How Fast Do Urban Migrants Change Their Diets?

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Abstract

Rapid urbanization is a major cause of structural change in food demand. In West Africa, urbanization is associated with a switch from coarse grains to rice and wheat, in Melanesia the switch is from root crops to rice and wheat, while in much of Asia the switch is away from cereals (and within cereals to wheat). Although reasons why urban diets differ from traditional rural diets are well known, the rate at which recent arrivals from the countryside switch their diet has not been estimated. Evidence on the speed of this dietary change can help to show whether studies of urban food demand need to control for cohort effects and may also help producers forecast the size of their future urban markets. This paper uses cross-sectional household survey data from urban areas of Papua New Guinea to estimate the rate at which migrant household's switch their diets from traditional root crops to imported rice and wheat products.

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I. Introduction

Do migrants from the countryside completely, and instantaneously, change their diets once they arrive in the cities of developing countries? Existing studies of the effect of urbanization on food demand cannot answer this question because they are mostly based on aggregate data, with urbanization effects captured by a single variable – the share of the population in cities.[1] Therefore it is not possible to distinguish between the effects of migration and the effects of natural increase, which contribute roughly equally to urban growth in developing countries.[2] However, there are reasons to believe that natural increase and migration will have different effects on food demand. Natural increase is a scale effect, which need not change the demographic composition of the urban population, while migration is highly selective, in terms of age,[3] gender (at least in the early stages of migration), and possibly ethnicity.

Cities in developing countries are often located away from the major concentrations of the rural population, with coastal locations especially favoured by the impact of colonialism and import-substituting industrialisation.[4] Consequently, it may take many years for migrants from ethnic groups in more distant rural areas to achieve the population share in the cities that they have nationally. If diets differ between ethnic groups, and if these food preferences are partially maintained by urban migrants, changing the ethnic composition of the urban population will shift food demand. Hence, it may be unwise to extrapolate from current per capita consumption when forecasting future needs for, say, imported cereals or urban demand for local staples. But few food demand studies in developing countries include controls for ethnicity,[5] despite such variables being routinely included in food demand equations in the United States.[6]

This article analyses the effect of ethnicity on the demand for staple foods in urban areas of Papua New Guinea (PNG). The rate at which diets are adjusted, as migrants spend more years in town, is also estimated for the ethnic group of major interest – people originating in the Highlands region. These Highlanders comprise 40% of the PNG population of approximately five million. Remarkably, they were discovered by the outside world only in the 1930s and large parts of the Highlands remained closed to outside contact until the 1960s.[7] A trickle of urban migrants began in the 1950s when Highlanders who were recruited as short-term labourers for plantations and public works in the lowlands moved to the coastal towns after their contracts were up.[8] These early arrivals stimulated a flow of migrants who came directly to the towns, especially after Independence in 1975. By the late 1980s, the share of the urban population that was of Highlands origin had risen to just over 15%.[9] Highlanders are likely to become more numerous in urban areas once the "trans-island Highway" is completed, because Port Moresby – the largest city with 40% of the urban population – will then be linked to the Highlands and North Coast regions of PNG.

There is considerable policy interest in the composition of staples demand in urban PNG. Annual imports of cereals from Australia exceed 300,000 tonnes, with wheat imports rising especially rapidly.[10] One reason for these imports is that it is cheaper to ship food to Port Moresby from Australia than from many parts of PNG, but it is also believed that consumers see rice and wheat as superior foods to the traditional root crop staples.[11] But despite repeated government efforts, local production of cereals in PNG is limited to a few hundred tonnes of rice. There has been more success at increasing the supply of locally produced root crops in urban markets, as smallholders diversify away from traditional cash crops, such as coffee. A further increase in the supply of root

crops to Port Moresby is likely once the trans-Island highway is built because it currently takes a 200 mile road journey plus a 800 mile sea voyage for produce from the Highlands to reach Port Moresby. Hence, a model of food demand that includes the shifting ethnic mix in urban areas may help when, say, comparing the benefits of further efforts at cereals self-sufficiency with the benefits of further development of transport infrastructure for the marketing of traditional staples.

