

Evaluation of the 2007 Ethiopian Census Data with an Emphasis on Coverage in Amhara Region

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Abstract

Ethiopia's 2007 census results are compared with the Central Statistical Agency's (CSA) forward projections from the 1984 and 1994 censuses for 2008. Given the undercounts in all regions in both the 1984 and the 1994 censuses, the 2007 census was expected to produce a higher population count for all regions than CSA's forward projections for 2008. Instead, the 2007 census gave a national total that was lower than the projected number by five million people. Three-fifths of the undercount was in Amhara Administrative Region. Evaluations using Whipple and Myers methods and consistency checks based on sex ratio and proportions of children under five also point to deficiencies in the 2007 census. The significant shortfall in Amhara cannot be explained fully based on available data. The possibility remains, however, that universally acknowledged problems with census taking - errors in data collection, processing, and reporting - may have affected Amhara far worse than the other regions. Our review of literature and data analysis found no evidence favoring the argument that a higher level of demographic transition caused the shortfall in Amhara Region. Census data need to be scrutinized critically even when there are reasons to suppose that they are accurate.

Key words: *undercount, demographic transition, Amhara Region, age misreporting*

Introduction

Population census is a complex, large-scale operation and therefore that a 'perfect' census is less likely attainable. Errors inevitably arise in collection and reporting of census data. It is essential to detect and quantify the errors

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by evaluation in order to reveal the quality of data to the users and make adjustments for future census (Gunasekera, 2009). The two major types of errors are known to be coverage errors and content errors. Coverage errors result from omissions, erroneous enumerations, duplications, and enumerations of individuals in the wrong place (Bell and Cohen, 2009; Talib *et al.*, 2007), and hence it affects all the information collected including the age-sex data which is extremely important for various decisions. Content errors, on the other hand, occur due to inadequate information supplied or mistakes made in reporting or recording information. A common form of content error is the misreporting of data (Gunasekera, 2009). It is observed that terminal digits of single age seem to suggest that misstatements in age reporting do exist due to digit preferred and digit avoided in censuses.

Sufficient training for the enumerators of census data is recommended (Talib *et al.*, 2007), while on the basis of post enumeration survey (PES) analysis, the need to revise census procedures or redesign census questionnaires is also suggested as a solution (Griffin and Moriarity, 1992) though the usefulness of a PES and care that must be taken in its implementation is also underlined (United Nations, 2010a). Others opted for making corrections to the misreported census data (Das Gupta, 1975). Accuracy of most of the data does not mean that all of the data are accurate, and it is noted that all data are guilty until proven innocent (Coale and Li, 1991).

Ethiopia conducted its third national census in 2007 and detailed results have been published in full on CSA's website (<http://www.csa.gov.et>). The published reports show a total population of 73.9 million (Federal Democratic Republic of Ethiopia (FDRE), 2008). This is more than five million people below the projected 2008 population based on the 1994 census (FDRE, 2008). The biggest gap between the 1994 census number and the 2008 projected number is in Amhara Region (hereafter Amhara) - 17,214,056 and 20,136,000, respectively; a 14.5% shortfall. Amhara is the second-most populous of the 11 administrative regions of Ethiopia (Fig. 1). An even larger gap was calculated for the City Administration of Dire Dawa (19.9%). The gap for Addis Ababa, where the percentage of the population under 15 years reportedly declined from 33% during the 1994 census (CSA, 1995) to 24% in 2007 (FDRE, 2008) is 13.0%. The figures for Addis Ababa are in contrast to expectations based on the high immigration rates resulting from its capital city

status. Amhara and Addis Ababa are reported to have had the lowest intercensal growth rate of 1.8% and 2.1% per year, respectively (FDRE, 2008). The smallest differences between projected numbers and those reported on the basis of the census were for Benishangul Gumuz Region (2.3%), while the highest positive difference was in Gambella Region, where the 2007 census count was 18.5% higher than the 2008 projection. Gambella's numbers actually represent the only "excess" in the 2007 census population numbers compared with the projected 2008 estimates. This is most likely the result of the government resettlement program and the incursion of Sudanese refugees (Sewonet, 2004).

In census taking the number of omissions (undercounts) almost always exceeds the number of duplications (overcounts). "Thus, it is common to have a net census undercount" (United Nations, 2010b: 7). For instance, it is often argued that the population in the Muslim dominated North Eastern Province in Kenya has always been undercounted (Wolf *et al.*, 2004). Even the well planned and designed Demographic and Health Surveys (DHS) tend to undercount young children and it appears that undercounts have plagued census taking throughout Africa, South Africa being one of the few exceptions where post-enumeration surveys are conducted to correct for undercounts (Young, 2005). Lack of resources and political will normally result in the acceptance of the original counts as final in most other African countries.

Although the magnitude of the discrepancies between projected and reported census figures are considerable and have many demographic, socioeconomic and political implications, no attempt has been made in Ethiopia to fully address this issue, and published numbers are being accepted at face value. Akol *et al.* (2007:7) have reported the existence of clear evidence of an advanced fertility transition, with delayed age at marriage, higher contraceptive use, greater women's empowerment, and out-migration" in Amhara without adequate supporting evidence.

