The Age Structure Gap between Rural and Urban Populations in Sub-Saharan Africa

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ABSTRACT

Urbanisation is both an integral component and outcome of the demographic transition. Together they generate considerable differences in population age structures between rural and urban populations. These gaps are influenced by diverse declines in vital rates as well as migration. Despite interest in age structure at the national level, few studies examine within-country age structure dynamics. These spatial gaps in age structure go through their own progression and the differences in rural/urban age structures could be significant when examining a country's progress through the demographic transition and certainly when estimating the impact of age structures on various outcomes. This study explores these gaps and the extent to which they are driven by migration or vital rates in Sub-Saharan Africa using data from the United Nations and Demographic and Health Surveys. Findings indicate an increasing gap between rural/urban age structures as countries urbanise and transit to lower fertility levels. Net rural-urban migration mitigates the gap. Multivariate analysis suggests that young adult migration plays a substantial role in shaping population age structures.

INTRODUCTION

Age structures are determined by a population's fertility, mortality and migration levels. During the course of the demographic transition, as mortality and fertility rates decline, countries are expected to move from a wide based age pyramid with a young population to a narrower one with an older population. This shift from a young to an old population has fundamental social, economic and political implications for societies. It defines the parameters for potential labour force participation, or the extent to which health care services need to be expanded or education opportunities broadened. Yet despite interest in age structures at the national level, there are few studies on within-country age structure dynamics. In particular, as countries urbanise, a gap between rural and urban age structures may emerge and may grow or decline over time.

This study focuses on the shift in age structure in SSA over the past three decades. A shift from rural to urban society has been initiated across all world regions although Sub-Saharan Africa (SSA) remains the region with the lowest levels of urbanisation to date. Yet, even while SSA remains predominantly rural, it is expected to have a majority of urban residents in the near future (Montgomery, 2008). Indeed, over the last 25 years the mean proportion of SSA populations living in urban settings shifted from 25.8% to 41.8%. Thus, while evidence suggests that some dimensions of urbanization in SSA may be different than other regions - in part because of the recognition that urbanization in SSA has progressed with relatively little industrialization and economic growth (Fay & Opal, 2000) - urbanization nonetheless is on the rise across the continent (United Nations, 2014).

While the general empirical trends are quite clear, the causes of urbanization are complex. It is clear that urbanisation itself is an ultimate outcome of the demographic transition (Dyson, 2011). In Pre-transition settings, death rates are higher than birth rates in urban populations, making the urban sector a demographic sink. Without rural-to-urban migration, the urban population would become extinct. Once mortality starts to decline, urban death rates fall more rapidly than rural death rates[1]. When urban death rates fall below urban birth rates the urban population begins to grow due to natural increase, though migration initially remains the main contributor to urban growth. A decline in mortality thus ultimately leads to urbanisation.

The relationship between the demographic transition and urbanization is key, but one element that has received limited attention is how these two parallel processes generate substantial and consequential differences in the population age and sex composition across the urban and rural sectors. These gaps across the sectors are a direct product of factors which produce the urbanization process. They are heavily influenced by a delay in the fall of vital rates, particularly fertility, in the rural sector once the transition is underway. They are similarly influenced by the role of migration across the urban and rural sectors. Both these processes – vital rates and migration –create gaps between the urban and rural populations.

In this study, we explore the gaps in age and sex structure across SSA and probe the extent to which migration or vital rates are driving these gaps over time. We measure these patterns using a large dataset combining data from various sources, including the United Nations and Demographic and Health Surveys. Our results cover an extended period and offer a new empirical perspective on the demographic forces shaping African populations.

METHODOLOGY

The United Nations (UN) Population Division produces estimates of urban and rural populations by age and sex (URPAS) for the period of 1980 to 2015[2]. We use these data for 48 Sub-Saharan African countries to depict the differentials in age composition between rural and urban areas. Age structure comparisons are measured per sex using the median age and the dependency ratio.

[1] This is due to a reduction of deaths from infectious diseases which are more prominent in urban settings.
[2] Urban and rural population by age and sex (URPAS), 1980-2015 (version 3, August 2014). Available from: http://www.un.org/en/development/desa/population/publications/dataset/urban/urbanAndRuralPopulationByAgeAndSex.shtml

Median ages indicate the age at which half of the population falls below and half above. A low median age suggests a young population. Dependency ratios measure how many children (aged 0 to 14) and older adults (aged 60 plus) are dependent on the working age population. It is a useful measure of social and economic dependency because it indicates for every working aged person how many people they need to support apart from themselves.

To assess at which stage in the demographic transition each SSA country is, total fertility rates (TFR) are used from the UN for every five years between 1980 and 2015. Using the TFR enables us to identify each country's stage along the fertility transition. The fertility transition can be divided into seven stages according to TFR levels at the national level (Bongaarts, 2003). Using this categorisation, countries can be situated at different stages for each five year period.