The results reported here also may have wider applicability because migration has shifted the ethnic composition of cities in other developing countries: In Malaysia under the *New Economic Policy*, the urban population of Malays grew twice as fast as other ethnic groups.[12] In Fiji, the cities that were long dominated by the Indian population now have approximately equal numbers of both Indians and ethnic Fijians.[13] Migration of upland populations into coastal cities is also common, with one documented example the movement of Quecha Indians from the *Sierra* into Lima.[14] There are also more complex migration patterns – the Yoruba cities of southern Nigeria have large enclaves of Hausa from the north,[15] but there have also been large movements of southerners to the northern cities.[16]

II. Highlanders, Lowlanders, and Diets in Papua New Guinea

There are considerable ethnic differences between Highlanders and the lowlands population of PNG. The genetic evidence suggests that Highlanders are descended from a small number of founders, who arrived in New Guinea earlier than the ancestors of lowlands people.[17] The subsequent increase in population in the Highlands appears due to the intensification of agriculture rather than to the inflow of later migrants from the coast, because Highlanders lack genetic markers that are present in the population of the lowlands and mid-elevation regions.[18] These genetic differences are evident in a somewhat paradoxical relationship between the weight and height of children: Highlands children are shorter (implying poorer health and nutrition) but heavier (implying better health and nutrition) than children in the lowlands.[19]

The present size of the Highlands population partly reflects the population explosion following the "Ipomean Revolution" – the widespread adoption of the sweet potato (*Ipomoea batatas*) approximately 350 years ago.[20] The replacement by sweet potato of earlier-established root crops, such as taro and yams, allowed cultivation and settlement at higher altitudes and in more marginal lands. The superior yields of sweet potato supported a greater density of population both for humans and for pigs, which are the major store of wealth. Sweet potato has spread into lowlands agricultural systems more recently but it doesn't yet play the dominant role in lowlands diets that it does in the Highlands (Table 1).

Table 1: Average Consumption of Staples in Papua New Guinea
(kg per person per year)

	Rural Areas		
	Highlands	Lowlands	Urban Areas
Sweet potato[a]	440	100	35
Banana[a]	60	95	45
Other root crops[a, b]	60	150	45
Sago	0	40	30
Rice	20	30	70
Wheat products[c]	10	15	50

Source: 1996 Papua New Guinea Household Survey (Gibson and Rozelle, 1998).

[a] Assumed edible fraction of 0.85.

[b] Includes cassava, potatoes, taro, and yams.

[c] Includes biscuits, bread, and flour and based on a conversion ratio of wheat to flour of 0.62.

The average rural dweller in the Highlands consumes 13 times as much sweet potato as does the average urban dweller but only one-quarter as much rice and one-fifth as much wheat (Table 1). Much of this variation in diet reflects economising choices in the face of relative price differences, which themselves are caused by environmental variation and transport costs. For example, in the Highlands, the price of flour relative to sweet potato is 9:1, while in Port Moresby it is only 1.4:1. Thus, responses to relative prices should see much of the difference in diets disappear once Highlanders migrate to lowland cities, with changes in income causing additional adjustment. But whether the diets of urban Highlanders differ from those of other urban dwellers, after controlling for incomes and prices, can be seen only with a system of food demand equations. The data and methods used to estimate these equations are discussed below.

III. Data and Food Consumption Measures

The data for this study were collected by the Papua New Guinea Urban Household Survey.[21] This survey was carried out in six provinces in 1985-87, with sampling of households in each area staggered over 12 months to capture any seasonal effects. Over 1300 households were surveyed but the available sample is smaller because of the removal of non-private dwellings and of households with missing data. The problem with non-private dwellings, which were usually individual rooms in hostels or work camps, is that staples consumption is difficult to calculate because food is being provided by the institution. This left a sample of 1091 private dwellings.

A feature of the survey is that data were collected with diaries, which were completed by all adults (and included questions on the spending of children) for a 14 day period (the usual pay period). Survey enumerators normally checked each household daily and also recorded details on behalf of illiterate households.[22] In addition to food purchases and other recurring expenses, the diaries also recorded details on the value of own-production, gifts given and received of goods, services and money, and the value of informal sector sales. Household stocks of major food items were also measured at the start and end of the survey period. These various modules of the personal diaries

allow food consumption values to be derived from net purchases, own-production, net gifts, and stock changes.

