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From corn to popcorn? Urbanization and food consumption in sub-Saharan Africa : Evidence from rural-urban migrants in Tanzania

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From Corn to Popcorn?

Urbanization and Food Consumption in sub-Saharan Africa: Evidence From Rural-Urban Migrants in Tanzania

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Abstract

There is rising concern that the ongoing wave of urbanization will have profound effects on eating patterns and increase the risk of nutrition-related non-communicable diseases. Yet, our understanding of urbanization as a driver of food consumption remains limited and primarily based upon research designs that fail to disentangle the effect of living in an urban environment from other socioeconomic disparities. Data from the Tanzania National Panel Survey, which tracked out-migrating respondents, allow us to compare individuals' dietary patterns before and after they relocated from rural to urban areas and assess whether those changes differ from household members who stayed behind or moved to a different rural area. We find that individuals who relocated to urban areas experience a much more pronounced shift away from the consumption of traditional staples, and towards more high-sugar, conveniently consumed and prepared foods. Contrary to what is often claimed in the literature, living in an urban environment is not found to contribute positively to the intake of protein-rich foods, nor to diet diversity. Though we do not find a strong association with weight gain, these changes in eating patterns represent a clear nutritional concern regarding the potential longer-term impacts of urbanization. Our results however also indicate that the growth of unhealthy food consumption with urbanization is largely linked to rising incomes. As such, health concerns over diets can be expected to spread rapidly to less-urbanized areas as well, as soon as income growth takes off there. Our findings clearly call for more in-depth research that may help to improve health and food and nutrition security as well as correctly predict food demand and adapt trade, agricultural and development policies.

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1. Introduction

Researchers and policy makers have traditionally focused on the problem of food insecurity and undernutrition in rural areas. Yet, the rising awareness that developing countries are now increasingly suffering from the “double burden of malnutrition”, with under- and overnutrition occurring simultaneously, and the fact that the prevalence of overweight appears to be higher and rising more rapidly in urban areas (e.g. Popkin et al., 2012) warrants adding an urban focus.

Urbanization is increasingly put forward as a crucial determinant of dietary patterns and considered as one of the driving forces behind the “nutrition transition”, giving rise to and accelerating profound shifts in diets, physical activity and the prevalence of several nutrition-related non-communicable diseases. More specifically, it is hypothesized that while part of the urban population still faces food insecurity, other subpopulations suffer from dietary excess and obesity as a consequence of more sedentary lifestyles and the transition towards diets high in sugar, fats and refined foods, but low in fibre (e.g. Popkin, 1999; 2001; Popkin and Gordon-Larsen, 2004). However, the extent to which these changes in the structure of diets and the prevalence of overnutrition may be attributable to living in an urban environment is poorly understood.

As sub-Saharan Africa is currently in the midst of an unprecedented wave of urbanization and more than 55 % of its inhabitants are projected to be living in urban areas by 2020 (UN, 2015), it is crucial to obtain a deeper understanding of how people interact with urban food environments to correctly predict food demand and develop the right policies for agriculture, trade and improving food and nutrition security.

Based upon nationally representative data from the Tanzania National Panel Survey (TNPS) covering the period from 2008 to 2013, this paper aims to improve our understanding of the importance of urban residence in the process of the nutrition transition from a micro-level perspective. Our data allow us to make several important improvements over existing work.

First, the majority of research on the impact of this rural-urban transition on food consumption is based on the descriptive comparison of rural and urban diets. This approach has serious limitations, as urban and rural populations differ in many more respects than only the environment they reside in. As such, it remains unclear whether the identified differences in diets can be attributed to a unique urbanization effect, or whether they merely reflect other socioeconomic disparities between urban and rural residents. Panel data can help resolve some of these issues, especially when tracking internal migration movements. Not only are rural-urban migrants an important source of urban population growth, but they also give us a before-and-after picture of the same person in two different environments, thus isolating the urban residence effect from many possible confounders.

Using a panel dataset containing detailed food consumption information for 9,070 individuals living in 1,879 rural households during the first survey round, we will investigate the impact of urbanization on food consumption. We compare rural-urban migrants' dietary patterns and body composition before and after they relocate from rural to urban areas and assess how this differs from those who did not move over the same period. Since we observe households in which some individuals migrate and others do not, we can restrict the difference-in-differences comparison to those originating from the same baseline household, effectively addressing concerns that observed or unobserved heterogeneity across migrant and non-migrant families may distort the results. Finally, we can also control for observable individual characteristics. In summary, the panel nature of the data and the tracking of individuals to new locations allow us to go much further in addressing selection bias than most studies.

Secondly, while there is a growing recognition that urban areas form a continuum ranging from small towns to major cities, little attention has been paid to the composition of the urban landscape and the role different types of urban environments play in stimulating dietary change. We extend existing analyses by moving beyond the rural-urban dichotomy and explore the heterogeneity of our results by the type of urban destination.

Finally, the mechanisms through which urbanization affects food consumption are poorly understood. Potential reasons as to why rural and urban food consumption may differ have been put forward and range from increases in income and changes in relative prices to different lifestyles and exposure to more global eating patterns. The validity of these hypotheses has however not been tested empirically. The detailed nature of our data allows us to assess the role of several pathways in explaining the changes in food consumption associated with urbanization.

Overall, the evidence presented in this paper confirms that, for the same individual, eating patterns will differ substantially, depending on whether they reside in an urban or a rural area. In line with expectations, the results demonstrate that relocating to urban areas is associated with a stronger shift away from traditional staples and towards more conveniently consumed, high-sugar or prepared foods. However, several other trends that are commonly associated with urbanization are not reflected in our results. In particular, we do not find that urban residence contributes to higher intake of animal source foods and oils and fats. Moreover, there is very limited evidence of a significant difference in diet diversity between individuals who relocated from rural to urban areas and their initial household members who stayed behind. Further exploring the factors underlying these changing dietary patterns, we find similar, though smaller, changes when migrating to smaller towns versus large cities, and we show that a substantial part of the impact of relocating to an urban area on diets is related to the transition out of agriculture as well as differences in food prices and incomes.

Though we do not find a strong association with weight gain, these changes in eating patterns represent a clear nutritional concern regarding the potential longer-term impacts of urbanization.

The remainder of this paper is organized as follows. The second section briefly reviews the available empirical evidence. Next, we discuss the food environment in Tanzania and the country's relevance as a case study for this particular topic. The data and identification strategy are described in Section 4. Section 5 presents the main results and Section 6 further disentangles the effects of urbanization on food consumption by exploring differences in the urban landscape (Section 6.1) and analysing the importance of several pathways (Section 6.2). Section 7 briefly summarizes several robustness checks and section 8 concludes.

2. Urbanization and food consumption

Urbanization interacts with several key determinants of food consumption. The shift away from agriculture for example results in more people being employed in sectors with lower energy requirements (Popkin 1999). This transition out of (smallholder) farming also implies that food consumption choices are no longer determined by own-production (Huang and Bouis, 2001). Overall, the more distinct separation of living and work location, improved (female) labour market opportunities and long commuting distances in urban areas are assumed to raise the opportunity costs of time spent on acquiring and preparing food and as such induce greater preferences for more conveniently consumed and pre-prepared foods (Bourne et al., 2002; Huang and Bouis, 2001; Huang and David, 1992; Regmi and Dyck, 2001). In addition, smaller living spaces and lack of storage and cooking facilities contribute to increased reliance on more conveniently consumed foods.

This is further facilitated by the fact that urban areas are characterized by markedly different food supply environments. Options for eating outside of the house or buying processed or prepared food are more abundant in urban areas, in part because food-manufacturing sectors are often based nearby (Codjoe et al., 2016). Moreover, the ongoing expansion of supermarket and fast food chains in the developing world is still mainly concentrated in urban areas (Hawkes et al., 2008).

More generally, these distinct demand and supply conditions will affect the availability and price of food. Whereas increased competition and thicker markets as well as improved access to imports can lead to lower prices (Fujita et al. 1996), transportation costs can raise consumer food prices in cities that are further located from domestic production areas (De Nigris, 1997). Overall, it is assumed that the relative prices of traditional food items will differ in urban areas and new items will be added to the mix.

Several authors also focus on the socio-cultural urban food environment. They note that changes in preferences and habits arise in urban areas as a consequence of greater exposure to more global eating patterns, modern mass media or of improved access to formal or informal nutrition knowledge (Huang and Bouis, 2001; Kearney, 2010; Nestle et al., 1998; Regmi and Dyck, 2001).

Finally, urbanization often coincides with increases in wealth, which in turn can be expected to significantly change dietary patterns (Regmi and Dyck, 2001). Stage et al. (2010: 204) even hypothesize that *“the difference between urban and rural households’ patterns of food consumption is not caused by urbanization and cultural change but income differences”*.