Urban age structure is driven in part by rural-to-urban migration. Estimates of migration flows are obtained by using an adjusted version of the census survival ratio method (CSRM) with the URPAS data. CSRM estimates survivorship for each age group between two censuses exactly ten years apart for the population as a whole, and then adjusts the survivorship levels for rural populations. These total survival ratios (the fraction of each age group alive after ten years) are the backbone upon which the estimates are based. To generate rural cohort survival ratios it is assumed that rural survival ratios are lower than urban survival ratios by 25%. These ratios predict the expected number of people in each rural cohort at the time of the second census by multiplying the number of people in each rural age group (in the first census) by the rural survival ratios. The difference in the expected number of rural people and the actual number measured at the time of the second census provide an estimate of rural-to-urban migration over the ten year period. In order to estimate the number of child migrants from ages 0 to 4 (those not born in the first census), the number of female migrants and distribution of childbearing by age (proportionate fertility rates) are used.

The CSRM produces rural-to-urban migration estimates for all 48 SSA countries between 1980 and 2015. Annual net rural out-migration rates are calculated as the estimated number of migrants over the rural population; annual net urban in-migration rates are calculated as the number of migrants of the urban population.

There are some important limitations to this approach that have been raised previously (Preston 1979). CSRM migration estimates are limited in that they do not account for international migration or reclassification. Rural-to-urban migration estimates may be biased downwards when there international immigration is high or biased upwards when emigration is high. The extent of reclassification, redefining rural areas as urban, is unknown making it hard to account for its effects on the migration estimates.

Estimates of the age structure gap between rural and urban populations without migration are made by moving the migrants back to the rural sector. This simple approach returns the migrants to their sector of origin for each period. Dependency ratios and median ages are then gauged.

The three components shaping rural and urban age structures- fertility, mortality and migration, are decomposed using regression models. The models are OLS with country fixed effects, to account for between-country sources of heterogeneity that are both observed as well as differences that are fixed but unobserved. The models evaluate the effect of urban versus rural fertility, mortality and migration (of different age groups) within countries over time on the dependency ratio. Data on fertility and child mortality are taken from the Demographic and Health Surveys (DHS) by sector[3]. Adult mortality (the probability of dying between ages 15 and 60) is indirectly estimated using DHS data for 30 SSA countries between 1991 and 2014.