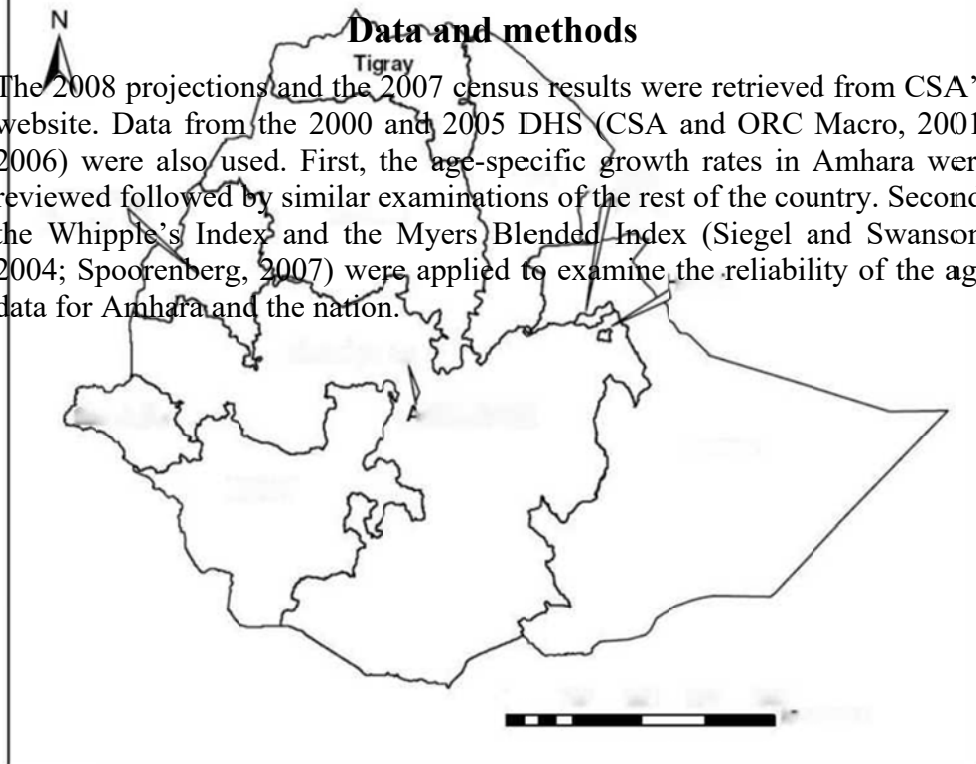
This article makes the examination of age-specific intercensal growth rates and compares the demographic and socioeconomic parameters for Amhara with other regions, particularly Oromia, to evaluate census data and find out the reasons for the differences. The article also investigates possible sources

of these differences.

In the general premises of the above, the objectives of this article are: (1) to reevaluate the age-specific population totals from the 2007 census of the 11 Regional States of Ethiopia (Fig. 1), with an emphasis on Amhara, (2) to determine whether the observed shortfall from projected numbers is an artifact of data error or a genuine result reflective of recent demographic changes in the Region, and (3) to examine census data accuracy by focusing on age reporting both at the national level and in Amhara.

Figure 1: Administrative Regions of Ethiopia

Source: Based on a Base Map (shapefile) from Addis Ababa University (No date).



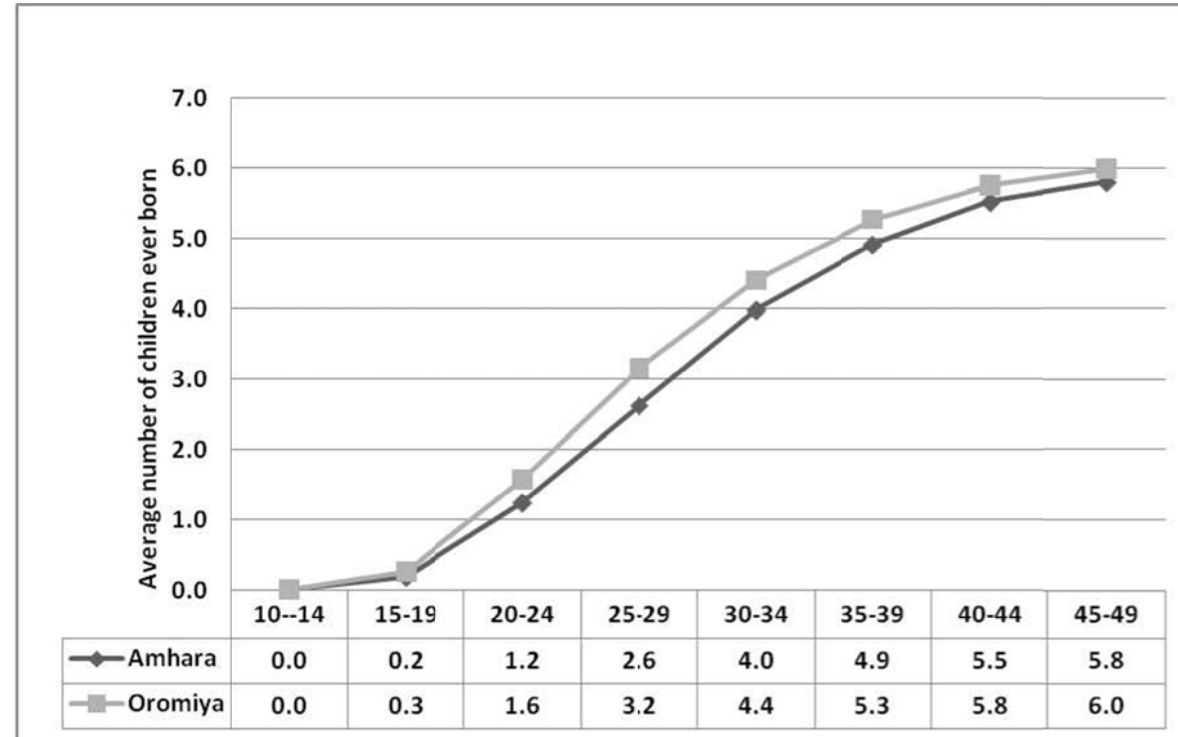
Data and methods

The 2008 projections and the 2007 census results were retrieved from CSA's website. Data from the 2000 and 2005 DHS (CSA and ORC Macro, 2001, 2006) were also used. First, the age-specific growth rates in Amhara were reviewed followed by similar examinations of the rest of the country. Second, the Whipple's Index and the Myers Blended Index (Siegel and Swanson, 2004; Spoorenberg, 2007) were applied to examine the reliability of the age data for Amhara and the nation.

Results

The demographic transition theory stipulated a progression from high fertility and mortality regimes to one with low fertility and mortality. Some have suggested that Amhara has achieved a higher level of demographic transition (Akol et al., 2007) than regions such as Oromia. Evidence cited for a higher transition in Amhara include: a) lower proportions of children in age groups 0-4 (13.6%), and 5-9 (15.1%) than in Oromia (16.4% and 17.3%), and b) the lower number of children ever born per woman in the 15-30 age groups (Figure 2) than in Oromia (FDRE, 2008). There is, however, ample evidence to the contrary. The hint of a nascent move toward a transition in Amhara, though notable for its consistency across several age groups (Figure 2), is unlikely to explain the 14.5% difference between the 2008 projection for the Region (based on 1994 census, which was itself incomplete) and the 2007 census count.