A substantial literature attempts to estimate the impact of urbanization on food consumption. Cross-country studies, often also exploiting variation across time, demonstrate the link between higher urbanization rates and increased consumption of animal source foods (Rae, 1998, Delgado, 2003) and sweeteners and fats (Drenowski and Popkin, 1997; Popkin, 1999; Popkin and Nielsen, 2003). In addition, there are within-country time series analyses showing that urbanization significantly affected cereal consumption patterns in Burkina Faso, Mali (Delgado, 1989) and a number of Asian countries (Huang and David, 1993).

Complementing these, there are several micro-studies, giving insight into these patterns at lower levels of granularity. Cross-sectional studies comparing rural and urban diets in Asia point to elevated levels of meat consumption (Huang and Bouis, 2001; Ma et al., 2004; Popkin, 1999; Popkin and Du, 2003; Regmi and Dyck, 2001; Zhai et al., 2009), lower grain consumption (Huang and Bouis, 2001; Popkin and Du, 2003; Zhai et al., 2009) and increased likelihood of eating meals away from home (Zheng and Henneberry, 2009) in urban areas. Other differences include that urban diets are more diverse (Popkin and Du, 2003) and contain more fats and refined carbohydrates (Mendez and Popkin, 2004; Popkin and Du, 2003; Shetty, 2002). This is confirmed for Latin American (Arimond and Ruel, 2004; Willaarts et al., 2013) and sub-Saharan African countries (Abdulai and Aubert, 2004; Bourne et al., 2002; De Nigris, 1997; Smith et al., 2006), where urban diets tend to be less dominated by traditional staples (De Nigris, 1997; Maxwell et al., 2000; Vorster et al., 2005). Similar to the findings from Asia, several studies also point to increased consumption of processed cereal products including bread (Kennedy and Reardon, 1994; Maxwell et al., 2000; Reardon, 1993) and growing reliance on street foods (Maxwell et al., 2000; Maruapula et al., 2011) in Africa.

While these studies have helped our understanding of existing variation in food consumption across urban and rural households, it is more difficult to draw from them any conclusions about how urbanization contributes to these differences (Popkin, 1999). In particular, it is not clear whether these rural-urban differences can be attributed to the effect of urban residence in itself or whether they merely reflect other socioeconomic disparities between urban and rural dwellers. This line of research is faced with the typical evaluation problem that we cannot observe the same person residing in both a rural and an urban area. Lacking experimental or quasi-experimental data, this can however be approximated by studying migrants who move from rural areas to urban areas. Huang and Bouis (2001:62) therefore conclude that “*an ideal data set for measuring structural shifts in food demand patterns records foods consumed before and after a large number of families migrated from rural to urban areas*”. To the best of our knowledge this paper will be the first to use this identification strategy, applied to nationally representative panel data, to study the link between urbanization and changes in diets and body composition.²

² We do know of one study that collects a retrospective panel among rural-urban migrants (Witcher et al., 1988), raising the usual concerns about recall bias. Ebrahim et al. (2010) and Bowen et al. (2010) compare food intake for rural-urban migrants with same-sex siblings still residing in their rural place of origin in India. Yet, the cross-sectional nature of the data still raises some concerns about selection bias due to individual heterogeneity.

3. The setting: Tanzania

As one of the world's most rapidly growing and urbanizing countries, The United Republic of Tanzania – a low-income, low human development country in East Africa – provides a relevant case study to investigate the impact of urbanization on food consumption. Average annual urban population growth over the past two decades amounted to over 5 %. As a result, nearly one third of the population is now living in urban areas and the country is projected to contribute more than 50 million people to the global urban increment by 2050 (UN, 2015; World Bank, 2016). The commercial capital, Dar es Salaam, currently home to more than 4 million people, is expected to hit the ten million mark by 2030 and become one of the 20 largest cities in the world by mid-century (UN, 2016). The growth of the urban population however goes beyond the expansion of Dar es Salaam. Other cities and towns have constituted a stable two thirds of the expanding urban population in Tanzania for the past 50 years (Ambroz and Wenban-Smith, 2014).

Although a substantial part of urbanization is the result of the natural increase of the urban population and the reclassification of previously rural areas into urban areas, Tanzania is also characterized by large internal migration movements. According to the 2012 census, about 7.8 million Tanzanians were living outside their place of birth and over 1.5 million people moved to a different region between 2011 and 2012 (NBS, 2015). For most regions, migration actually accounted for around half of the total urban population growth between 1978 and 2012 (Wenban-Smith, 2014).

Overall, this swift process of urbanization has coincided with a period of rapid economic growth, with an average annual GDP per capita growth rate close to 3 % between 1995 and 2014 (World Bank, 2016). While according to the 2012 National Household Budget Survey, poverty declined dramatically in Dar es Salaam, progress was much less pronounced in other urban areas and lacking in rural areas. Moreover, food security improvements do not match average national economic gains (WFP, 2013). An estimated 34.4 % of children under five was still affected by stunting in 2015-2016 (UNICEF-WHO-WB, 2016a). This again hides an important rural-urban divide with stunting rates averaging 44.2 % in rural areas compared to 30.8 % urban areas and 15 % in Dar es Salaam (WHO, 2016a; THDS-MIS, 2016).

At the same time, the prevalence of overweight and obesity is rising. While an estimated 18 % of women in Tanzania was overweight in 2004/05 , this number had gone up to 28 % by 2015/16 (THDS-MIS, 2016). Again, there is a marked spatial divide, with the total prevalence of female overweight and obesity in urban areas (42 %) being twice as high as in rural areas (21 %). With a staggering 26 % of the female population overweight and an additional 21% obese, Dar es Salaam has the highest prevalence of overnutrition (THDS-MIS, 2016).

The food environment in Tanzania is undergoing rapid changes as well. The “supermarket revolution” has arrived in Tanzania. While this transformation is still just taking root in other regional capitals, Dar es Salaam already hosts various supermarket chains (Ijumba et al., 2015). Processed and imported foods are also becoming widely available in urban areas and their share in the budget is expected to increase dramatically in the future (Ijumba et al., 2015; Tschirley et al., 2015). The country has however been faced with strong food price inflation of an estimated 8.51 % per year between 2002 and 2012, faster than the increase of non-food prices (Adam et al., 2012). As a result, the average share of food in the total household consumption basket increased over the past years and the majority of households report to have been negatively affected by the large food price increases (NBS, 2014).

4. Materials and methods

4.1 Data and descriptive statistics

4.1.1 Sample

The Tanzania National Panel Survey (TNPS) was conducted as part of the World Bank Living Standards Measurement Study-Integrated Surveys on Agriculture project. The initial sample covered 3,265 households and was designed to represent the nation as a whole as well as urban/rural and major agro-ecological zones.

Figure 1

Information on food consumption was derived from an extensive one-week consumption recall questionnaire on home food consumption administered at the household level, combined with a questionnaire on expenditures on eating outside home at the individual level. For the former respondents were asked to report the physical quantity of household consumption of 59 different items in grams, litres or pieces.³ All these units were converted to grams per capita, from which their calorific content could be calculated based on detailed local conversion tables (De Weerd et al., 2014). The latter part of the survey captured the monetary value of individual consumption of 7 different types of food and drinks outside home, which were subsequently converted into physical values using information on the price and content of typical items within these categories.⁴ For the purpose of this analysis, we consider only individuals for whom complete and plausible data on their consumption of food (and non-alcoholic beverages) at home and outside home were recorded.⁵ During the 2008/09 survey round 10,267 and 5,323 of these individuals were residing in rural areas and urban areas respectively (see Figure 1). For our main analysis, we focus on the former only.

³ We excluded alcoholic beverages (bottled beer, local brews, wine and spirits) from our analysis as well as items for which calorie contents were not available (package fish, salt, other spices, other raw materials for drinks).

⁴ Full meals, barbecued meat, chips, roast bananas, other snacks prepared on charcoal, local brews (not included), wine, commercial beer and spirits (not included), sodas and other non-alcoholic drinks, sweets and ice-cream, tea coffee, samosa, cake and other snacks.

⁵ We exclude those for whom total food consumption per adult equivalent per day was below 400 kcal or above 6500 kcal

In 2012/13, the survey team attempted to locate all baseline household members aged 15 years and above (except for live-in servants), including those members who had migrated. Figure 1 shows how the survey teams managed to re-interview 9,365 out of the 10,267 individuals (with plausible baseline food consumption data) by 2012/13. An interesting feature of the survey, and one of the sources of identifying variation in our study, is that many households had split over this 4-year period. In particular, the 1,905 rural baseline households with complete consumption information that were relocated had split into 2,778 households by 2012/13.

Our final analytical sample consists of 9,070 individuals, living in 2,708 households in 2012/13 for whom we have complete and plausible baseline and endline information on their sources of calories.⁶ The fact that about 10% of this sample had migrated within the 4-year window of the survey is quintessential for our identification strategy.⁷ Out of the 913 migrants, the majority (680) moved to another rural area, whereas 233 moved out of the rural areas into urban areas. Figure 2 maps the original and migrant households.