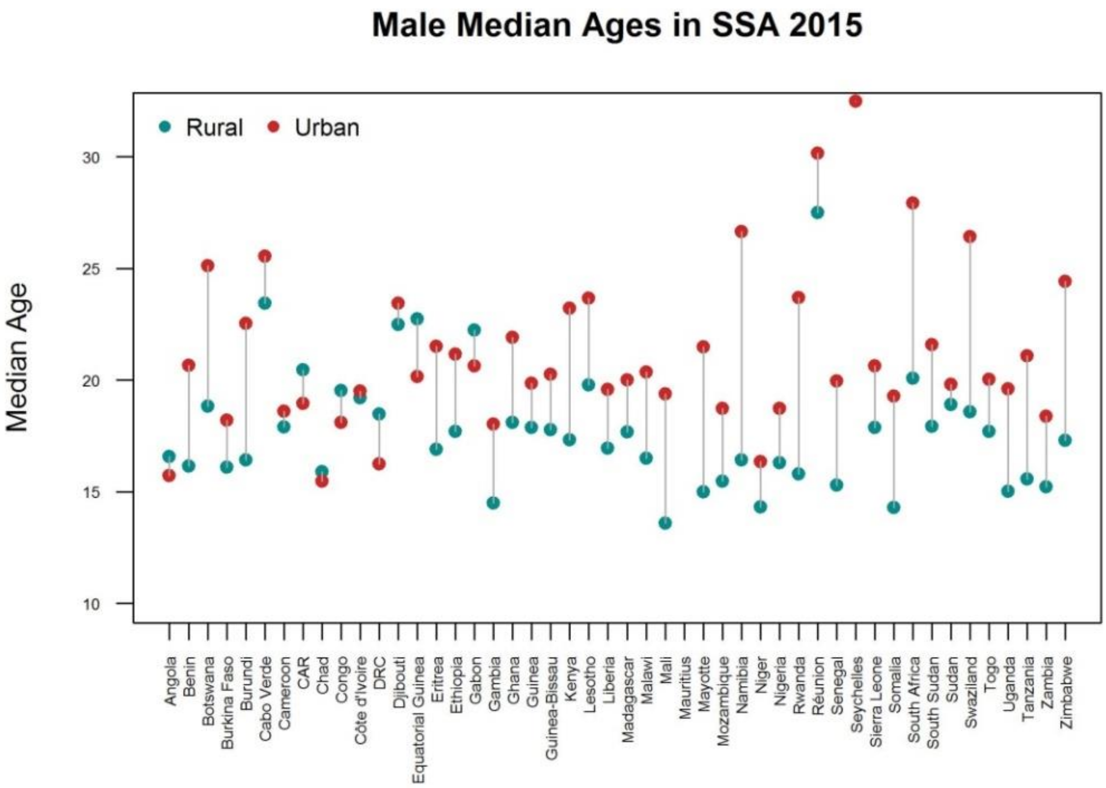
[3] http://www.statcompiler.com/

RESULTS

Assessing the Gap

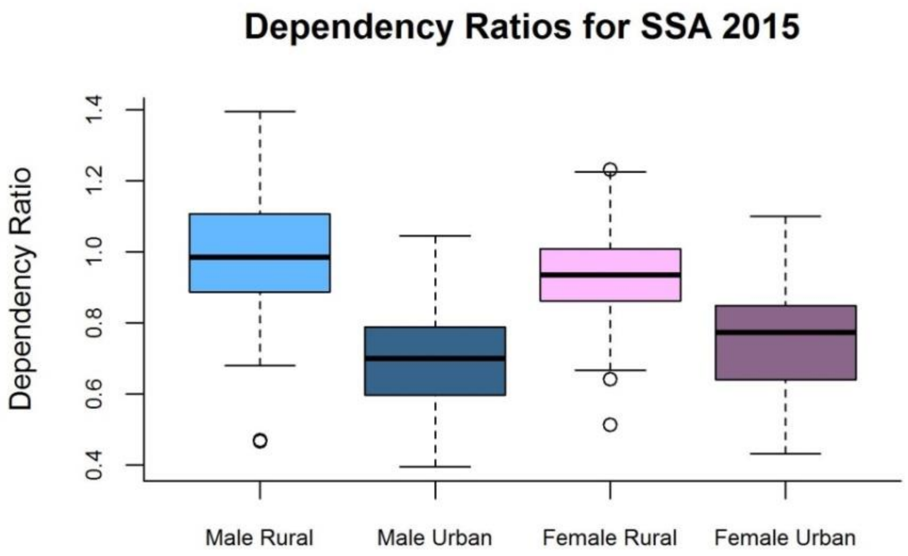
The first stage of our analysis considers the overall gap separating urban and rural median ages by country in 2015 (see Figure 1). In over 85% of Sub-Saharan African countries urban median ages are higher than rural median ages amongst both men and women. Among countries with higher urban median ages, the differences between the ages varies from less than a year difference to ten years, indicating heterogeneity in the age structure gap between rural and urban populations. While there are some exceptions where rural median ages are higher than urban, such as in Angola, Central African Republic and Gabon, in these cases the difference in the median age tends to be small. On average the urban population is older than the rural by 2.9 years.

Figure 1: Rural/Urban Male Median Ages in 2015



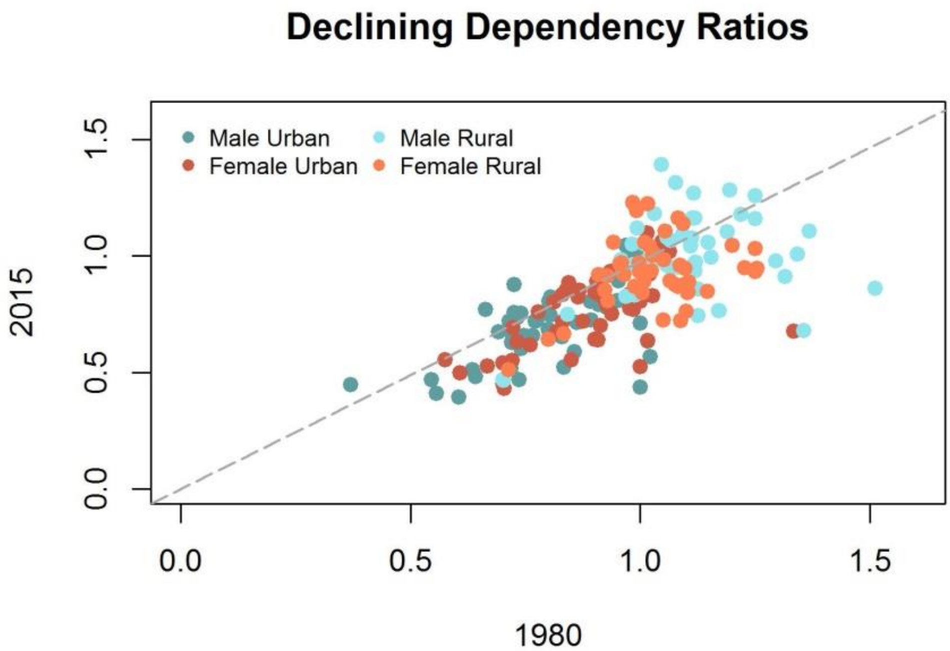
While the median age is informative, the dependency ratio is generally preferable given that it has a direct association to important information on how resources are produced and consumed within society. In Figure 2, a set of box plots show dependency ratios for different subsets of our population with a broadly similar story emerging. In the urban population, in comparison to the rural, the population is shown to be concentrated in the working ages with much lower levels of dependency. This is true for both sexes; however, the gap between the rural and urban dependency ratios is smaller amongst women. These differences imply differences in how the burden of dependency is experienced across different sectors and in particular they manage to highlight the massive gap for men.

