall, the own children method fails to present us with conclusive evidence on this phenomenon, owing to its inherent inefficiency to give

reliable trends for the most recent periods (see also McDevitt and Johnson 2005). Therefore, a more accurate picture regarding this phenomenon will probably emerge from the 2008 KDHS and 2009 Population Census data.

6. Conclusions

This study finds several trends regarding the Kenyan fertility transition:

(1) Kenyan total fertility increased from a little more than 6.0 in the 1950s and 1960s to about 8.0 during the late 1970s, before declining to about 6.5 in the late 1980s and to about 5.0 in the late 1990s.

(2) Fertility transition appears to have been well underway in Kenya by early 1980s, rather than the mid- and late- 1980s suggested elsewhere.

(3) Although the decline first observed in 1989 was regarded as the most precipitous ever recorded, our findings show that the decline was more rapid beginning in the early 1990s.

(4) Fertility transition in Kenya is largely driven by "stopping behavior" – through family size limitation facilitated by contraceptive use - rather than by delayed onset of reproduction.

(5) While the transition started earlier in central Kenya compared to other regions, no clear-cut differences were observed by socio-economic characteristics. However, the pace appeared faster in western Kenya, and among rural dwellers, women of average education, and households of middle wealth category, as opposed to their complements. This resulted in the narrowing of differentials over time, consistent with theories of fertility decline.

In sum, the own children method of fertility estimation is a very useful tool for studying fertility levels, trends and differentials. The method is extremely useful in determining long term trends when a variety of fairly accurate data sets collected at regular interval are available. Even in contrary circumstances, the method can provide reliable and more revealing results than the conventional methods.

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Appendix

Table A.1: TFR and ASFR based on the own children technique: Kenyan censuses

Source / date	TFR	Mother's age						
		15-19	20-24	25-29	30-34	35-39	40-44	45-49
CENSUSES								
1999 Census								
1997-99	4.5	0.082	0.204	0.214	0.182	0.128	0.067	0.026
1994-96	5.4	0.11	0.24	0.252	0.212	0.147	0.081	0.034
1991-93	5.8	0.124	0.263	0.271	0.222	0.157	0.089	0.036
1988-90	6.8	0.157	0.308	0.311	0.256	0.183	0.101	0.041
1985-87	7.6	0.183	0.347	0.344	0.289	0.198	0.115	0.043
1989 Census								
1987-89	6	0.1	0.261	0.282	0.246	0.176	0.098	0.047
1984-86	7.4	0.141	0.314	0.332	0.291	0.21	0.13	0.056
1981-83	7.4	0.164	0.32	0.333	0.281	0.211	0.123	0.052
1978-80	8.1	0.187	0.351	0.352	0.298	0.234	0.131	0.059
1975-77	8.3	0.204	0.362	0.355	0.312	0.224	0.139	0.059
1979 Census								
1977-79	7.2	0.126	0.293	0.334	0.279	0.218	0.132	0.066
1974-76	8.1	0.165	0.337	0.354	0.301	0.234	0.144	0.081
1971-73	8.3	0.192	0.362	0.347	0.319	0.217	0.147	0.067
1968-70	8.2	0.216	0.355	0.349	0.3	0.218	0.142	0.063
1961-67	8	0.233	0.342	0.348	0.273	0.22	0.124	0.066
1969 Census								
1967-69	6	0.135	0.26	0.25	0.211	0.164	0.108	0.064
1964-66	7	0.159	0.293	0.288	0.249	0.194	0.132	0.075
1961-63	7	0.178	0.295	0.293	0.249	0.193	0.13	0.073
1958-60	6.3	0.166	0.264	0.254	0.223	0.166	0.116	0.064
1955-57	6.7	0.181	0.285	0.278	0.247	0.178	0.118	0.06

Table A.2: TFR and ASFR based on the own children technique: Kenyan DHS Surveys

Source / date	TFR	Mother's age						
		15-19	20-24	25-29	30-34	35-39	40-44	45-49
DEMOGRAPHIC AND HEALTH SURVEYS								
2003 KDHS								
2001-03	4.7	0.111	0.236	0.228	0.189	0.121	0.056	0.008
1998-00	5.1	0.106	0.26	0.256	0.191	0.133	0.062	0.007
1995-97	5.9	0.121	0.298	0.291	0.228	0.161	0.074	0.014
1992-94	6.0	0.141	0.287	0.274	0.246	0.158	0.075	0.022
1989-91	7.1	0.16	0.333	0.339	0.265	0.186	0.1	0.033
1998 KDHS								
1996-98	4.9	0.111	0.255	0.24	0.186	0.119	0.058	0.006
1993-95	5.4	0.118	0.275	0.265	0.209	0.135	0.069	0.019
1990-92	7.1	0.155	0.319	0.343	0.277	0.198	0.088	0.035
1987-89	7.4	0.174	0.359	0.356	0.289	0.177	0.097	0.03
1984-86	8.5	0.189	0.398	0.398	0.34	0.208	0.126	0.037
1993 KDHS								
1991-93	5.2	0.113	0.247	0.243	0.197	0.142	0.074	0.025
1988-90	6.4	0.141	0.299	0.298	0.232	0.175	0.101	0.03
1985-87	8.4	0.189	0.358	0.375	0.323	0.258	0.126	0.044
1982-84	8.0	0.186	0.354	0.348	0.305	0.236	0.127	0.041
1979-81	8.9	0.211	0.394	0.39	0.365	0.258	0.128	0.043
1989 KDHS								
1987-89	6.2	0.113	0.252	0.265	0.225	0.191	0.134	0.065
1984-86	7.4	0.147	0.299	0.283	0.269	0.244	0.148	0.087
1981-83	8.5	0.186	0.327	0.332	0.312	0.284	0.169	0.081
1978-80	8.5	0.205	0.324	0.338	0.329	0.274	0.149	0.081
1975-77	9.5	0.222	0.36	0.378	0.358	0.267	0.191	0.116