Figure 2

It is important to note that the process of migration is not random. For example, as marriage in Tanzania is primarily characterized by patrilocal residence, where a woman leaves her kin to live with her husband (Kudo, 2015), the majority of migrants in our sample are female. Relatively higher female employment opportunities in urban areas constitute an alternative explanation for the feminization of migration in Tanzania (NBS, 2014). We further note that better educated people from smaller, wealthier, non-farming households are more likely to migrate to urban areas (see Table 1). We discuss how we address this key concern of heterogeneity affecting both food consumption and the process of migration in Section 4.2.

Table 1

⁶ The fact that this sample is substantially reduced raises some concerns regarding the selectivity of attrition. We address this in more detail in Section 7.

⁷ We applied strict criteria for distinguishing migrants. Individuals whose 2012/13 place of living was less than a one-hour drive away from their original location, were not considered migrants.

4.1.2 Dependent variables

4.1.2.1 *Consumption of different food categories*

In line with the hypothesis that urbanization has a greater impact on the composition rather than the level of food consumption (Regmi and Dyck, 2001), we disentangle changes in dietary patterns by looking at the consumption of 12 different categories of food (and non-alcoholic beverages). The construction of these categories was influenced by the structure of the questionnaire and adjusted to distinguish traditional staples from types of foods typically associated with the nutrition transition (see Appendix A, Table A1).

To allow for a comparison to the existing literature which is largely based on cross-sectional comparative descriptive analysis, Figure 3 depicts average total calorie intake per capita per day and for each of the 12 food categories during the 2008/09 round of the TNPS.

Figure 3

In contrast to earlier findings from Tanzania (Abdulai and Aubert, 2004) and other sub-Saharan African countries (De Nigris, 1997; Garrett and Ruel, 1999; Smith et al., 2006), these data indicate that total food consumption is slightly higher in urban areas. Aside from this, the differences in diets among rural and urban dwellers reflect conventional wisdom about rural-urban dietary patterns and are similar to previous studies in this region (e.g. De Nigris, 1997; Maxwell et al., 2000; Vorster et al., 2005).

More specifically, urban dwellers derive considerably less energy from the main traditional staple foods including maize, cassava and sweet potatoes and cooking bananas (included in other starchy foods). Daily calorie intake of maize and cassava in urban areas is even respectively 40 % and 78 % lower compared to rural areas. We further note that urban residents on average consume more than double the amount of rice and almost 7 times more bread and other processed cereal products than rural residents.

Besides the elevated levels of urban consumption of oils and fats and high-sugar foods in urban areas, one of the most striking differences is the much higher consumption away from home. Whereas rural dwellers consumed a modest 55 kcal worth of meals and snacks outside their home per day on average, this amounted to 227 kcal for urban residents. This presents a nutritional concern because of their

tendency to have higher fat, sugar and salt content (Steyn et al., 2013). In addition, several authors have raised questions over their safety and quality (e.g. Mensah et al., 2002; Omemu and Aderoju, 2008).

4.1.2.2 *Diet diversity*

In order to assess whether urbanization is associated with more diverse eating patterns, we construct several measures of diet diversity. A very straightforward way to measure diversity is to count the number of food items or groups consumed. As there is no consensus in the literature as to whether individual food products or broader food groups (see Appendix A, Table A2) should be used to assess diversity as a proxy for more nutritious diets (e.g. Torheim et al., 2004), we report both. The count measure – although easy to interpret – has the disadvantage that it does not consider the distribution of food consumption over food products or groups. We therefore also report the Berry Index (Thiele and Weiss, 2003), which is calculated using the following formula:

$$BI = 1 - \sum s_i^2 \quad \text{where } s_i \text{ is the share of the } i^{th} \text{ food item/group in total caloric intake.}$$

This index ranges from 0, in the case where food consumption is entirely based on one food item or group, to $1-1/n$, when n food items or groups contribute an equal proportion of calories.⁸

Figure 4

Figure 4 demonstrates that urban residents in Tanzania tend to consume diets that are more diverse. The average level of diversity is consistently higher for those living in urban areas regardless of the measure used.

4.1.2.3 *Body composition*

To provide some insights whether – in part as a consequence of changing diets – urbanization is associated with changes in body composition and contributes to rising levels of overweight (Popkin et al., 2012), we also calculate the Body Mass Index (BMI). For children BMI varies with age and sex, necessitating comparison with international child growth standards by calculating z -scores.⁹

⁸ For this particular dataset n equals 57 or 12 when considering food items or broader food groups respectively. The upper bound of the Berry Index is therefore equal to 0.983 or 0.917 respectively.

⁹ Z -scores were calculated for children aged 0 to 5 and 5 to 19, using the STATA igrowup package (WHO,2011) and WHO 2007 package (WHO, 2007) respectively. Children with biologically implausible values, as defined by the WHO growth standards, were excluded.

Unfortunately, not all respondents for whom we have complete and plausible food consumption data were measured during both survey rounds, reducing the size of our analytical sample to 3,727 adults and 3,215 children.

Similar to findings for other African countries (e.g. Abubakari et al., 2008), Figure 5, depicting the prevalence of overweight for adults (BMI > 25) and children (BMI for age > 1 standard deviation above international growth standards) reveals a clear cross-sectional urban-rural disparity in the prevalence of overweight.

Figure 5

According to these data, one third of urban women in Tanzania has a BMI above 25, whereas the prevalence of overweight was only 13 % in rural areas. Also average male BMI is considerably greater in urban areas (see Table 2). Similarly, the prevalence of overweight is higher for urban children (see Figure 5), though only significantly so for girls.

Table 2

At the same time, a large body of literature documents a clear rural-urban disparity in child nutrition outcomes (e.g. Smith et al., 2005; Van de Poel et al., 2007), thus suggesting that urbanization could have positive effects on child health in developing countries. In line with expectations, the z-scores summarized in Table 2 reveal that on average child nutrition outcomes are indeed better in urban areas. The negative deviation from the WHO growth standards is clearly larger for rural children.

The review of empirical evidence in Section 2 pointed to the fact that urban diets tend to be more diversified and “*show trends toward consumption of superior grains (e.g., rice or wheat) and contain more food higher in fat, more animal products, more sugar and more food prepared away from home and more processed food*” (Popkin, 1999:1908) as well as a higher prevalence of overweight among urban populations (Popkin et al., 2012). The summary statistics reported here thus clearly show that eating patterns in rural and urban Tanzania differ in much the same way as has been documented in the large descriptive literature. In Section 5, we will however demonstrate that some of these differences do not survive a tighter identification of the urban residence effect.

4.2 Identification strategy

As mentioned above, a simple cross-sectional comparison of average food consumption patterns in rural and urban areas is unlikely to capture the true impact of living in an urban environment. Ideally, we would want to observe the same individual in both settings. Our identification strategy is therefore based upon a comparison of individuals' dietary patterns before and after they migrated from rural to urban areas. More specifically, we employ a difference-in-differences estimator that compares respondents' dietary patterns before and after they relocated and assess whether those changes across a four-year period differ systematically from individuals who stayed in their baseline rural community.

Our specification controls for individual fixed heterogeneity, thus resolving a large number of possible sources of endogeneity. We further address this issue by including initial household fixed effects, thereby restricting the comparison to people originating from the same household and thus controlling for all observed and unobserved time-invariant baseline household characteristics. Finally, there are a number of personal attributes that we control for by including observed individual baseline characteristics. This approach, however, does not resolve the problem that unobserved time-variant differences may influence migration as well as eating patterns. To mitigate against this possibility to some extent, we include comparisons between urban and rural migrants. This further resolves any heterogeneity problems related to the decision to migrate or not. Unobserved heterogeneity influencing the choice of destination and, separate from that destination channel, also dietary changes, remains unaddressed.

In sum, the regression model looks as follows:

$$\Delta C_{ij,t+1,t} = \alpha + \beta_1 M_{i,t+1}^{\text{Rural}} + \beta_2 M_{i,t+1}^{\text{Urban}} + \gamma X_{i,t} + \delta_{i,h} + \epsilon_{i,t}$$

Where $\Delta C_{ij,t+1,t}$ represents the absolute change in kilocalories, that person i obtains from food category j . In other regression specifications, the left hand side variable will be the change in the share of food category j in total calories consumed, the diet diversity indices or body composition measures.