Although the diaries provide details for over 200 separate food items, this study concentrates on four major staples: bananas, sweet potato, rice, and wheat products (comprised of flour, bread and biscuits). These staples constitute one-third of the average food budget and provide almost 60 percent of calories.[23] Moreover, these staples have monthly price data available from the Consumer Price Index (CPI) surveys for urban areas, while some of the less important foods do not. The CPI was not available for two urban areas in the sample so average monthly prices were calculated from individual purchase details in the expenditure diaries of households in these areas. These average prices were for foods of exactly the same specification as used in the CPI regimen, which avoids quality biases due to the use of "unit values".[24] For the price of wheat products, a Laspeyre's index is used, where the weights are the average budget shares for flour, bread and biscuits in each urban area.

The survey also collected many demographic details on the members of respondent households, including their province of birth and the number of years they had lived in their current town. Hence, households where the occupants were of Highlands origin were identified by having a household head who was born in one of the five provinces in the Highlands region. While some members of these households may not be related to the head they are still likely to come from the same region.[25] Also, if it is the head of the household who dictates the family diet then identifying households on the basis of the head's birth province is appropriate.

Table 2 reports the variables used in the staples demand equations. The largest share of the staples budgets of urban households is spent on rice, followed by wheat products, sweet potato, and bananas. The traditional staples appear to have greater price variation (which is across months and across towns in the sample), given their higher standard deviation of (log) prices, compared with rice and wheat products. This is mostly likely due to the high transport costs of bulky root crops because seasonality effects are not apparent in most areas of PNG, with staple foods being harvested continuously throughout the year.

Households headed by Highlanders comprise 21% of the sample, those headed by other Papua New Guineans (i.e., from lowland regions) are 72%, while 7% of the sample households are headed by expatriates. Although surveys in some countries exclude expatriates, they are included in PNG because they make a large contribution to the demand for certain products, and for that reason these households are also kept in the sample for estimating the staples demand equations. Table 2 shows that the average household head has spent less than one-half of their lifetime in their current town, and given the recent nature of urbanization in PNG, the most likely previous location of these persons was a rural area, although the survey data cannot confirm this.

Table 2: Variables Used

	Mean	Std. Deviation
Total household expenditure (log)	9.767	0.744
Staples expenditure (log)	3.359	0.739
Share of staples budget spent on:		
Rice	0.434	0.219
Wheat products	0.329	0.220
Sweet potato	0.138	0.173
Banana	0.099	0.120
Price of rice (log)	4.101	0.067
Price of wheat products (log)	4.594	0.107
Price of sweet potato (log)	3.476	0.380
Price of banana (log)	3.594	0.523
Household size (log)	1.542	0.704
Proportion of household members:		
Male, 15 years and above	0.384	0.269
Female, 15 years and above	0.252	0.166
Male, 0-14 years	0.203	0.183
Female, 0-14 years	0.161	0.168
Household head is:		
Highlander	0.214	0.410
Other Papua New Guinean (i.e. lowlands)	0.718	0.450
Expatriate	0.069	0.253
Years of education of household head	7.411	5.015
Age of household head	37.440	10.774
Household head has wage job? (Yes = 1)	0.768	0.422
Household head's years lived in current town	17.222	14.770
Household head is female? (Yes = 1)	0.039	0.195
Average years of education of adult males	6.759	4.124
Average years of education of adult females	4.535	3.978
Town that household is located in:		
Port Moresby	0.306	0.461
Goroka	0.163	0.370
Ambunti	0.013	0.113
Wewak	0.165	0.371
Kieta	0.148	0.355
Lae	0.056	0.230
Rabaul	0.149	0.357

N=1091.