Figure 2: Rural/Urban Dependency Ratios by Sex in SSA 2015



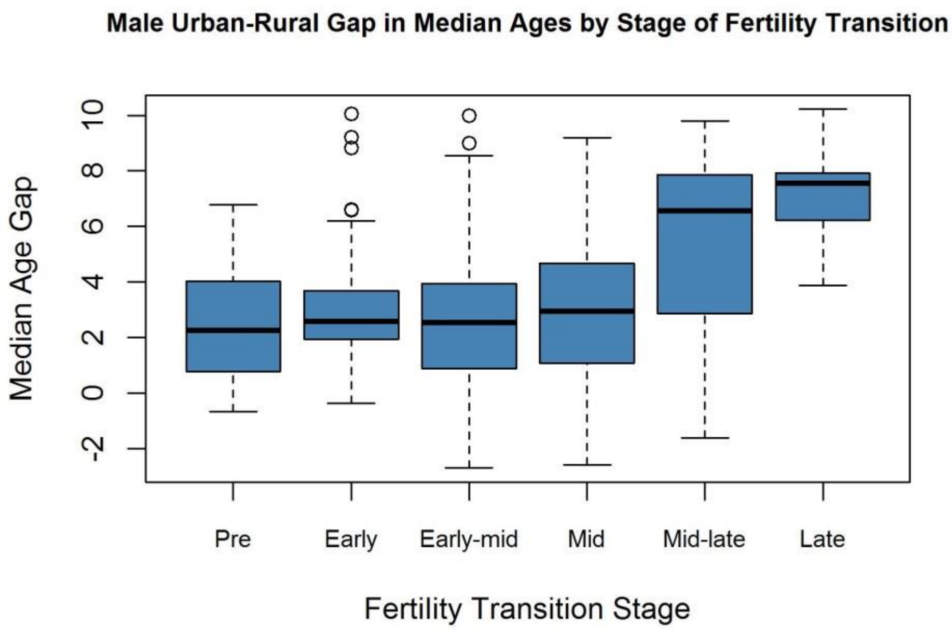
An additional useful perspective is gained by considering how dependency ratios change over time. In Figure 3, we show dependency ratios for 1980 (X-Axis) and 2015 (Y-Axis). The figure enables us to explore how similar these temporal changes are for rural and urban sectors. We note that urban dependency ratios are considerably higher for both men and women when compared to ratios in rural areas. In addition, dependency ratios in both sectors show consistently lower levels across the 35 years period. Thus, despite considerable variation, there is a clear decline in dependency ratios between 1980 and 2015. (We note that results are qualitatively similar when using the youth dependency ratio (aged 0-14 only to working aged population) instead of the total dependency ratio.)

Figure 3: Comparison of Rural and Urban Dependency Ratios in SSA between 1980 and 2015



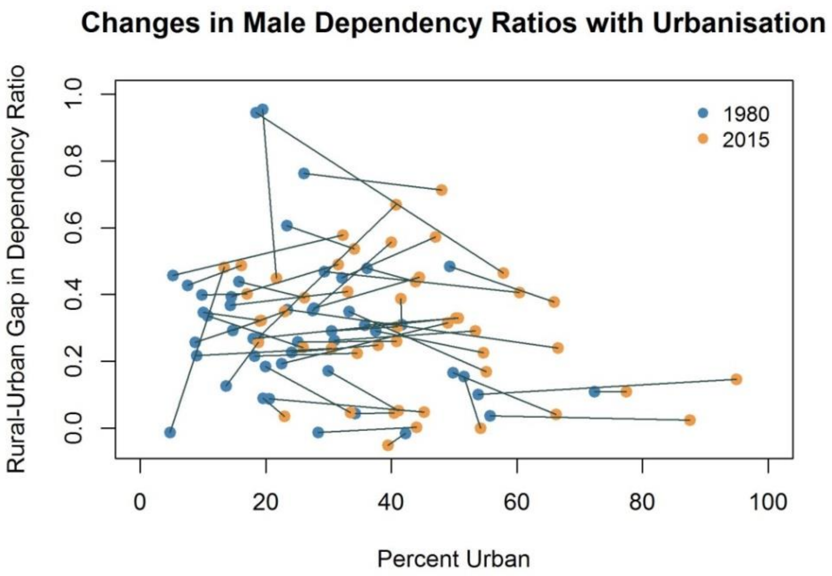
In Figure 4, we explore the extent to which the age structural gaps shift over the course of the fertility transition using median ages for males. We see that in the early stages of fertility transition, between the Pre- to Mid-level where TFR is above 4, the urban-rural gap in median ages is quite modest, roughly 2-3 years. However, once the fertility transition progresses more fully – the Mid-late and Late stages – the gap rapidly increases. It is also clear from the very large distance in the inter-quartile range in the box for Mid-late period that during this particularly period we are most likely to see variation in the extent of the gap. In the later stages of the transition, urban median ages are between seven and eight years higher than rural median ages. While this perspective includes countries in different stages at different periods, it does offer tentative evidence showing that gaps expand over the course of the transition.