The change is assessed between 2008/09 (t) and 2012/13 ($t+1$). $M_{i,t+1}^{Rural}$ and $M_{i,t+1}^{Urban}$ are dummy variables that equal one when individual i migrated from their baseline rural community to a different rural or urban area respectively by period $t+1$. The term $X_{i,t}$ represents a vector of individual level baseline characteristics: age, sex, relation to the household head, education and marital status.¹⁰ Finally, $\delta_{i,h}$ stands for the initial household fixed effects and $\epsilon_{i,t}$ represents the error term. Our main interest lies in establishing the sign, size and statistical significance of β_2 , comparing urban migrants to those who stayed in their baseline rural villages. Finally, we also perform an F-test comparing β_1 and β_2 , which informs us whether our results hold when rural migrants rather than rural stayers make up the comparison group.¹¹

¹⁰ We attribute missing values to zero years of schooling and include a dummy variable that equals one when the observation was originally reported as missing. Similarly, we assume that individuals are unmarried when information on their marital status is missing and again include a dummy variable for the original missing values.

¹¹ The F-statistic for the equality of the coefficients for rural-rural and rural-urban migration in our baseline specification is equal to the square of the T-statistic testing whether the coefficient for rural-urban migration is significantly different from zero in the regression $\Delta C_{ij,t+1,t} = \alpha + \beta_1 M_{i,t+1}^{Stayed} + \beta_2 M_{i,t+1}^{Urban} + \gamma X_{i,t} + \delta_{i,h} + \epsilon_{i,t}$.

5. Results

5.1 Food consumption

Table 3 depicts the results of the regressions on the absolute changes in kilocalories per capita per day between for each of the 12 food categories considered. Table 4 repeats that analysis, but now using the change in share of energy derived from each of these 12 categories over this 4-year period as the left hand side variable, which allows us to assess the relative importance of these changes. The first line of both tables presents the baseline level and baseline share of kcal consumption for each food category.

Table 3

Table 4

In line with the results from the cross-sectional comparison and several studies documenting that urban diets in sub-Saharan Africa are less dominated by traditional staples (De Nigris, 1997; Maxwell et al., 2000), the results in Table 3 and 4 clearly demonstrate a much more pronounced shift away from home consumption of traditional staples after relocating to urban areas. The differences in maize and cassava consumption growth are large and highly significant. Compared to household members who remained in their original rural villages, rural-urban migrants experienced an additional decline of 172 and 131 kilocalories per day for maize and cassava respectively. In Table 4 we see that these absolute changes result in a greater decline in their relative importance as well. Whereas maize and cassava accounted for 39 % and 12 % of total energy intake among rural households at the baseline, urban migration led to a decline in the importance of these staples of 7.5 and 6.8 percentage points respectively. We find a similar trend in the consumption of other starchy foods, and of cooking bananas in particular.

The analysis further reveals a positive effect of relocation to urban areas on the consumption of rice, bread and other cereal products; time-saving foods commonly associated with busy urban lifestyles (e.g. Frimpong, 2013; Huang and David, 1992; Kennedy and Reardon, 1994; Maxwell et al., 2000; Reardon, 1993; Senauer et al., 1986). The positive coefficient for migration to urban areas in the regression of the growth of rice consumption is however barely statistically significant.

Confirming concerns about the sweetening of urban diets (e.g. Popkin, 1999; Popkin and Nielsen, 2003), the regressions highlight that the growth of the consumption of high-sugar foods – sugar, sweets, pastries and sodas – is much stronger for those who relocated to urban areas than individuals who remained in their baseline rural villages.

Relocating to urban areas also results in a large and highly significant divergence in the consumption of meals and snacks outside home between people who initially lived together. Whereas intake of this food category was almost negligible for rural residents at the baseline (56 kilocalories on average), moving to urban areas was found to generate an additional increase in consumption of 254 kilocalories. This shift appears to be driven by male migrants. The coefficient for rural-urban migration becomes insignificant when we restrict the analysis to women (see Appendix B, Tables B1 and B2).

Rural-urban migration does not seem to induce significantly larger growth in the intake of oils and fats. However, note that the share of meals consumed outside rises by an additional 10.6 % of total energy intake, which is likely to raise the fat-content of diets even when the growth of at-home consumption of oils and fats does not appear to be different for those who moved to urban areas. In addition, relocation to urban areas does not appear to significantly contribute to greater intake of nutritious food groups such as animal source products, fruits and vegetables and pulses, nuts and seeds.

So far we have compared urban migrants to those who remained in the rural areas, but it is also instructive to assess the differences among migrants. The last rows of Table 3 and Table 4 do so by presenting an F-test for the equality of the urban and rural migrant dummies. Except for rice, comparing those who moved to urban areas to those who moved to rural areas produces differences of similar magnitudes and significance levels. This indicates that the dietary shifts we have identified relate to living in an urban environment and not migrant selection.

5.2 Diet diversity

Contrary to both conventional wisdom and to what we find in the cross-sectional comparisons of Section 4, the results of the regressions of the four different measures of diet diversity summarized in Table 5 show little support for the hypothesis that living in an urban environment contributes positively to diet diversity.

Table 5

There is some evidence that individuals who relocated to urban areas experienced a stronger increase in the number of food items consumed compared to those who remained in their baseline rural villages. This association holds as well when we take rural-rural migrants instead of stayers as the relevant category for comparison. Yet there is no significant difference for the number of food groups consumed nor for both Berry Indices. This suggests that the higher urban diet diversity observed in our own cross-sectional comparison (see Figure 4) may have been largely driven by selection bias. It also highlights the possibility that other cross-sectional studies – such as De Nigris(1997), Bourne et al. (2002), Abdulai and Aubert (2004) and Smith et al. (2006), that find diet diversity to be higher in urban areas than rural areas – should not be interpreted to imply that urbanization will lead to more diverse diets.

5.3 Body composition

Despite the large and significant differences when just exploiting spatial variation (see Section 5.2.1) and several studies documenting that rural-urban migrants show a higher incidence of overweight and obesity compared to their rural counterparts (e.g. Carillo-Larco et al., 2016; Ebrahim et al., 2010; Miranda et al., 2011; Unwin et al., 2010; Varadharajan et al., 2013), we find very limited support for the hypothesis that relocating to urban areas affects body composition once controlling for individual fixed heterogeneity and initial household fixed effects. The results of the regressions on changes in BMI (for age) are summarized in Table 6.

Table 6

The results demonstrate that compared to their counterparts that stayed in their baseline rural villages, individuals who moved to urban areas appear to have experienced an additional increase in their BMI. The effect of rural-urban migration is however only weakly statistically significant and the F-tests fails to reject the hypothesis that the same effect occurs for rural-rural migrants. We find no evidence of any significant effect of rural-urban migration on weight gain in children.

It is important to note that this absence of a clear association between rural-urban migration and weight gain could be related to the relatively short time-span of the survey. In a study comparing rural-urban migrants that had spent more than 20 years in their urban environment and their rural siblings, Ebhrahim et al. (2010) do find that relocation to urban areas is associated with an increase in obesity. In addition, their results also suggest that the prevalence of obesity in rural-urban migrants increases with duration of stay.

6. Unpacking the effects

6.1 The composition of the urban landscape

There is great diversity in the characteristics of urban environments. Dorosh and Thurlow (2013) show that the urban population in sub-Saharan Africa is bimodally distributed, with roughly 40% living in major cities with a population exceeding 1,000,000 and 40% in small towns with less than 250,000 people.

Cities and secondary towns differ in their sectoral compositions (Dorosh and Thurlow, 2013); influencing energy requirements, opportunity costs of time and income level. Regarding the latter, several studies have documented the existence of an urban gradient, with average income higher and poverty levels lower in cities compared to secondary towns (e.g. Christiaensen and Kanbur, 2016). Large cities may also have markedly different food environments. Greater international exposure could result in a wider range of foods being available and changing preferences. The thicker markets also make cities the place where supermarkets get established (Hawkes, 2008), and options for eating outside of the house or buying processed or prepared food are more abundant. Secondary towns on the other hand are on average closer to the rural areas and may have cheaper supplies of locally produced food products.

While these supply and demand factors are thus likely to differ systematically between towns and cities, it is unclear how this will affect food consumption. This section therefore extends existing analyses of the impact of urbanization on food consumption by exploring heterogeneity of our results by the type of urban locality the migrant moves to. More specifically, we distinguish the cities of Dar es Salaam and Mwanza from smaller secondary towns.¹²

Table 7

¹² The census classification of locations of areas into urban or rural was used. Mwanza city – which consists of the Ilemela (343,001 inhabitants) and Nyamanga districts (363,452 inhabitants) – and DSM (4,364,541 inhabitants) are the only cities if we consider the common threshold of a population exceeding 500,000 (e.g. OECD, 2012). Our results are robust to changing this to 1,000,000 or 250,000.

We note that the coefficient for relocation to cities in the regressions is consistently larger in all but one of the regressions. Also, the coefficient on migration to secondary towns is not significantly different from zero for the food categories of maize, other starchy foods, sugar sweets and pastries. In addition, in the regressions of the number of food items consumed and adult BMI (see Appendix B, Tables B3 and B4), only migration to cities seems to matter.