IV. The Staples Demand Model

The share of the food staples budget allocated to each food is modelled as a linear function of (log) staples expenditure, (log) prices for each staple, and a vector of household demographic characteristics:

$$w_{ih} = \alpha_i + \beta_i \ln\left(x_h / P_{kt}\right) + \sum_{j=1}^{4} \gamma_{ij} \ln p_{jkt} + \theta' \mathbf{z} + u_{ih} \tag{1}$$

where w_{ih} is the staples budget share of food i for household h, x_h is total expenditure on staples by household h, p_{jkt} is the price of the jth food in town k in month t, u_{ih} is a random disturbance, and P_{kt} is a price index for the staples group in town k in month t (household h lives in town k). This price index is defined as:

$$\ln P_{kt} = \sum_{j=1}^{4} \overline{w}_{jk} \ln p_{jkt} \tag{2}$$

where $\overline{w}_{jk}$ is the average budget share for food j in the kth town. The parameters to be estimated in equation (1) are α_i, β_i, γ_{ij} (j=1,..,4), and the vector θ, which contains the coefficients for the dummy variables indicating the ethnicity of the household head, along with coefficients for other characteristics of the household head (age, education, and employment status). The vector θ also contains the coefficients on household size and composition variables, and the coefficients for dummy variables that indicate the town that the household is located in.

Although equation (1), minus the vector of demographic variables and the subscripts for households and towns, is identical to the linear approximate Almost Ideal Demand System (LA/AIDS), some caution is needed in interpreting it as an AIDS model. Almost 55% of households report zero consumption of at least one of the staples, while the AIDS model is derived under the assumption that all goods are purchased.[26] While Tobit-type models can handle zero purchases, the current data have 15 different regimes – depending on which combination of foods was consumed – making it difficult to model these multiple corner solutions. So instead of an AIDS model, equation (1) can be best thought of as a linear approximation to the regression function of the budget share conditional on the right-hand-side variables, averaging over zero and non-zero purchases.[27] This enables average behaviour to be modelled, in much the same way as it is for aggregate demand systems. If the restrictions from demand theory hold, the efficiency of estimating the regression parameters may be improved. These restrictions are:

$$\sum_{i=1}^{4} \alpha_i = 1, \quad \sum_{i=1}^{4} \beta_i = 0, \quad \sum_{i=1}^{4} \gamma_{ij} = 0, \quad \sum_{i=1}^{4} \theta_{ij} = 0 \qquad \text{adding – up} \tag{3}$$

$$\sum_{j=1}^{4} \gamma_{ij} = 0 \qquad \text{homogeneity} \tag{4}$$

$$\gamma_{ij} = \gamma_{ji} \qquad \text{Slutsky symmetry.} \tag{5}$$

The expenditure and price elasticities for the model are given by:

$$\eta_i = \frac{\beta_i}{w_i} + 1 \tag{6}$$

$$\varepsilon_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i \tag{7}$$

$$\varepsilon_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i\left(\frac{w_j}{w_i}\right) \tag{8}$$

where η denotes the expenditure elasticities and ε denotes the uncompensated price elasticities. The elasticity formulas in equation (7) and (8) assume that the budget shares in the price index are constants, which is correct given that equation (2) implies $d\ln P_{kt}/d\ln p_{jkt} = \overline{w}_{jk}$.[28] The elasticities vary with budget shares, and hence will differ between ethnic group if the average predicted budget share for each ethnic group differs with the intercept shifter. A more general form of equation (1), where the ethnic group of the household head also shifts the slope of the staples expenditure variable, β_i is investigated below.

Equation (1) provides predicted budget shares that are conditional upon the level of staples expenditure. These conditional allocations can be thought of as the second stage of a two-stage budgeting process, where the first stage is the allocation of expenditure to major commodity groups. The first stage allocation is not modelled here, due to a lack of group price indices for two urban areas in the sample. This restriction is not too serious because existing studies of the effect of urbanization on food demand have restricted their attention to particular food groups (e.g., cereal grains, meat products).

V. Estimation Results for the Basic Staples Demand Model

Equation (1) was estimated for three budget shares – rice, wheat products, and sweet potato – with the coefficients for the banana budget share equation derived from the adding up restrictions. Estimation was by Three Stage Least Squares, with staples expenditure treated as endogenous and (log) total household expenditure used as the instrument.[29] The exogeneity of staples expenditures was doubtful because the large share of group expenditures due to single foods created a danger of regressing a variable on itself, causing a correlation between group expenditures and the error term. Furthermore, a Durbin-Wu-Hausman test indicated that staples expenditure could not be considered exogenous, with this being especially apparent in the rice and wheat share equations ($\chi^2_{(4)}$=36.68). A further feature of the estimation was that heteroscedastically-consistent convariance matrices were used for the calculation of all reported standard errors and hypothesis tests.