Figure 2: Average Number of Children per Woman (by age group of women), Oromia and Amhara 2007



Source: FDRE(2008)

Table 1 compares Amhara with Oromia to see if there is any evidence in support of the claim of an advanced stage of demographic transition in Amhara (Akol *et al.*, 2007). The choice of Oromia for comparison is based on the fact that: a) Amhara and Oromia are the two most populous regions (over 60 % of the country's total population live in these two regions), b) shared demographic characteristics, c) socio-cultural characteristics which are likely to have produced similar demographic outcomes (fertility rates, and mortality rates, etc.) for the period between the last two censuses, d) economic systems characterized by settled agriculture and animal husbandry in the highlands and nomadic pastoralism in the lowlands, e) similar environmental challenges - drought, deforestation, massive loss of top soil, and land degradation (AMAREW, 2007; Kouwonou, 2007) *albeit* with greater intensity in Amhara than Oromia, f) similar levels of outmigration (De Gobbi, 2006; Mberu, 2006; Sharp, Devereux and Yared, 2003), and g) a low social status for women and lax enforcement of regulations protecting female rights as well as their safety and social welfare (Kebede , 2001; Erulkar and Mekbib, 2007, 2008; Ferede and Erulkar, 2009; Erulkar *et al.*, 2007).

Many of the variables point to a somewhat better socioeconomic environment in Oromia than Amhara. For instance, women in Oromia are slightly better educated, more of them are in the highest wealth quartile, and greater percentages have access to modern mass media and employment than women in Amhara. Moreover, important demographic markers - age at marriage and at first intercourse, percentage of teenage mothers and those pregnant at the time of survey, the proportion of husbands with two or more wives, and a lower urbanization rate (12%) than in Oromia (14%) (CSA, 2006) - are all predictive of a higher fertility in Amhara than in Oromia. However, the total fertility rate (TFR) is lower in Amhara than in Oromia. This could be due to what Bongaarts (1978) referred to as proximate determinates. A collaborative research project of Jimma University and Brown University (Partnership in Improving Reproductive Health, 2003) applied the Bongaarts model to Oromia and showed prolonged breastfeeding and delayed marriages as the main contributors to lower fertility than the biological maximum. Since breastfeeding and postpartum amenorrhea are even longer in Amhara it may be concluded that proximate determinants might be playing a far greater role in the fertility difference between Oromia and Amhara than factors cited by Akol *et al.* (2007).

Table 1: Percentage distribution of respondents by selected socioeconomic, demographic and other related variables in Amhara and Oromia Regions, 2005

Socioeconomic Variables/Indicators	Amhara (%)	Oromia (%)
Female household population with some primary	24.	26.5
Distribution of women by level of school attended and level of literacy - secondary school or higher	8.5	10.0
Distribution of men by level of school attended and level of literacy - secondary school or higher	12.6	20.3
Distribution of the <i>de jure</i> population by highest	15.	17.9
Distribution of women by employment status: percent currently employed	27. 9	32.0
Women who are exposed to specific media: listen to the radio at least once a week	14. 6	16.6
Men who are exposed to specific media: listen to the radio at least once a week	24. 9	35.6
Fertility and family planning		
Women who heard family planning messages on	24.9	34.5
Currently married women by contraceptive method currently used: any modern method	15.7	12.9
Husband/partner knows about use of contraceptives	86.7	87.6
Husband has one or more additional wives	2.8	15.9
Women aged 15-19 who have had a live birth	16.7	15.8
Women aged 15-19 who are pregnant with first	3.6	3.2
Median age at first birth among women age 25-49	18.1	19.1
Median age at first sexual intercourse among	15.5	18.7
Median number of months of postpartum	20.8	14.5
Percentage of currently married childless women who want no children	15.2	5.3
Median duration (months) of breastfeeding	>36.0	24.6
TFR (total fertility rate)	5.1	6.2

Sources: Based on CSA and ORC Macro (2006)

Population growth between 1994 and 2007 in Ethiopia

With the exception of the 2000 border war with Eritrea, the intercensal years (1994-2007) represented a period of relative sociopolitical calm in Ethiopia.

This, in the sub-Saharan African context, should translate into periods of normal population growth. This was, indeed, the case in Ethiopia with the apparent exception of the Amhara where reported growth rates (1.9 % per year) were only two-thirds of the national average of 2.6% (FDRE, 2008).

Table 2 shows the 2007 census numbers for nine regions and two city administrations side by side with forward projections for 2008 based on the 1994 census. The largest percentage deficit was in Dire Dawa Region (19.9%) but Amhara ranked first in absolute numbers - nearly three million people. Given the universal problems of census undercounts to which the 1994 census was not immune, the 2007 census populations of Amhara, Addis Ababa and other regions should have been at least as large as the 2008 projections based on the 1994 census.

1994 Census

Table 2: Ethiopia's 1994 and 2007 Population and Growth Rates by Regions, and Projections for 2008, Based on the