Overall, these results and the F-tests summarized in the last row of Table 7 in particular indicate that the effects of urbanization on food consumption manifest themselves in secondary towns as well as larger cities. Even though several of the cross-sectional differences between secondary towns and cities are rather large, it seems that, once controlling for individual fixed and initial household effects and observable characteristics, the impact of urban residence on food consumption is not significantly different between smaller secondary towns and large cities (except for the case of other starchy foods). These findings suggest that the different sectoral composition and food environment will affect food demand in much the same way, both in secondary towns and in larger towns, even though these drivers of dietary change may be stronger and faster in the latter. In the next section we explore these potential pathways in more detail.

6.2 Impact pathways

In order to develop policies to respond to the dietary changes associated with urbanization, we need to understand the underlying mechanisms. Does increased income or the urban lifestyle affect food preferences or do people simply adjust their consumption in response to different supply conditions? The answer to these questions could help illuminate whether interventions should be sought on the demand or supply side. Yet, what drives dietary change through urbanization has not been addressed empirically in the literature before.

In this section, we therefore aim to shed light on the pathways through which urban residence affects diets. In a first set of regressions, we assess whether controlling for the difference in income and prices and living in a non-farming household alters the coefficients of the rural-urban migration dummy.

Secondly, we want to assess to what extent the observed changes in consumption patterns are the result of a slow (socio-cultural) adaptation process, or rather an immediate response to the different environment migrants arrive at.

Table 8 summarizes the results of the regression on the change in energy intake derived from the different food categories, including the three pathway variables; a dummy for whether the respondent now lives in a non-farming household, the change in the logarithm of total household consumption per capita and the change in local prices captured by our price index.¹³

Table 8

The first column of Table 8 shows how higher prices and leaving agriculture serve to reduce total calorie intake, while rising incomes increase it. Once we control for all these mechanisms, the urban residence effect on total calorie consumption becomes significantly negative.

The declining consumption of traditional staple foods appears to be partly explained by the transition out of farming. This is no surprise, since our data reveal that maize and cassava are mostly consumed from home production in rural areas. However, a large part of the shift away from consumption of cassava seems to be related to changes in prices. The price of cassava in urban areas, and especially in cities, is considerably higher than in rural areas. After controlling for prices, the negative effect of the rural-urban migration dummy completely disappears. A similar pattern arises for other starchy foods.

Income growth then again appears to account for part of the larger growth in the consumption of bread, pasta and other cereal products, high-sugar foods and meals and snacks outside home after relocating to more urbanized areas. After controlling for the change in income, the positive coefficients of migration to urban areas decline dramatically in magnitude and significance. This is particularly the case in the regression of sugar, sweets and pastries and meals and snacks consumed outside home. For this group of items the change in the consumption of rural-urban migrants is no longer significantly different from those who remained in their baseline rural community nor rural migrants once the difference in income is accounted for.

¹³ More details about the construction of the price indices and the other pathway variables are given in Appendix A, Table A3.

In line with expectations about increasing opportunity cost of time and commuting distances, moving out of agriculture also seems to explain part of the increase in the consumption of more conveniently consumed foods such as bread and meals away from home after migration to urban areas.

After building in the pathways, there are only two product groups where the urban migration dummy remains significant; bread, pasta and other cereal products and sodas, tea and coffee. It is possible that these changes persist because of the specific urban lifestyle and supply environment, with supermarkets and abundant local food processing.

We further note that there is a positive effect of increased income on diet diversity and adult BMI (see Appendix B, Tables B5 and B6). While the coefficient for rural-urban migration was significant at the ten percent level in our main regressions on the count of food items and adult BMI (see Table 5 and Table 6), this is no longer the case after controlling for differences in income. As mentioned above however, there was very limited evidence that urban residence influences diet diversity and body composition even without controlling for the pathways.

Finally, we explore whether the previously mentioned effects are the results of a slow (socio-cultural) adaptation process or whether rural-urban migrants change their consumption habits immediately in face of the different way of life and food supply environment in urban areas. To this end, we exploit the information we have on each individual's location in 2010/11. We interact the different migration variables with a dummy equal to one if an individual had relocated by 2010/11 already and as such has been living there for at least two years. The interaction terms thus captures those migrants that have been staying for a longer period in their new environment and as such had the possibility to adapt over a longer period of time.

The results of the regressions (see Appendix B, Tables B7 and B9) show few significant interaction terms. This seems to suggest that migrants adapt their consumption patterns immediately in response to the new physical context they are facing, and that socio-cultural impact on dietary preferences, which is likely to be a slower process, are less important. Panel data covering a longer time span would however be desirable to test this more rigorously.

7. Robustness checks

We test the robustness of our results against a number of potential concerns. First, we ascertain that the results are not biased by attrition. Second, we test the robustness of our findings to the definition of ‘rural’ and ‘urban’ locations. Finally, we test whether measuring food consumption in per adult equivalents instead of per capita alters our findings. We only summarize the main conclusions from these robustness checks.

First, because we lose close to 18 % of our sample between baseline and endline, it is important to look at the potential bias related to unit and item non-response. To test the robustness of our results to these sources of attrition, we computed inverse-probability-of-attrition weights for each individual. None of the previously discussed effects loses any significance in the weighted regressions and differences in the size of the effects are negligible (see Appendix C, Tables C1, C2 and C3).

Second, as mentioned above, an important caveat in this type of research is the lack of consensus on a clear classification of rural and urban areas. We therefore test whether our results hold when we move away from the 2002 Census administrative classification of locations of areas into rural or urban (as included in the TNPS data) and focus on local population density estimates instead. It can be argued that population density is a crucial gradient in delineating the rural-urban nexus as it can generate economies of scale and agglomeration effects, which are defining features of urban centres (Chomitz et al., 2005; Fujita et al., 1999) and which are found to propel economic growth (Spence et al., 2009). This seems relevant in the case of Tanzania, since Muzzini and Lindeboom (2008) find that approximately 17 % of the population in mainland Tanzania live in high density settlements (>150 people/km²) that possess significantly different characteristics than rural areas but are nevertheless not officially recognized as ‘urban’. We prefer to use the administrative classification for our main analysis however, as Wenban-Smith (2014b:3) concludes that “*despite the advantage of consistency, a density-based measure has limitations unless used in conjunction with other criteria*”.

The measure of population density that accompanies the TNPS is derived from WorldPop data (NBS, 2014) providing population density estimates per 100m², that were matched to household GPS coordinates. These estimates were subsequently converted to 19 ranges, of which we use the arithmetic mean, of inhabitants per square kilometre (for details see Appendix A, Table A3).

In line with our previous results, we find that living in a higher density area compared to your initial household members is associated with a stronger shift away from traditional staple foods, towards more easily prepared and processed foods as rice and bread and increased consumption of meals consumed outside the home. Though the results demonstrate a strong positive effect of population density on the growth of the consumption of sugary drinks, the effect on intake of sugar, sweets and pastries is not significantly different from zero. In addition, we again fail to find support for the hypothesis that urbanization is associated with increased intake of oils and fats, animal-source foods and diet diversity. The results do however provide some more evidence that urbanization might be associated with weight gain in adults (see Appendix C, Tables C4, C5 and C6).

As a final robustness test, we use food consumption per adult equivalent rather than per capita, which does not alter our findings.¹⁴

¹⁴ Results not shown but available upon request.

8. Conclusion

Although urbanization is increasingly put forward as one of the main determinants of changes in eating patterns and a driver of the nutrition transition in the developing world, our understanding of its effects on diets and the pathways through which these take place, remains limited. Using data from the Tanzania National Panel Survey for 2008/09 and 2012/13 that traced household members who moved throughout this period, this paper provides empirical evidence on the impact of relocating to an urban area on the energy intake derived from different food categories, diet diversity and body composition. Not only is this focus on rural-urban migrants novel in the literature, it enables us to more accurately capture the effect of living in an urban environment as we are able to observe the same individual in a rural and urban setting. Moreover, the panel nature of the data combined with the tracking exercise in this survey allows us to address concerns about observed or unobserved heterogeneity across migrant and non-migrant families by restricting the comparison to individuals originating from the same baseline household.

The results summarized in this paper clearly demonstrate that urban residence is associated with important changes in eating patterns. A simple comparison of rural and urban food consumption patterns based on our data confirms the differences that are usually described in the literature. Yet when controlling for individual fixed heterogeneity, baseline observable characteristics and initial household fixed effects, not all these trends hold. We find that individuals who relocated to urban areas do experience a much more pronounced shift away from the consumption of traditional staples, and towards more conveniently consumed foods such as bread, and high-sugar and prepared foods. However, contrary to what is often claimed in the literature, living in an urban environment is not found to contribute to a higher intake of meat, fish and dairy nor fats. Also, we find only very limited evidence of an increase in diet diversity, suggesting that higher diversity as well as increased intake of animal source foods and fats in cross-sectional comparisons is driven by socio-economic differences between rural and urban inhabitants rather than by the urban environment itself.