Results in Table 3 suggest that the ethnicity of the household head significantly affects the budget shares of wheat products and sweet potato even after controlling for staples expenditure, prices, household size, composition and location, and for other characteristics of the household head. In households headed by Highlanders, the share of the staples budget allocated to sweet potato is seven percentage points higher than in households headed by other Papua New Guineans. Conversely, the budget share for wheat products is almost nine percentage points lower in Highlander households. Thus it appears that urban Highlanders do not completely change their diets once they leave the rural areas, with a continued preference for sweet potato.

Table 3: Three Stage Least Squares Budget Share Regressions

	Share of Staples Expenditure Allocated to:		
	Rice	*Wheat products*	*Sweet potato*
Staples expenditure (log)[a]	-0.132***	0.095***	-0.003
	(0.030)	(0.027)	(0.019)
Household size (log)	0.100***	-0.062***	-0.007
	(0.025)	(0.022)	(0.017)
Proportion of household members:			
Female, 15 years and above	-0.117***	-0.031	0.091***
	(0.045)	(0.042)	(0.034)
Male, 0-14 years	-0.087*	0.117***	-0.021
	(0.045)	(0.041)	(0.031)
Female, 0-14 years	-0.101**	0.091**	-0.017
	(0.045)	(0.042)	(0.032)
Household head is:			
Highlander	0.017	-0.086***	0.071***
	(0.019)	(0.016)	(0.014)
Expatriate	-0.139***	0.279***	-0.096***
	(0.037)	(0.038)	(0.019)
Years of education of HH head	-0.006***	0.008***	-0.001
	(0.002)	(0.001)	(0.001)
Age of household head	-0.002**	0.000	0.001**
	(0.001)	(0.000)	(0.000)
Household head has wage job	0.013	0.039**	-0.040***
	(0.018)	(0.016)	(0.013)
Price of rice (log)	-0.172	0.281	-0.194
	(0.297)	(0.273)	(0.186)
Price of wheat products (log)	-0.578	-0.913	2.996***
	(1.459)	(1.210)	(0.988)
Price of sweet potato (log)	0.061	-0.110	0.014
	(0.101)	(0.089)	(0.063)
Price of banana (log)	0.000	-0.026	0.027
	(0.058)	(0.054)	(0.040)
Household located in:			
Goroka	0.247	-0.007	-0.601**
	(0.352)	(0.294)	(0.239)
Ambunti	0.029	-0.153	0.020
	(0.151)	(0.138)	(0.107)
Wewak	0.174**	-0.266***	0.144***
	(0.081)	(0.073)	(0.053)
Kieta	0.050	-0.103*	-0.016
	(0.067)	(0.060)	(0.045)
Rabaul	0.226	-0.030	-0.445**
	(0.272)	(0.233)	(0.184)

Lae	0.122	-0.007	-0.291**
	(0.182)	(0.158)	(0.122)
Intercept	3.924	3.545	-12.831***
	(6.174)	(5.190)	(4.140)
χ^2 (slopes=zero) test	171.36***	436.22***	256.02***
R^2	0.10	0.22	0.27

Note: Heteroscedastically consistent standard errors in ( ). ***=statistically significant at 1% level, **= statistically significant at 5% level, *= statistically significant at 10% level.

[a] Treated as endogenous. First-stage regression includes the log of total household expenditures plus all exogenous variables in the table.

The results in Table 3 were subjected to a number of tests to see whether the effect of ethnicity on staples demand was just due to some misspecification of the model. Tests for imposing the homogeneity and symmetry restrictions from demand theory, and for excluding various groups of variables from the model are reported in Table 4. Both the homogeneity and symmetry restrictions are rejected ($p<0.03$), so the elasticity results reported below are based on the unrestricted parameter estimates in Table 3. Moreover, the group of 16 coefficients for prices of the four staples in the demand system were not statistically significant ($p<0.16$), so attention is restricted to the expenditure elasticities. None of the groups of variables measuring household demographic and locational characteristics should be excluded from the model, according to the hypothesis tests reported in Table 4.