Figure 4: Median Age Urban-Rural Gap by Stage of Fertility Transition



The previous perspective ignores individual countries and their patterns in order to paint a clearer picture of trends over the transition. In Figure 5, we explore how individual countries change by examining shifts in the male dependency ratios between 1980 and 2015 where each pair of points for an individual country is linked with a line. The line thus traces the trend for each country over time as over the course of urbanization. Several important features emerge including the not surprising tendency for an increase in urbanization over time. In general, between 1980 and 2015 the gap in dependency ratios on the whole remained relatively constant, increasing only slightly while countries became more urban. Yet, as shown in Figure 5 there is also an impressive degree of heterogeneity in patterns over time within SSA.

Figure 5: Dependency Ratio Gap over Urbanisation

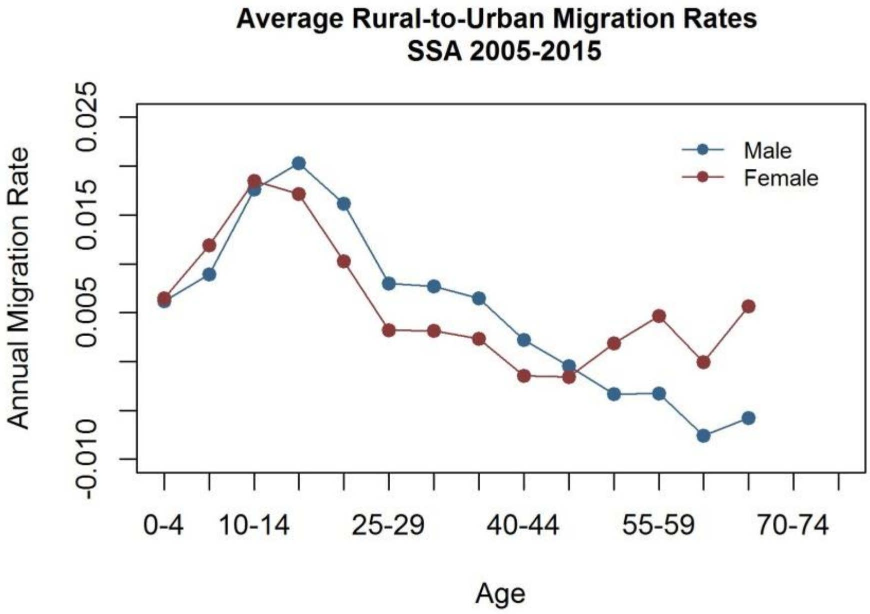


The Role of Migration

Whereas shifts in vital rates in the urban and rural sectors have an immediate effect on their own age structures, rural-urban migration obviously can play a direct role in shaping both rural and urban age structures. Migrants leaving the rural sector for cities impact both sector simultaneously and in opposite directions. Assuming a migrant is of working age – every rural-to-urban migrant increases the dependency ratio in the rural sector and reduces the ratio in the urban. In this section, we explore the impact of migration using newly estimated profiles of net rural-urban migration across countries and over time in SSA.