Our analysis goes further in exploring the underlying pathways driving these dietary changes. Distinguishing migrants according to their destination reveals the role of different types of urban environments. While consumption patterns change more drastically when migrating to large cities, the same trends can be observed at lower degrees of urbanization. In addition to the new urban environment with different food supply and relative prices in which migrants arrive, we find that a substantial part of the observed dietary shifts associated with urbanization are driven by the transition to off-farm employment and the increases in income that come along with it. More specifically, the declining consumption of traditional staple food items that are typically home-produced in rural areas such as maize, cassava and cooking bananas, appears to be strongly related to changes in prices and living in a non-farming household. The latter also seems to explain part of the greater consumption of timesaving foods, most notably bread and prepared meals after relocating to urban areas. Rising incomes induce a shift towards more conveniently prepared and consumed foods as well as high-sugar products. While underlying factors as higher incomes, different employment and changes in relative food prices do explain a significant share of the dietary changes due to urban relocation, there is still an additional unexplained urban residence effect for certain food groups, such as bread, pasta, sodas, coffee and tea. Potentially the specific urban supply environment, with expanding supermarkets, nearby food processing and more international exposure may play a role here.

Considering the health consequences of these changing diets, it is important to emphasize that once implementing our improved identification strategy, we find little support for the hypothesis often put forward in the literature that urbanization contributes positively to the intake of protein-rich foods or diet diversity. On the other hand, our results do confirm a significantly stronger growth in the consumption of high-sugar foods and prepared meals, which tend to be energy-dense but nutrient poor. Even though we do not find a clear association between rural-urban migration and weight gain in the short term, these changes in eating patterns do represent a clear nutritional concern regarding the potential longer-term impacts of urbanization on overweight and obesity and related diseases. At the same time, our results also indicate that the growth of unhealthy food consumption with urbanization is largely linked to rising incomes. As such, health concerns over diets can be expected to spread rapidly

to less-urbanized areas as well, as soon as income growth takes off there. While a more detailed analysis of the nutritional value and longer-term health consequences of changing diets after migrating to more urbanized areas would be desirable, our results do provide some important insights for the design and targeting of health and nutritional policies.

Overall, this paper demonstrates that up to now our understanding of urbanization as a driver of food consumption has remained limited and mostly based upon research designs that fail to disentangle the effect of living in an urban environment from other socioeconomic disparities, leading to erroneous conclusions about the impact of urbanization. While our findings are confined to the Tanzanian case, they clearly call for more in-depth research that may help to improve health and food and nutrition security policies. In addition, given the fast projected rates of urban population growth in the coming decades, a better understanding of its impact on dietary patterns will contribute to improved projections on future food demand, which may be crucial to adapt trade, agricultural and development policies in Africa and the rest of the developing world. For example, increased demand for easily prepared and processed cereals generates opportunities for investment in domestic processing facilities, while improved rural-urban linkages may reduce price differentials for more perishable traditional staples.

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Figures

Figure 1: Sample

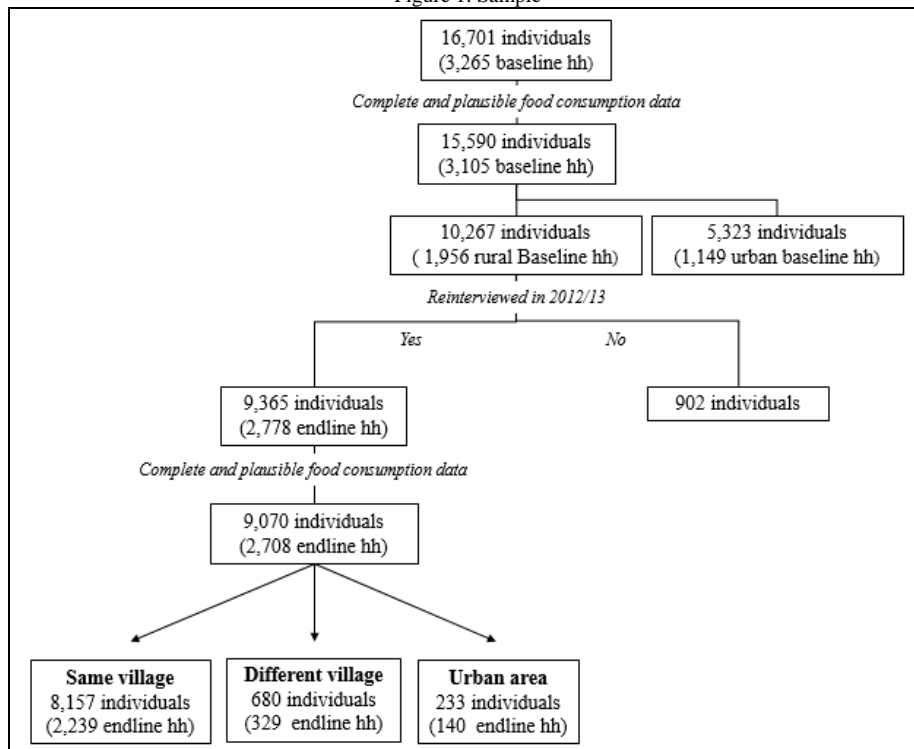


Figure 2: Geographical location sample households

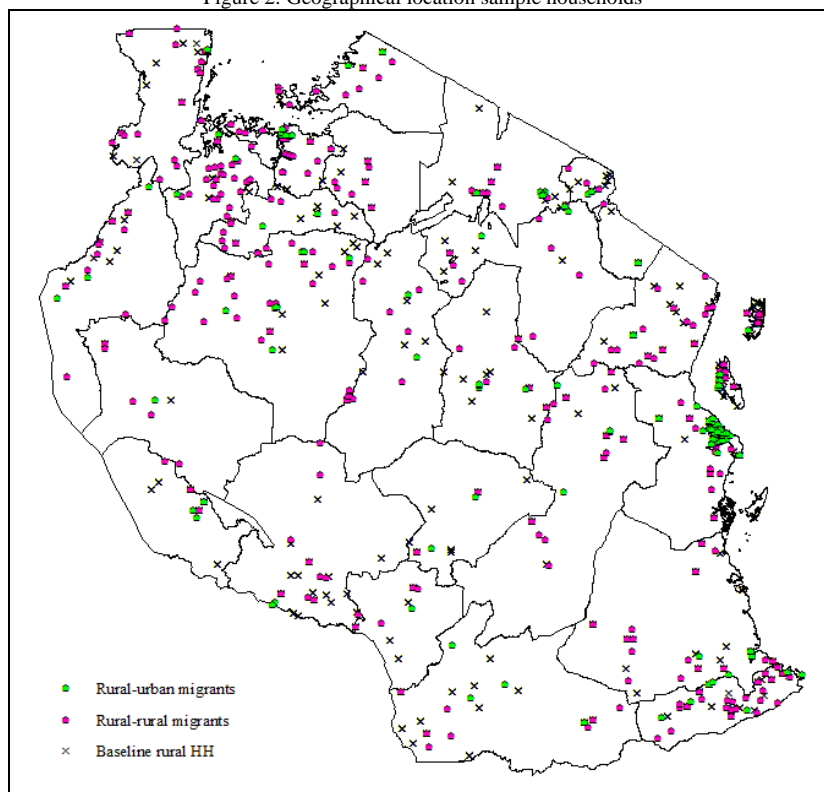
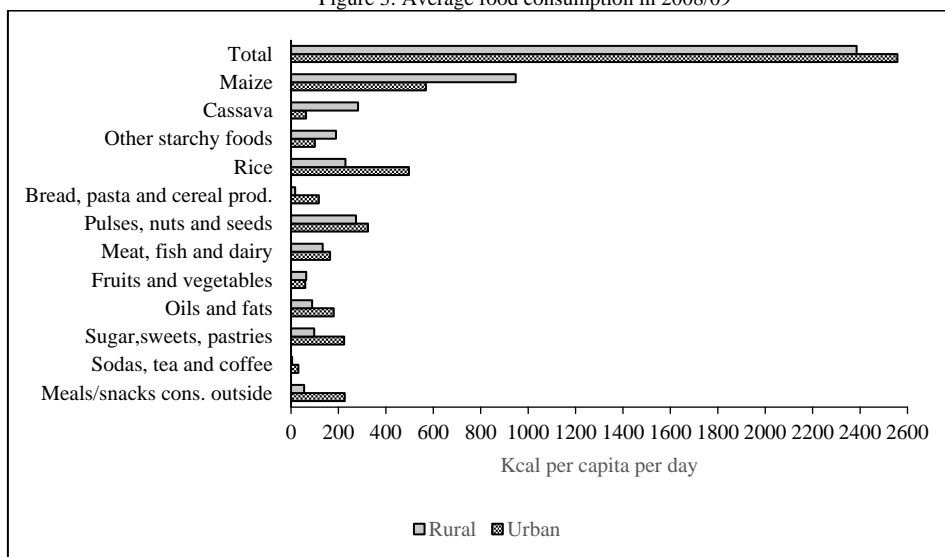
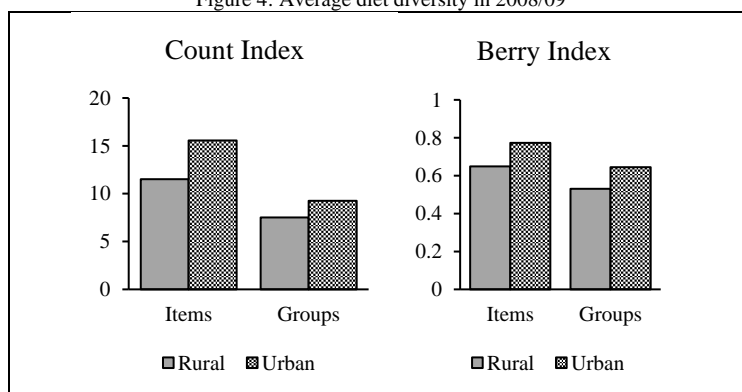