Table 4: Tests of Restrictions in the Staples Demand System

	Restriction	Degrees of Freedom	Wald χ^2 Statistic	probability level
I	Homogeneity	4	13.12	$p<0.02$
II	Symmetry	6	14.27	$p<0.03$
III	No household composition effects	12	26.42	$p<0.01$
IV	No Highlands ethnicity effects	4	42.50	$p<0.00$
V	No household head characteristics[a]	12	72.55	$p<0.00$
VI	No town-of-residence effects	24	59.08	$p<0.00$

Note: Results are from a three equation system estimated by Three Stage Least Squares, with coefficients of the fourth (banana) equation derived from the adding-up conditions. Hypothesis test results use a heteroscedastically-consistent covariance matrix.

[a] Characteristics are the head's age, whether in wage employment, and years of education.

Although the model in Table 3 has a large number of explanatory variables, there are others that could be plausibly included, so various tests were carried out to see if the reported results reflected the omission of a relevant variable. The most important of these showed that the ethnic group of the household head did not shift the slope of staples expenditure, β_i so it was sufficient to model ethnicity with just an intercept shifter. In particular, the interaction between the Highlands ethnic dummy variable and staples expenditure was statistically insignificant, with ($p<0.21$) or without ($p<0.11$) the homogeneity and symmetry restrictions imposed. Additional

regressions also indicated no need to add further variables to the model to proxy for the opportunity cost of women's time, which contrasts with some findings in the literature.[30] While the household average for women's years of schooling affected the allocation of staples budgets, it did so in exactly the same way as did men's years of schooling ($p<0.13$), so it was sufficient to just consider the household head's years of schooling. Moreover, the gender of the household head had no effect on the pattern of staples demand ($p<0.62$).

Table 5: Ethnic Differences in Staples Demand Controlling for the Characteristics of Households and Locations[a]

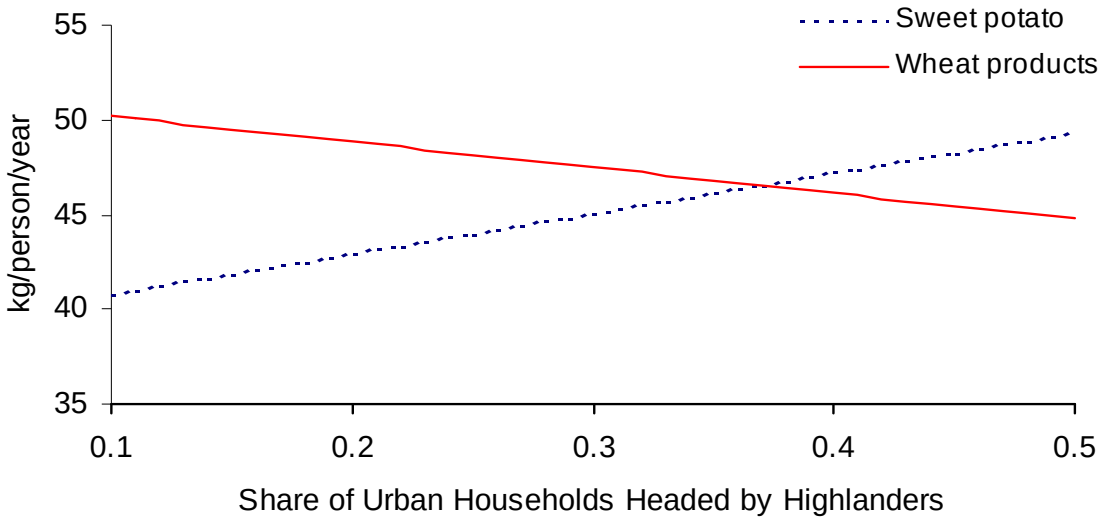
	Predicted Average Budget Share	Conditional Expenditure Elasticity[b]	Marginal Budget Share[b]
		Households headed by Highlanders	
Rice	45.7	0.711 (0.066)	32.5 (3.0)
Wheat products	24.2	1.393 (0.114)	33.7 (2.7)
Sweet potato	20.1	0.984 (0.096)	19.8 (1.9)
Banana	10.0	1.404 (0.161)	14.0 (1.6)
		Households headed by Lowlanders	
Rice	44.0	0.700 (0.069)	30.8 (3.0)
Wheat products	32.8	1.290 (0.084)	42.3 (2.7)
Sweet potato	13.0	0.975 (0.149)	12.6 (1.9)
Banana	10.2	1.395 (0.158)	14.2 (1.6)