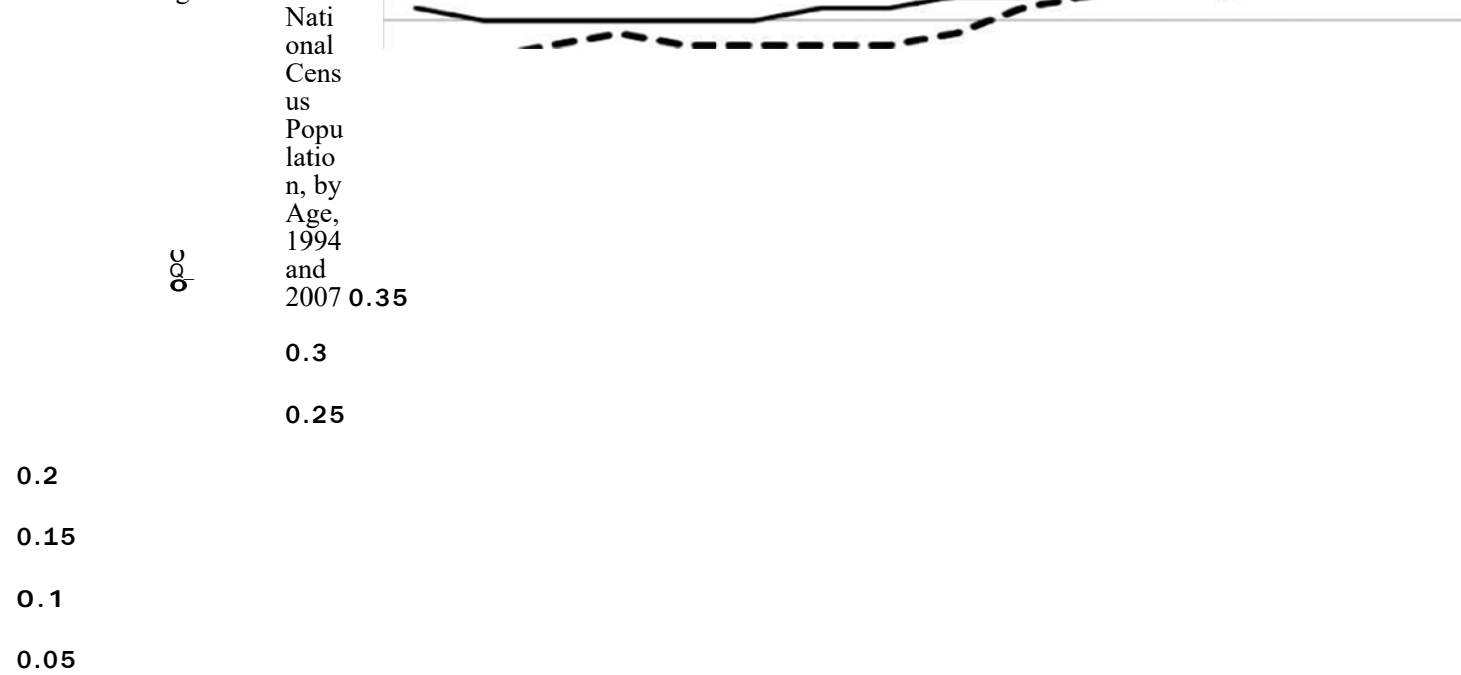
Region	1994* Population	2008 ** projection based on the 1994 census	Implied annual growth rate (%) 1994 - 2008	2007 *** census population	Actual annual growth rate (%) 1994 - 2007	Difference between the 2008 projection and 2007 census population	Percent difference between 2008 projection and 2007 census
Amhara	13,834,297	20,136,000	3.3	17,214,056	1.9	2,921,944	-14.5
Addis Ababa	2,112,737	3,147,000	3.5	2,738,248	2.3	408,752	-13.0
Afar	1,052,693	1,449,000	2.7	1,411,092	2.6	37,908	-2.6
Dire Dawa	251,864	428,000	5.0	342,827	2.8	85,173	-19.9
Tigray	3,136,267	4,565,000	3.3	4,314,456	2.9	250,544	-5.5
Harari	131,139	209,000	4.2	183,344	3.1	25,656	-12.3
Somali	3,145,390	4,560,000	3.2	4,439,147	3.2	120,853	-2.7
Benishangul Gumuz	460,459	656,000	3.0	670,847	3.5	-14,847	2.3
SNNPR	10,371,192	15,745,000	3.7	15,042,531	3.5	702,469	-4.5
Oromia	18,437,820	28,067,000	3.7	27,158,471	3.6	908,529	-3.2
Gambella	162,397	259,000	4.2	306,916	6.8	-47916	18.5
Total	53,096,255	79,221,000	3.5	73,821,935	3.0	5,399,065	-6.8

Sources: *CSA (1995), ** CSA (2006), *** FDRE (2008).

The 1.9% intercensal annual growth rate for Amhara (FDRE, 2008; CSA, 1995) is just over half the growth rate for the adjacent Oromia Region (3.6%). The growth rates of above 4% for Dire Dawa and Harari implied by the projected numbers are acceptable given their urban area status. The implied 3%+ growth rate for most of the regions are also plausible in view of their youthful populations, high birth rates, declining crude death rates, and the likelihood of population undercounts during the 1994 census as is the case in most censuses in Africa. Post-enumeration surveys in Uganda, Zambia, Rwanda, Burundi and South Africa have shown recurrent undercounts (Uganda Bureau of Statistics, 2005; Statistics South Africa, 2003). The 2002 census in Uganda had one of the better results with a reported coverage of 94.6 % and with greater completeness in rural than urban areas (Uganda Bureau of Statistics, 2005). Moreover, with the exception of deliberate tampering that inflated populations of several sub regions in northern Nigeria in the 1950s (Bamgbose, 2009), over-counting is rarely a significant problem. The main inference from the table is the possibility of undercounts in the 1994 Ethiopian census, and even greater undercounts in the 2007 census, especially in Amhara and Addis Ababa.

Intercensal declines in fertility and childhood mortality are reflected in falling growth rate of the population of the young. Figure 3 highlights differences in reported proportions of the population of Amhara in 1994 and 2007, showing declines ranging from 1% to 5% (except for the 55-59 age group).