Figure 3: Average food consumption in 2008/09



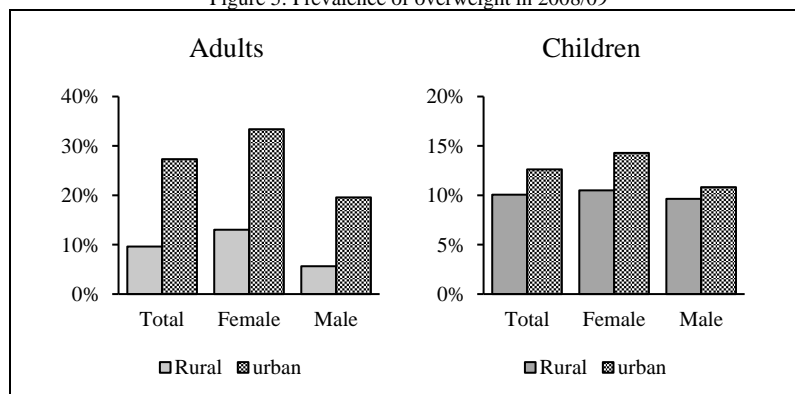
Notes: Food consumption is expressed in kcal per capita per day. The sample consists of 10,267 and 5,322 individuals living in rural and urban areas. All rural-urban differences are significant at the 1 % level.

Figure 4: Average diet diversity in 2008/09



Notes: Based upon food consumption in kcal per capita per day. The sample consists of 10,267 and 5,322 individuals living in rural and urban areas. All rural-urban differences are significant at the 1 % level.

Figure 5: Prevalence of overweight in 2008/09



Notes: The sample consists of 6,434 and 3,260 adults and 5,342 and 2,082 children living in rural and urban areas. Except for overweight in boys all rural-urban differences are significant at the 1 % level.

Tables

Table 1: Baseline characteristics (2008/09)

	Rural stayed (8157)	Rural-rural migrants (680)	T-stat. Ha: diff \neq 0	Rural-urban migrants (233)	T-stat. Ha: diff \neq 0
Age	22.379	21.713	0.857	20.639	1.345
Sex (1=male, 2=female)	1.514	1.568	-2.689***	1.571	-1.710*
Education (years)	3.172	3.204	-0.241	4.429	-5.646***
Married	0.317	0.346	-1.542	0.245	2.342**
Household head or spouse	0.335	0.356	-1.131	0.292	1.3637
Child of household head	0.501	0.490	0.568	0.506	-0.162
Household size	6.911	5.912	6.254***	6.021	3.296***
Farming household	0.835	0.835	0.509	0.579	10.284***
Total consumption per capita (TZS)	379697.7	392611.7	-1.292	474440.4	-5.649***

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Average BMI (for age) in 2008/09

	Rural	Urban	T-stat. Ha: diff \neq 0
<i>Adults >19 (N=9,694)</i>			
BMI	20.142	22.367	-23.192***
BMI (women)	20.463	23.076	-18.404***
BMI (men)	19.767	21.456	-13.919***
<i>Children (N=7424)</i>			
BMI for age, z-score	-0.396	-0.260	-4.5911***
BMI for age (girls), z-score	-0.339	-0.129	-5.2761***
BMI for age (boys), z-score	-0.455	-0.402	-1.1956

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Results regressions of changes in food consumption (2008/09-2012/13)

	Δ Total	Δ Maize	Δ Cassava	Δ Other starchy foods	Δ Rice	Δ Bread, pasta, cereal products	Δ Pulses, nuts, seeds	Δ Meat, fish, dairy	Δ Fruits, veg.	Δ Oils, fats	Δ Sugar, sweets, pastries	Δ Sodas, tea, coffee	Δ Meals, snacks cons. outs.
<i>Baseline</i>	2377.49	940.45	283.67	190.31	228.23	16.60	273.67	134.35	64.93	87.57	97.23	4.84	55.62
<i>M^{Rural}</i>	20.62 (80.71)	-13.51 (51.08)	20.38 (32.55)	16.75 (16.13)	37.82 (29.00)	12.17 [*] (6.390)	-37.66 ^{**} (19.14)	-1.818 (13.65)	-4.752 (6.962)	-3.615 (6.809)	-7.987 (11.29)	2.196 (2.257)	0.644 (37.73)
<i>M^{Urban}</i>	88.28 (131.6)	-172.0 ^{**} (77.22)	-130.6 ^{***} (34.59)	-99.06 ^{**} (40.42)	93.54 [*] (49.18)	68.95 ^{***} (17.46)	-21.41 (31.98)	17.23 (19.99)	-4.903 (9.457)	-2.425 (14.91)	57.41 ^{***} (18.73)	24.48 ^{***} (6.010)	257.1 ^{***} (65.31)
Const.	-378.4 ^{***} (25.97)	-175.7 ^{***} (15.40)	-84.71 ^{***} (8.568)	-34.20 ^{***} (7.431)	11.67 (9.191)	0.352 (1.817)	-38.15 ^{***} (5.711)	-21.24 ^{***} (3.844)	-6.817 ^{***} (2.536)	-51.72 ^{***} (2.466)	-12.30 ^{***} (3.243)	-0.0847 (1.200)	34.54 ^{**} (16.07)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>N</i>	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070
F-stat. Ha: $M^{\text{Urban}} \neq M^{\text{Rural}}$	0.201	3.270 [*]	9.150 ^{**}	7.621 ^{**}	0.946	9.630 ^{**}	0.194	0.585	0.000	0.005	9.959 ^{**}	12.13 ^{***}	12.45 ^{***}

Notes: Food consumption is expressed in kcal per capita per day.

We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Results regressions of changes in the composition of food consumption (2008/09-2012/13)

	Δ Maize	Δ Cassava	Δ Other starchy foods	Δ Rice	Δ Bread, pasta, cereal products	Δ Pulses, nuts, seeds	Δ Meat, fish, dairy	Δ Fruits, veg.	Δ Oils, fats	Δ Sugar, sweets, pastries	Δ Sodas, tea, coffee	Δ Meal, snacks cons. outs.
<i>Baseline</i>	38.58	11.99	8.37	9.79	0.73	11.67	5.89	2.80	3.78	4.36	1.91	1.84
<i>M^{Rural}</i>	-0.134 (1.774)	-1.382 (1.285)	1.503 [*] (0.783)	1.151 (1.021)	0.490 [*] (0.266)	-0.615 (0.728)	-0.522 (0.536)	-0.261 (0.300)	-0.040 (0.247)	-0.358 (0.407)	0.111 (0.082)	0.056 (1.560)
<i>M^{Urban}</i>	-7.494 ^{**} (2.987)	-6.838 ^{***} (1.449)	-2.889 ^{**} (1.163)	2.973 [*] (1.804)	2.388 ^{***} (0.547)	-1.295 (0.947)	-0.407 (0.661)	-0.375 (0.385)	-0.055 (0.481)	2.409 ^{***} (0.693)	0.873 ^{***} (0.222)	10.71 ^{***} (2.871)
Const.	0.201 (0.608)	-1.628 ^{***} (0.365)	-0.509 (0.357)	1.740 ^{***} (0.344)	0.054 (0.072)	-0.033 (0.226)	-0.284 [*] (0.162)	0.085 (0.103)	-2.032 ^{***} (0.093)	-0.160 (0.129)	0.019 (0.042)	2.547 ^{***} (0.635)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>N</i>	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070
F-stat. Ha: $M^{\text{Urban}} \neq M^{\text{Rural}}$	4.571 ^{**}	8.304 ^{***}	10.85 ^{***}	0.805	10.14 ^{***}	0.347	0.019	0.061	0.001	13.07 ^{***}	9.756 ^{**}	11.50 ^{***}

Notes: Food consumption of different categories is expressed as a share of total per capita per day energy intake.