[a] Calculated at sample averages (except for ethnic dummy variables), using the regression coefficients reported in Table 3.

[b] Heteroscedastically-consistent standard errors in ( ).

These results suggest that average consumption levels of sweet potato and wheat products in urban PNG will depend on the share that Highlanders have in the urban population. To further examine this point, the predicted shares in Table 5 were applied to the average staples budget, and per capita quantities for each ethnic group were then derived by dividing predicted expenditures by average household size and the average price of each staple. The average urban consumption level was then calculated as a weighted average of the predicted consumption by Highlanders and the predicted consumption by lowlanders (with the consumption by expatriate households ignored because they are assumed to maintain a constant share of the population). Figure 1 plots the average urban consumption levels of sweet potato and wheat products that would result as the balance between Highlanders and other Papua New Guineans in the urban population changes.

Fig 1: Average Consumption of Staples in Urban PNG as Ethnic Mix Changes



According to Figure 1, once households headed by Highlanders comprise 40% of the urban population – which is their share of the national population – the average consumption level of sweet potato in urban areas will exceed the average consumption level of wheat products. Whether this actually happens depends on whether the ethnic differences in the allocation of staples budgets reported in Table 5 persists through time. Therefore, the basic model is augmented in the next section to see whether the diets of urban Highlanders depend on the amount of time they have spent in urban areas.

VI. Results for Models That Allow Dietary Changes Over Time

Although the data are cross-sectional, rather than the ideal longitudinal data covering an urban-to-rural move,[31] it is possible to explore some of the temporal aspects of dietary change. One way to do this relies on variation in the length of time that each household has spent in the urban area. Another way is to examine the effect of household age structure on food demand, to see if there is evidence of diets shifting across generations.

There is no evidence that the more intense preferences for sweet potato of Highlanders diminishes as they spend more years in urban areas (Table 6). The tendency for Highlanders to allocate a greater share of their staples budget to sweet potato than do other Papua New Guineans, actually increases as they spend more years living in the urban area. The budget share of wheat products in Highlander households also increases over time, implying some convergence towards the wheat budget share in the households of other ethnic groups. These increases in the budget share of sweet potato and wheat products are accommodated by a fall in the share of Highlander's staples budgets allocated to rice, the larger the number of years they spend in the urban area.

Table 6: Results From Interacting Highlands Ethnicity Variable With The Number of Years Spent in the Current Town by the Household Head

Budget share equation	Coefficient	Standard error	*p*-value
Rice	-0.0036	0.0011	0.001
Wheat products	0.0014	0.0008	0.089
Sweet potato	0.0021	0.0011	0.049
Banana	0.0001	0.0007	0.825