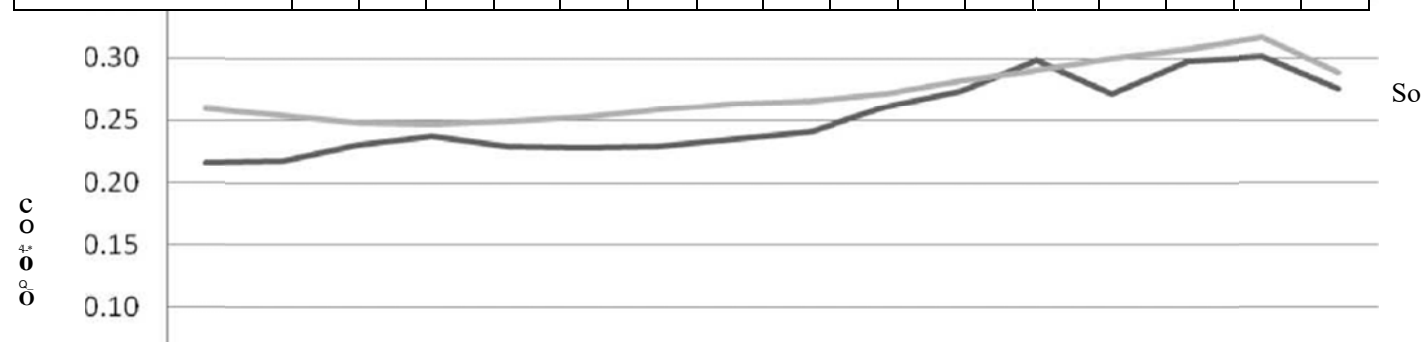
Figure 3: Proportion (Percent) of the Population of Amhara Region in the



Aynalem, Helmut and Terefe: Evaluation of the 2007 Ethiopian Census

Age Group

	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
----- 2007 census	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.2
	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2

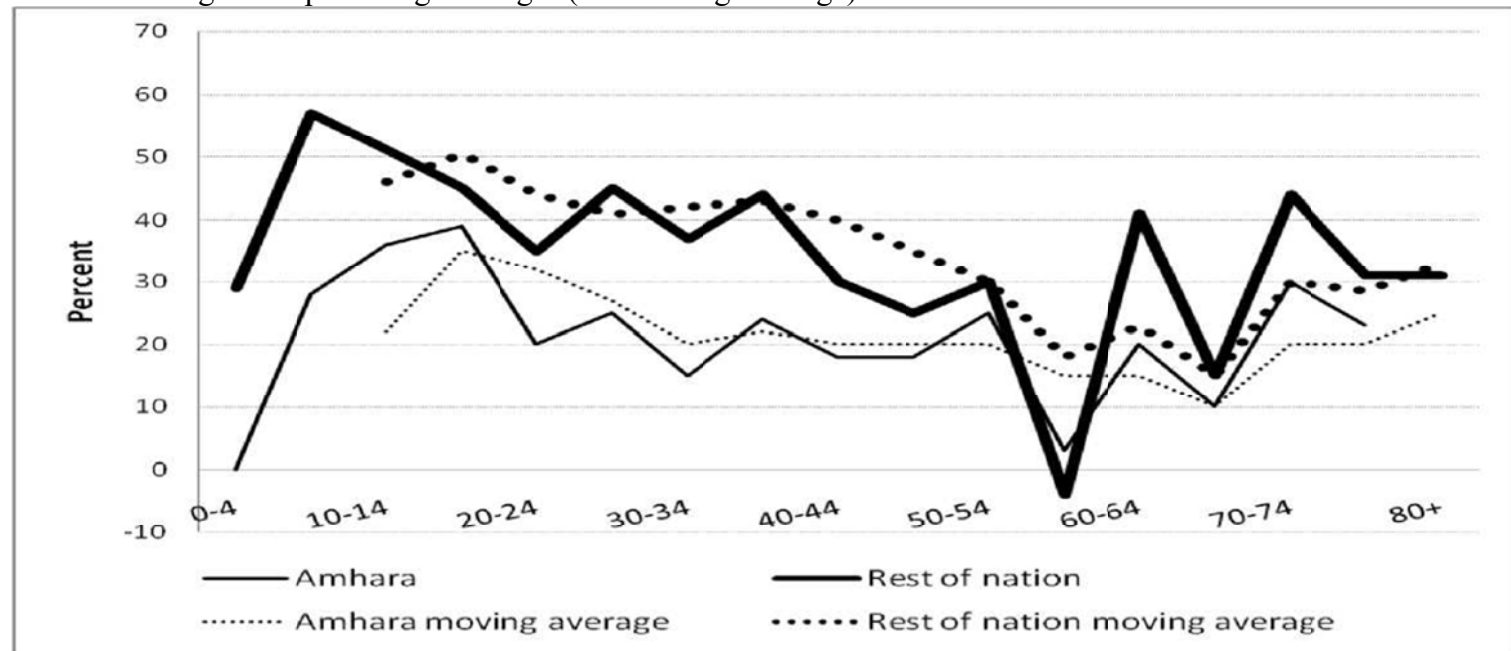


A rapid fertility decline could possibly have led to a decrease in proportions in the lower age groups but not in age groups above 13 years (the census interval is 13 years). The numbers shown are most likely the result of data error in which the population of Amhara was undercounted universally across all ages; the exception (age 55-59) is most likely due to age shifting (from the 50-54 age group) in the 2007 census.

Age-specific growth was investigated further (Figure 4) by comparing rates in Amhara with the rest of the country. Trend lines of 3-age-group moving averages are added to smooth-out erratic variations rates both at the national level and for Amhara. The consistently lower rates in Amhara are a strong indication of undercounts in this region. The 0-4 age group apparently grew by less than 1% in Amhara between 1994 and 2007 despite the significant increases in the number of women in their reproductive ages (ages 10-44), from 3.87 million to 4.94 million (a 27.7% increase). A growth of less than 1% is low even by the standards of developed countries now experiencing an overall population decline. The total intercensal growth for the 0-4 age group in the rest of Ethiopia was 27.9%, showing a big departure from Amhara.

The finding in Amhara is unexpected and unlikely to be the result of true demographic transition or changes to a higher level of development. Although fertility declined somewhat both nationally and in Amhara, the decrease is a more recent phenomenon and did not occur at low enough levels to produce the results reported for Amhara (Figure 4). TFR for Amhara for the year 2005 was 5.1, which is more than double the replacement TFR of 2.1. It is to be noted (in view of the substantial intercensal increase in the number of Amhara women in the reproductive age group of 10-49), that even a replacement TFR cannot reduce the rate of growth for the 0-4 age group during the 13-year period under consideration to the levels implied by the 2007 census count. Moreover, below-replacement fertility was reported only for Addis Ababa (Lindstrom and Zewdu, 2003; Amson *et al.*, 2003; Ferede and Erulkar, 2009).