We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Results regressions of changes in diet diversity (2008/09-2012/13)

	Δ Count (items)	Δ BI (items)	Δ Count (groups)	Δ BI (groups)
<i>Baseline</i>	11.52	0.649	7.52	0.532
M^{Rural}	-0.422 (0.354)	0.012 (0.016)	-0.036 (0.180)	-0.002 (0.016)
M^{Urban}	1.205* (0.666)	0.037 (0.024)	-0.018 (0.301)	-0.010 (0.023)
Const.	-0.253** (0.111)	-0.039*** (0.005)	0.007 (0.056)	-0.031*** (0.005)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
<i>N</i>	9070	9070	9070	9070
F-stat. Ha: $M^{\text{Urban}} \neq M^{\text{Rural}}$	4.827**	0.777	0.003	0.083

Notes: Based upon food consumption in kcal per capita per day.

We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Results regressions of changes in body composition (2008/09-2012/13)

	Adults (> 19 years old)			Children (0 to 19 years old)		
	Δ BMI	Δ BMI (women)	Δ BMI (men)	Δ BMI for age z score	Δ BMI for age z score (girls)	Δ BMI for age z score (boys)
<i>Baseline</i>	21.472	21.864	20.957	-0.332	-0.342	-0.320
M^{Rural}	-0.010 (0.403)	-0.395 (1.002)	-0.055 (1.005)	0.400** (0.187)	0.452* (0.267)	-0.141 (0.567)
M^{Urban}	1.104* (0.605)	1.209 (1.121)	1.291 (2.343)	0.252 (0.252)	0.313 (0.510)	0.121 (0.252)
Const.	-1.337*** (0.335)	-1.256** (0.626)	-1.020* (0.586)	-1.049*** (0.111)	-1.106*** (0.177)	-0.550*** (0.167)
Controls	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓
<i>N</i>	3727	2117	1610	3215	1681	1534
F-stat. Ha: $M^{\text{Urban}} \neq M^{\text{Rural}}$	2.700	1.268	0.309	0.235	0.063	0.176

Notes: We control for individual baseline characteristics; age, (sex), relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 :Results regressions of changes in food consumption on migration to different rural areas, secondary towns or cities (2008/09-2012/13)

	Δ Total	Δ Maize	Δ Cassava	Δ Other starchy foods	Δ Rice	Δ Bread, pasta, cereal products	Δ Pulses, nuts, seeds	Δ Meat, fish, dairy	Δ Fruits, veg.	Δ Oils, fats	Δ Sugar, sweets, pastries	Δ Sodas, tea, coffee	Δ Meals, snacks cons. outs.
<i>Baseline</i>	2377.49	940.45	283.67	190.31	228.23	16.60	273.67	134.35	64.93	87.57	97.23	4.84	55.62
M^{Rural}	16.71 (80.60)	-16.08 (51.08)	20.10 (32.44)	14.80 (16.20)	37.10 (28.89)	12.40* (6.381)	-37.91** (19.13)	-1.728 (13.71)	-4.562 (6.973)	-3.276 (6.797)	-7.586 (11.31)	2.126 (2.276)	1.325 (37.84)
$M^{Sec. Towns}$	252.0 (166.5)	-64.64 (108.7)	-118.7*** (41.66)	-17.26 (33.26)	123.5** (62.66)	59.40** (24.85)	-10.96 (36.57)	13.48 (27.56)	-12.88 (11.94)	-16.60 (22.83)	40.63* (23.19)	27.40*** (9.279)	228.6*** (84.04)
M^{Cities}	-132.1 (207.7)	-316.5*** (101.3)	-146.7** (58.65)	-209.2** (81.64)	53.17 (77.49)	81.82*** (23.15)	-35.49 (56.15)	22.28 (28.52)	5.838 (15.12)	16.66 (15.89)	80.01*** (29.77)	20.55*** (6.277)	295.5*** (101.1)
Const.	-378.8*** (25.89)	-176.0*** (15.37)	-84.74*** (8.576)	-34.41*** (7.387)	11.59 (9.185)	0.377 (1.801)	-38.18*** (5.713)	-21.24*** (3.843)	-6.795*** (2.534)	-51.69*** (2.468)	-12.26*** (3.240)	-0.0925 (1.199)	34.62** (16.07)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>N</i>	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070
F-stat. Ha: $M^{Sec. Towns} \neq M^{Rural}$	1.680	0.171	7.019***	0.785	1.626	3.352*	0.434	0.218	0.381	0.315	3.620*	6.683***	6.063**
F-stat. Ha: $M^{Cities} \neq M^{Rural}$	0.456	7.695***	5.485**	7.611***	0.036	8.676***	0.002	0.620	0.426	1.335	8.291***	8.549***	8.122***
F-stat. Ha: $M^{Sec. Towns} \neq M^{Cities}$	2.098	2.920*	0.151	4.784**	0.504	0.439	0.135	0.049	0.953	1.440	1.116	0.379	0.264

Notes: Food consumption is expressed in kcal per capita per day.

We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Regression of changes in food consumption incl. pathways (2008/09-2012/13)

	Δ Total (at home)	Δ Maize	Δ Cassava	Δ Other starchy foods	Δ Rice	Δ Bread, pasta, cereal products	Δ Pulses, nuts, seeds	Δ Meat, fish, dairy	Δ Fruits, veg.	Δ Oils, fats	Δ Sugar, sweets, pastries ^a	Δ Sodas, tea, coffee ^a	Δ Meals, snacks cons. outs. ^b
<i>Baseline</i>	2320.88	940.52	283.81	190.85	227.43	16.58	273.46	134.14	64.84	87.55	96.29	4.83	55.26
M^{Rural}	-24.97 (67.55)	-14.40 (51.97)	-3.568 (32.41)	10.78 (17.07)	16.40 (28.89)	10.66 (6.635)	-31.70* (18.23)	-13.12 (11.94)	-6.589 (6.853)	-0.956 (7.068)	-18.50* (10.46)	-0.106 (1.769)	1.995 (30.70)
M^{Urban}	-325.4** (137.4)	-139.9 (87.37)	21.41 (40.41)	-50.25 (32.05)	19.21 (48.23)	55.75*** (17.70)	0.847 (35.01)	-6.437 (20.55)	-9.419 (10.32)	-20.57 (17.02)	17.59 (20.42)	17.15*** (5.934)	67.04 (63.24)
Δ Farm	-350.1*** (75.81)	-166.9*** (50.96)	-62.81** (24.52)	-18.88 (19.11)	66.72** (27.20)	3.732 (9.079)	-108.9*** (20.85)	-13.63 (13.93)	-29.44*** (7.196)	-15.93 (9.727)	25.23** (12.06)	2.834 (2.046)	88.55** (37.71)
$\Delta \ln(\text{Cons. pc})$	764.6*** (61.32)	196.2*** (32.08)	-3.038 (19.76)	47.58*** (12.24)	165.8*** (20.58)	22.27*** (4.687)	111.5*** (13.24)	109.9*** (9.927)	42.37*** (5.819)	22.26*** (5.278)	57.39*** (6.522)	7.722*** (1.388)	222.2*** (26.95)
PI_{Total}	-466.4*** (128.8)	-32.41 (103.7)	-260.9*** (93.63)	8.625 (33.50)	12.49 (53.22)	7.388 (12.43)	-34.10 (33.20)	29.32 (24.40)	-9.950 (15.39)	23.77 (18.83)	9.414 (16.88)	-0.308 (4.641)	
PI_j		-256.8 (291.3)	-816.9*** (201.5)	-639.6*** (193.6)	-559.9*** (154.0)	-343.1** (170.2)	-94.22 (58.64)	-42.54*** (14.61)	-50.62 (34.37)	-9.668** (4.745)	10.10 (29.42)	0.317 (1.749)	
Const.	1622.9*** (611.4)	1089.3** (474.5)	1700.6*** (449.2)	260.2* (135.0)	541.6* (283.2)	64.92 (74.52)	495.5*** (173.4)	78.96 (102.0)	142.7* (86.55)	111.1** (54.53)	5.297 (79.70)	3.035 (26.61)	-55.87*** (16.89)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>N</i>	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995
F-stat. Ha: $M^{\text{Urban}} \neq M^{\text{Rural}}$	4.320**	1.536	0.234	3.142*	0.003	5.788**	0.675	0.0738	0.055	1.096	2.854*	8.210***	0.974

Notes: Food consumption is expressed in kcal per capita per day.

We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

^a Whereas the dependent variable includes both home and outside consumption, the price index is based upon the former. Restricting our analysis to at home consumption does not alter our findings.

^b Since the data do not contain price information for meals and snacks consumed outside the home, no price index could be included for this food category.