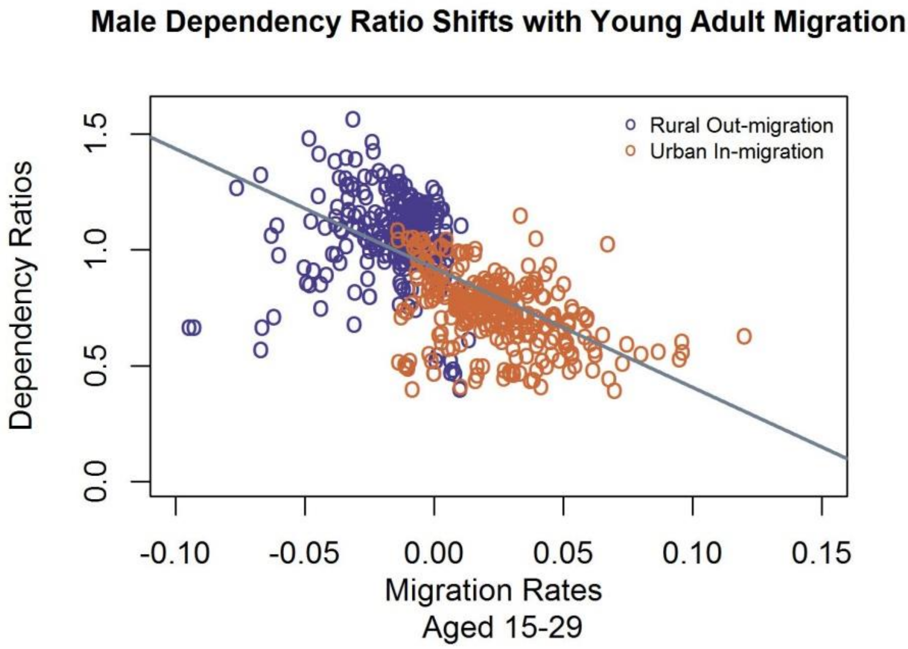
We begin by first showing estimates of the average net rural-to-urban age-migration profile in Figure 6. These profiles show the expected peak of migration in younger ages with male migration reaching its highest levels at ages 15-19, while female migration peaking at ages 10-14. From age 45, the net male migration is reversed, from urban to rural areas. Female migration in older ages starts to rise again. This suggests a hollowing out of young adults from the rural population and bulge in these age groups in the urban population.

Figure 6: SSA Country Average Migration Age Profile by Sex



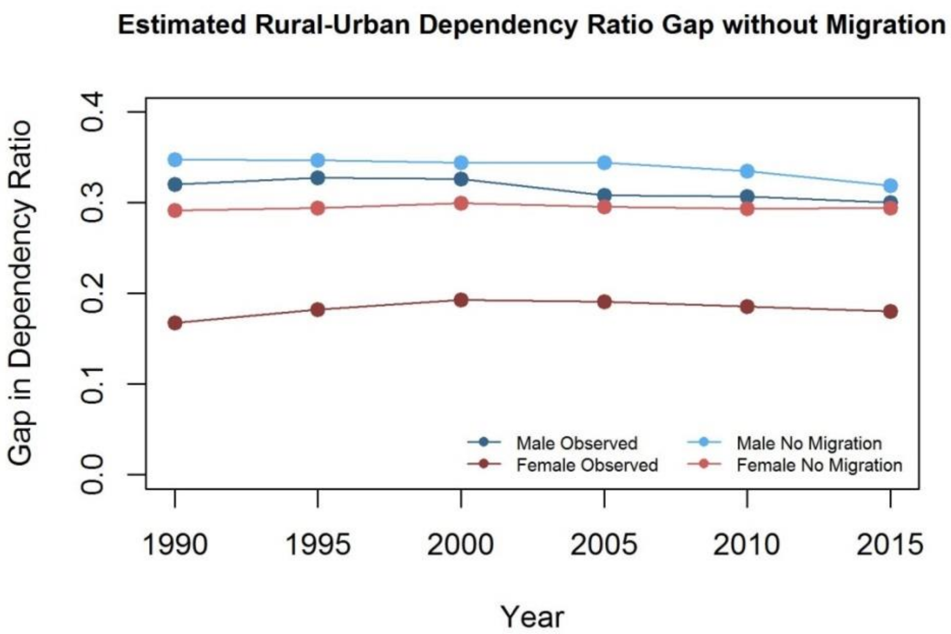
A principle component of our argument is that migration rates have the potential to significantly alter age structures across the two sectors. Figure 6 above emphasises the strong pattern of net migration with age. In Figure 7, we show how our estimated dependency ratios are associated with two separate estimates of our migration rates. We see that our migration estimates of 15-29 year olds - both net rural out-migration as well as net urban in-migration - have strong negative associations with dependency ratios. In both cases, as the migration rate becomes more positive, the dependency ratio declines. In the rural sector the greater the net out-migration the higher the dependency ratios. In the urban sector, as the net in-migration grows the dependency ratios decline.