Figure 4: Percent Population Increase in Amhara Region and in Ethiopia by Age Group, Between 1994 and 2007, and Fitted 3-Age-Group Moving Averages (3% Moving Average)

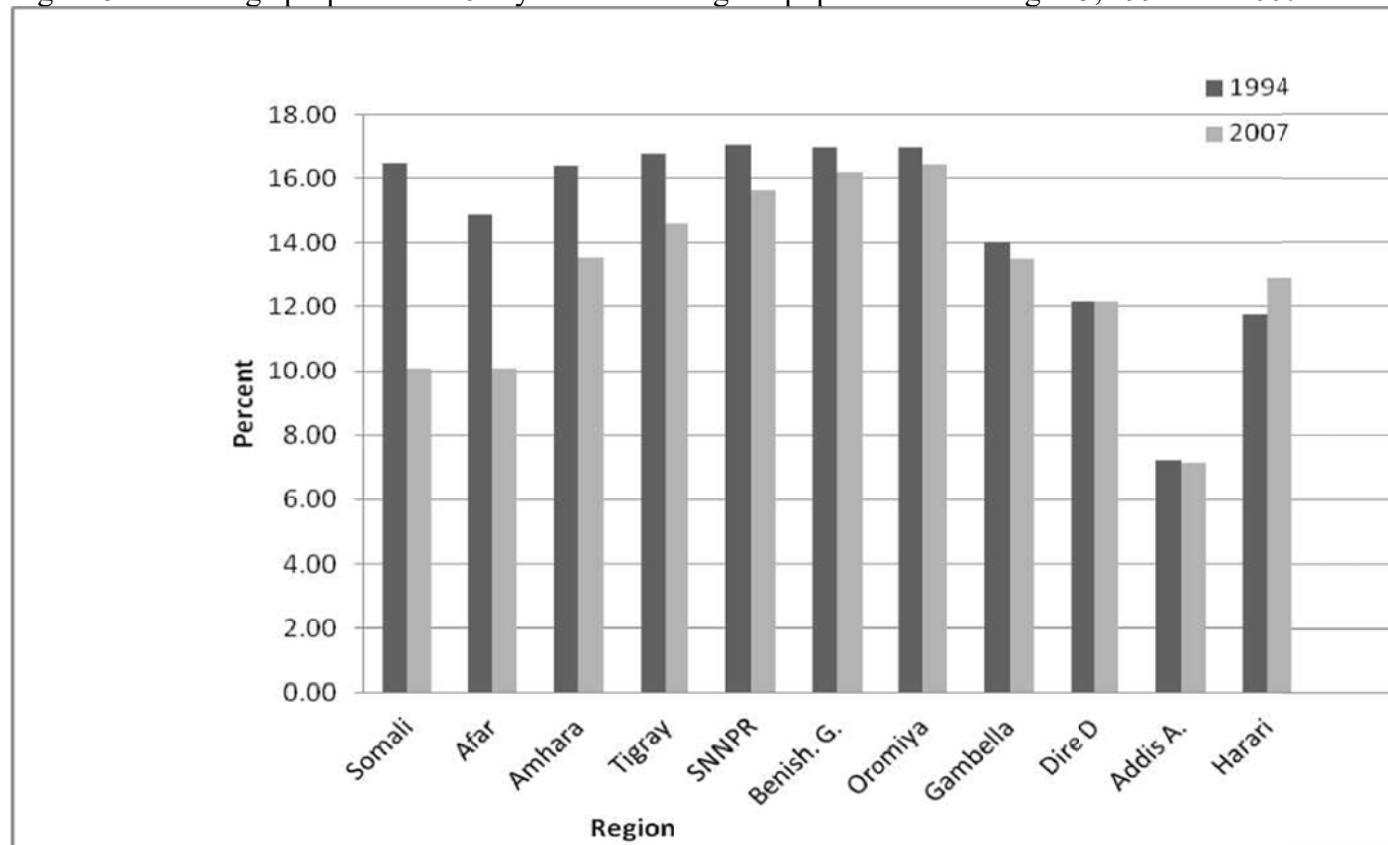


Source: Based on CSA (1995), FDRE (2008)

The 3-age-group moving averages are 10% to 22% lower in Amhara up to age 50 and 3% to 10% lower above age 50 (Figure 4). If the age-specific growth rate in Amhara was equal to the intercensal growth rate for the rest of the nation, the population count in Amhara for 2007 would have given a total of 19,695,063. This is larger than the census count by 2.5 million and close to the projected 2008 estimate of 20,136,000 people (Table 2). Figure 4 also shows that the population of children under five grew nearly 30 times faster in the rest of the country than in Amhara during the 1994-2007 intercensal years. The number of children in the 5-9 age group grew by 57% nationally - the highest growth rate of any age group. This suggests higher fertility during the first half of the decade preceding the 2007 census (1996 - 2001) than during the second half (2002-2007). The 15-19 age group registered the highest rate of growth in Amhara, although significant age shifting caused by respondents choosing digits ending in zero was noted in all regions. The shifting is best exemplified by the low numbers in the age 55-59 and 65-69 groups and peaks in the age 60-64 and 70-74 groups.

Figure 5 further highlights the reliability issues surrounding the 2007 census. In the ideal world the ratio of 0-4 year-olds to the population below 15 years of age would reveal subtle changes (decreases or increases) in the proportion of children under five, depending on whether fertility has been rising or declining. Spatial differences in fertility trends could also be observed and measured.

Figure 5: Percentage proportion of 0-4-year-olds among the population under age 15, 1994 and 2007



Aynalem, Helmut and Terefe: Evaluation of the 2007 Ethiopian Census

Differences in the ratio of 0-4-year-olds (numerator) to the total population under 15 (denominator) in 1994 and 2007 vary regionally, suggesting high fertility growth in some regions (Somali, Afar, Amhara, Tigray) and minimal growth in others between 1994 and 2007. The highest decline as shown in Figure 5 is for Somali and Afar. The change in Amhara is equal to that of Tigray's. Given that the apparent decline of the proportion of 0-4 year olds applied to all regions, the drastic shortfall in the numbers for all other age groups in Amhara the 2007 census could only be attributed to serious undercounts in this region affecting all age groups.