Figure 7: The Impact of Male Migration between Ages 15-29 on Dependency Ratios



One very simple approach for assessing the role of migration on the difference in age structures is to assume the migrants in each period did *not* move. The estimated migrant flow is essentially returned in each cycle to the sector of origin – whether urban or rural. Once the population is adjusted, a new population age structure is obtained. Thus, the dependency ratios can be calculated for each sector both with migration as well as under this assumption of short-term non-migration. Our findings are shown in Figure 8, where we see that the rural/urban gap in dependency ratios increases without migration, particularly amongst females (Fig. 12). In other words, migration plays a role in mitigating the gap in age structures. Without migration, the gap in age structure would be considerably larger than what we actually observe. The most important point though to emerge is the difference in the impact of migration for women versus men. For men the gap is reduced by 8% on average whereas for women the gap is reduced by 47%.

Figure 8: Expected Age Structure without Migration



Multivariate analyses

By decomposing the components of fertility, mortality and migration, it is possible to estimate the differential effects of each factor on age structure. Table 1 presents regression results predicting dependency ratios in SSA by rural/urban sector of country, between 1990 and 2015, for men and women separately. All told, we would have a total of 1,676 observations for each country, sector, sex and year. In order to more easily assess the role of migration, we have collapsed migration into three separate age groups: child migration (between 0-14); young adult migration (aged 15-29); and older adult migration. Sector-specific variables are also included to allow estimation of the separate roles of fertility (TFR) and mortality (child mortality rates and adult mortality rates).

Model 1 is the baseline and shows how dependency rates change over time. The evidence is clear that dependency ratios decline and the decline is quite substantial over time. By 2015, the dependency ratio is reduced by 0.1 units or by about 11% of its mean. We also note that the dependency ratio is lower for females and that the ratio on average is lower in urban areas by 0.24

units. In terms of migration, child migration significantly increases the dependency ratio while young adult migration significantly lowers the dependency ratio. Migration of older adults is not significant in this model. In quantitative terms, an increase in the adult migration rate by 0.01 is associated with a decline in the dependency ratio by .005 units, or by 0.5% of the average dependency ratio.

Model 2 includes child mortality and total fertility rates (TFR) by rural/urban sector. The addition of these demographic factors has some impact on the other controls, but nothing very notable. The early year dummies become weaker but the later ones are similar. Also, the coefficient on gender becomes stronger and the urban coefficient somewhat weaker. We find that the TFR variable is highly significant and positive and indicates, unsurprisingly, that higher fertility is associated with higher dependency ratios. Similarly, higher mortality reduces the dependency ratio. The most interesting change is that the child migration coefficient is now insignificant. Thus, accounting for differential fertility and mortality removes the added importance of child migration on dependency ratios. In contrast, migration of older adults now becomes significant, increasing the dependency ratio.

Two further specifications that are similar to Model 2 are also shown. The first with country fixed effects (Model 2 FE) and the second using standardised variables (Model 2 Z). With country fixed effects, which give us more leverage on the results by focusing on changes within countries over time, adult migration rates, TFR and child mortality remain significant factors in determining the age structure. Also, the effect of elderly migration is amplified. Standardizing the independent variables[4] allows us to evaluate which demographic components have a greater impact on age structure in SSA. Young adult migration has the greatest absolute impact on dependency ratio, where an increase in one standard deviation from the mean of migration between ages 15-29 significantly lowers the dependency ratio by 0.063 units. The urban setting has the largest effect of reducing dependency ratios.

[4] All explanatory variables have been rescaled to have a mean of zero and a standard deviation of one; the outcome variable - the dependency ratio - is not standardised.

Model 3 builds on Model 2 by adding adult mortality by rural/urban sector. It has a slightly higher R^2 but the number of cases included in analysis is reduced. The probability of dying between ages 15-59 significantly increases the dependency ratio. A mean probability of dying (0.284) lowers the dependency ratio by .03 units. Adult migration rates remain significant. Models 4-6 build on Model 2, including interaction terms between the components of age structure and urban setting. All interaction terms are found to be significant, suggesting that the urban dependency ratio is affected more by migration, fertility and mortality levels than the rural. For example, an annual migration rate of 0.1 amongst 15-29 year olds is expected to lower the urban dependency ratio by 9.32 and increase the rural dependency ratio by 0.48.