The final investigative tool used is the sex ratio at birth. Most national censuses in developing countries fail to provide accurate information on the gender of the newborn, thereby diminishing the accuracy of sex ratio calculations. However, in the absence of sex-selective mortality (infanticide of girls, for example), the sex ratio of infants may be a reasonable approximation of sex ratios at birth. Sex ratios at birth are universally about 104 male births for every 100 female births (Siegel and Swanson, 2004; United Nations, 1997). This is the expected average for all of Ethiopia's regions. The national average is 102.4 male births for every 100 female births. However, the numbers vary from 99.9 and 103.3 in Gambella and Benishangul Gumuz, respectively, to 112.3 in Afar and 114.3 in Somali (FDRE, 2008). This could only be due to data errors.

Evaluation of the National and Amhara Age Data Using the Whipple and Myers Methods

The above-mentioned age preference by respondents, also known as age heaping or digit preference, commonly leads to overrepresentation of ages ending in 0 or 5. Various techniques have been developed to measure heaping on individual ages or terminal digits. One such measure, the Whipple Index (Spoorenberg, 2007; Siegel and Swanson, 2004), is known for its prime focus on heaping on ages ending in 0 and 5 in the age range 23-62. Values range from 1 (no heaping or preference for ages 0 or 5) to 5 (only digits 0 and 5 are reported). A more refined method by Myers (1940) evaluates ages ending in any digit, with values ranging from 0 (no preference for any digit) to 9 (all ages reported a single ending digit). The expected value for each digit is 10%. Figure 6 shows the number of respondents (males and females) by single ages

for the Ethiopian population. Significant heaping on ages ending in 0 and, to a lesser extent, in 5 is observed. Indices for the Amhara and the nation are presented in Table 3. Unlike the graph, the indices evaluate male and female age data separately. Whipple's Index is the quotient of the population between the ages 23 and 62 whose reported age ends in 0 or 5 (numerator) divided by a fifth of the population between the ages of 23 and 62 (denominator) (Siegel and Swanson, 2004). The Myers Method (also referred to as the Blended Method) is not limited to the digits 0 and 5 but analysis departures from normality in all ending digits.

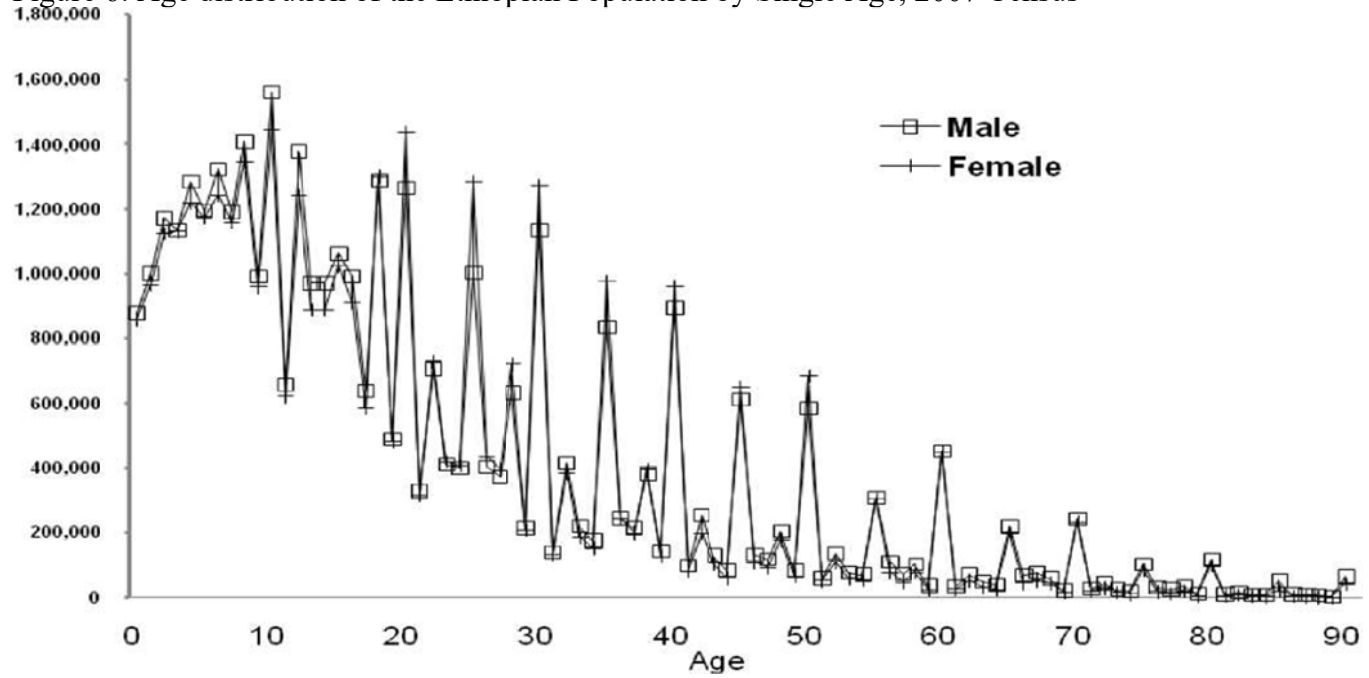
Whipple's Index uses the following formula (Siegel and Swanson, 2004):

$$\frac{Z (P_{25}+P_{30}+ \dots +P_{55}+P_{60})}{1/5 Z (P_{23}+P_{24}+P_{25}+ \dots +P_{60}+P_{61}+P_{62})}$$

where P = Population

Table 3 shows the absence of significant differences in age reporting errors between males and females in Amhara as well as nationally. The highest absolute deviations from the expected value of 10 (per digit) are for ages ending in 0 and 5, both at the national level and in Amhara.

Figure 6: Age distribution of the Ethiopian Population by Single Age, 2007 Census



Source: Based on FDRE (2008)

Aynalem, Helmut and Terefe: Evaluation of the 2007 Ethiopian Census

Table 3: Whipple's and Myers Indices for Single Age Reporting for Ethiopia and Amhara Region (2007)

Ethiopia				Amhara			
Method and Terminal Digit	Male	Female	Both sexes	Method and Terminal Digit	Male	Female	Both sexes
Whipple's Method (23-62)				Whipple's Method (23-62)			
Index	2.4	2.6	2.5	Index	2.2	2.7	2.5
Myers Method				Myers Method			
Index 4	47.8	55.5	51.7	Index *	44.9	58.0	51.5
0	13.3	15.4	14.3	0	11.5	16.0	13.8
1	-6.0	-6.3	-6.2	1	-5.7	-6.1	-5.9
2	-0.1	-0.9	-0.5	2	0.0	-1.2	-0.6
3	-3.7	-4.3	-4.0	3	-2.9	-3.9	-3.4
4	-3.8	-4.4	-4.1	4	-4.0	-5.0	-4.5
5	8.1	9.8	9.0	5	7.7	10.2	9.0
6	-1.8	-2.4	-2.1	6	-1.8	-3.0	-2.4
7	-3.3	-3.9	-3.6	7	-3.0	-4.0	-3.5
8	2.4	2.6	2.5	8	3.2	2.8	3.0
9	-5.1	-5.5	-5.3	9	-5.1	-5.8	-5.5

4 me sum of the absolute values of the deviations from 10. Source: Based on FDRE (2008)

Discussions and conclusions

Although inaccurate age reporting and preference for certain end digits were expected based on results from prior censuses and literature reviews (Kidane, 2009; Engelhardt, 2005; Chirwa *et al.*, 2005), our calculations using Whipple's and Myers indices reveal serious age reporting problems in the 2007 census. Both indices showed significant heaping on preferred digits - 0 and 5. The absence of major differences in levels of reporting errors between males and females and between the national population and Amhara confirms the national scope of the problem.

In the absence of significant regional disparities in demographic parameters - mortality, fertility and differences in socioeconomic levels, the discord between the projected 2008 numbers and the 2007 census can only be understood in the context of population undercounts which would not be unique to Ethiopia's 2007 census. Almost all of Africa's censuses suffer population undercounts. In sum, there is strong evidence in the data presented here that undercounts took place in Amhara and several other regions.

Table 4 lists other likely factors (in addition to undercounts) that may have contributed to the lower population numbers in Amhara's 2007 census than was expected on the basis of earlier projections. The list includes demographic factors - fertility, mortality, and migration - economic factors (labor mobility is used as proxy), environmental factors²⁵ including drought and famine, politically motivated killings, and government resettlement policies. Factors known to cause population undercounts top the list, however. These include interviewer errors, respondent errors, accessibility of polling places, regional and local security concerns, and incomplete coverage.

Table 4: Likely Contributing Factors to the Less Than Expected Population Count in Amhara Region in the 2007 Census in Addition to Undercounts

Factors	Which other regions (other than Amhara) have been affected?
Census undercounts	All other regions
Decreasing fertility	Tigray and the primarily urban regions of Harari, Dire Dawa and Addis Ababa
Higher mortality	Afar and Somali
Generational effects of famine-related mortality of the 1970s and 1980s	All regions except the primarily urban regions of Harari, Dire Dawa and Addis Ababa
Outmigration to government resettlement sites	Tigray, SNNPR, Somali, Afar
Outmigration of females to urban centers	All regions except the primarily urban regions of Harari, Dire Dawa and Addis Ababa
Land shortages and outmigration of male job seekers	All of the primarily rural regions
Outmigration to foreign destinations	All regions but higher border crossings into Sudan from Amhara
Generational effects of political-killings of the 1970s and 1980s, and refugee flight across Ethio- Sudan border	Tigray, Oromia

Some officials have attributed the apparent low growth of population in Amhara and observed deficits to excess HIV/AIDS mortality in the Region (AIDS Portal-Global Network, 2009). Similar claims have been made for Addis Ababa, where life expectancy reportedly declined from the 1994 levels due to HIV/AIDS (Yared *et al.*, 2002). It was also reported that mortality from all causes in the 25-29 age group increased by 8.5% annually (Sanders, 2003). Although there is some evidence that Amhara suffered elevated levels of HIV/AIDS mortality, HIV prevalence among antenatal attendants in health centers was similar in the regional capitals of Mekele in Tigray (13.4%), Adama in Oromia (9%), Awassa in SNNPR (9.2%), Bahir Dar in Amhara (14%), and other regions. Moreover, rural mortality rates were only slightly higher in Amhara (Federal Ministry of Health, 2006) than in other regions. Also, the HIV/AIDS impact, if significant, would be most consequential for the 15 and 35 age groups, and cannot explain fully the low population counts outside of this range (Figure 4). Since the HIV/AIDS prevalence in Ethiopia is higher among women than men (World Bank, 2008; Federal Ministry Of Health, 2006) a significant HIV/AIDS impact would also reveal itself in the sex ratios of young adults. There were 95.5 Amhara males for every 100 Amhara females in the 20-24 age group and 86 males for every 100 females in the 25-29 age group (FDRE, 2008) despite the higher female out-migration rate for this age group (Ezra and Kiros, 2001; UNFPA, 2008; Feleke *et al.*, 2006). Similarly, the sex ratio in the 30-34 age group was 96.3 males per 100 females.

A review of the fertility component of the 1998 migration survey cited by Akol *et al.* (2009) yielded no evidence that population growth in Amhara was lower than in other regions prior to 2007 (DTRC-PSTC, 2000). Based on the consistently lower age-specific population increase in Amhara than in the rest of Ethiopia and the comparison of socioeconomic and demographic characteristics of Amhara and Oromia regions, we can conclude that the numbers reported for Amhara in the 2007 census represented a gross undercount. Although the low numbers for Amhara can, in theory, result from deliberate misreporting or intentional exclusions, there is no evidence that this took place. In sum, therefore, census works and data need to be scrutinized critically even when there are reasons to suppose that the work and data are accurate.

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