Table 1: Regression Results Decomposing Components of Dependency Ratios

	Model 1	Model 2	Model 2 FE	Model 2 Z	Model 3	Model 4	Model 5	Model 6
1995	-0.009	-0.007	-0.018	-0.006	-0.01	-0.004	-0.007	-0.008
	0.012	0.015	0.015	0.005	0.018	0.012	0.015	0.014
2000	-0.032**	-0.023	-0.043**	-0.015**	-0.028*	-0.017	-0.021	-0.022
	0.011	0.012	0.013	0.005	0.014	0.01	0.012	0.012
2005	-0.062**	-0.028*	-0.054**	-0.018**	-0.036*	-0.017	-0.026*	-0.027*
	0.012	0.013	0.015	0.005	0.015	0.011	0.013	0.013
2010	-0.077**	-0.074**	-0.105**	-0.035**	-0.076**	-0.051**	-0.068**	-0.066**
	0.012	0.014	0.017	0.006	0.016	0.011	0.014	0.013
2015	-0.104**	-0.101**	-0.149**	-0.048**		-0.069**	-0.097**	-0.093**
	0.012	0.019	0.023	0.008		0.016	0.019	0.019
Female	-0.015*	-0.029**	-0.027**	-0.013**	-0.030**	-0.019**	-0.029**	-0.028**
	0.007	0.009	0.009	0.004	0.011	0.007	0.008	0.008
Urban	-0.242**	-0.156**	-0.210**	-0.105**	-0.146**	-0.065**	-0.319**	-0.276**
	0.008	0.013	0.018	0.009	0.017	0.016	0.044	0.026
Migration Rates 0-14	1.953**	-0.076	-1.111	-0.017	-0.819	-1.338	-0.023	-0.152
	0.508	0.561	0.653	0.01	0.711	1.113	0.554	0.547
Migration Rates 15-29	-3.362**	-3.388**	-3.616**	-0.063**	-3.834**	4.802**	-3.232**	-3.198**
	0.342	0.402	0.578	0.01	0.533	0.617	0.399	0.394
Migration Rates 30-59	0.459	1.457**	2.531**	0.038**	2.325**	-2.942**	1.235**	1.364**
	0.364	0.429	0.539	0.008	0.527	0.808	0.428	0.419
TFR		0.054**	0.024**	0.033**	0.051**	0.057**	0.037**	0.048**
		0.006	0.008	0.011	0.007	0.005	0.007	0.006
Child Mortality		-0.001**	-0.001**	-0.046**	-0.001**	0.000	-0.000**	-0.001**
		0.000	0.000	0.008	0.000	0.000	0.000	0.000
Probability of Dying 15-59					0.107*			
					0.049			
Urban*Migration 0-14						2.525*		
						1.192		
Urban*Migration 15-29						-9.795**		
						0.635		
Urban*Migration 30-59						4.516**		
						0.879		
Urban*TFR							0.031**	
							0.008	
Urban*Child mortality								0.001**
								0.000
Constant	1.094**	0.901**	1.165**	0.959**	0.907**	0.730**	0.989**	0.956**
	0.008	0.038	0.058	0.005	0.049	0.034	0.043	0.038
R-squared	0.461	0.766	0.783	0.783	0.793	0.843	0.773	0.778
No. of cases	1676	546	546	546	356	546	546	546

b coefficient

Standard errors

*Two-tailed test: ** p<0.01; *p<0.05*

CONCLUSION

The demographic transition plays a formative role in society and in development (Dyson, 2001). One key shift over the course of this process is the urban transition. This paper explores a mostly unexplored dimension of the relationship between the demographic transition and the urban transition: the dynamics of age structure. The evidence here enables a broad look at how age structure shifts across the urban and rural sectors over the course of urbanization.

A number of key findings have emerged in our study of Sub-Saharan Africa. One is that rural/urban age structure gaps increase over the course of the demographic transition, as countries urbanise. It is an important finding because it indicates important divergences that emerge over the course of the transition. As urban communities are increasing in size, they are also finding a reduced dependency burden. Their age structures are increasingly conducive to productive investments and they can enjoy a more substantial demographic dividend. Rural communities, in contrast, face more challenging age structures with higher dependency ratios.

Using the United Nations data we produced estimates of net age-specific rural-to-urban migration rates for 48 countries in SSA. We used these profiles to assess the role of migration and found that migration curbs this gap in age structure. In particular, adult rural-to-urban migration plays an important role in shaping urban age structures. While fertility and mortality are important, the largest role is played by adult migration. Most interesting is that while migration reduces the gap in age structure for men by a relatively modest amount, it has a very large effect on the measured dependency ratio for women.

This key role of migration is a critical finding of this paper. While evidence has noted that urbanization is driven primarily by natural increase (versus rural to urban migration) (Preston, 1979; UN, 2001), migration continues to play a very substantial role in population age structures.

Migration helps balance the two sectors and closes the distances between rural and urban age structures.

Imbalanced rural/urban age structures create tensions and challenges across both social and economic dimensions. Across social dimensions, gender gaps may cause a marriage squeeze. High proportions of urban youth may be associated with greater risks of conflict. Rural children may be left by their labour migrating parents to be raised by extended kin and the elderly. Across economic dimensions, it may become very difficult to productively invest resources in rural sectors with such high dependency ratios. It indicates that governments need to acknowledge this age structure gap, particularly when investing in education and health provision. Urban populations may require more palliative care services for the elderly while such services would be excessive in rural populations. Alternatively, not providing enough educational opportunities for rural children may leave the rural sector with fewer human resources.

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