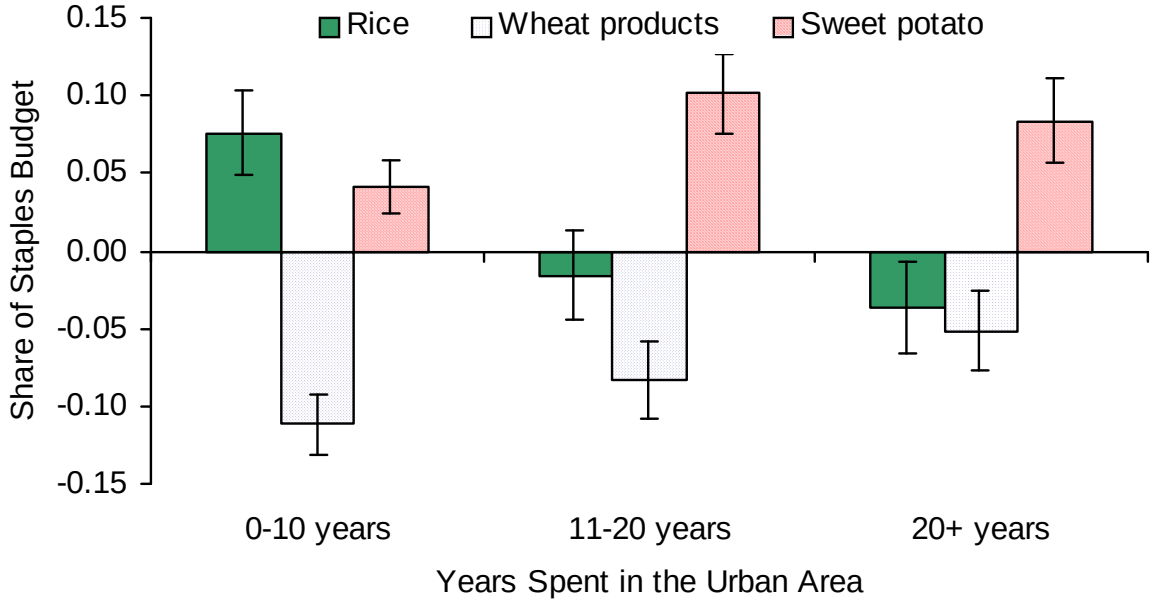
Note: Results are based on the model reported in Table 3, with the interaction effect added. Standard errors and hypothesis tests use heteroscedastically-consistent covariance matrix.

It is notable that the results in Table 6 are not caused by the 'years spent in this town' variable being a relevant regressor by itself. When the 'years in town' variable is added to the model in Table 3, it is statistically insignificant ($p<0.26$), while when it is included as both a direct effect and as an interaction with the Highlands ethnicity variable, it is only the interaction terms that are statistically significant ($p<0.03$). To further explore the interaction between ethnicity and the length of time that each household has spent in the urban area, the Highlands ethnicity intercept terms in the Table 3 model were split into three groups: those who have lived in the current town less than 11 years, those who have lived there 11-20 years, and those there more than 20 years.

The higher budget share for sweet potato in Highlander households is most apparent in the group who have spent 11-20 years in the urban area and least apparent amongst the households where the head has spent less than 11 years in the urban area (Figure 2).[32] This pattern is not consistent with a process where recently migrated Highlanders have a strong preference for sweet potato but then gradually lose that as their diets converge to the more typical urban, lowlands diet. However, the allocation of Highlander's staples budgets to wheat products does seem to converge to the budget shares of lowlander households, although it is still significantly lower even amongst the group of Highlanders who have spent more than 20 years in the urban area.

Perhaps the most interesting pattern in Figure 2 is for the differences in the budget share of rice. Controlling for expenditures, prices and demographics, Highlands households who have only recently lived in the urban area allocate a significantly higher share of their staples budget to rice than do other urban Papua New Guineans. However, Highlands households who have spent more time in the urban area have rice budget shares which are indistinguishable from the rice budget shares of other ethnic groups, while Highlanders who are long-term urban residents allocate less of their budget to rice than do lowlanders. Possibly the recent urban arrivals from the Highlands 'over-react' to the different expenditure and price conditions in the urban areas, and concentrate their budgets on rice, which is the cheapest source of calories in urban areas, but as they become more acclimatised their preferences for sweet potato (and also wheat products) re-establish themselves.[33] An alternative explanation is that the patterns in Figure 2 reflect factors that were relevant to specific time periods in the 10 or 20 years prior to the survey which still influenced dietary behaviour at the time of the survey.

Fig 2: Staples Shares for Highlanders versus Lowlanders (Conditional on Demographics, Expenditure and Prices)



The final analysis of whether diets change over time considered the impact of children's demographic share on the allocation of the staples budget. The results in Table 3 for the wheat products equation showed that an increase in the share of the household who were 0-14 years old significantly increased the budget share for wheat products (with the effect for boys slightly greater than for girls). It is not clear whether this signals a dietary change, with wheat-eating children becoming wheat-eating adults, or whether it just reflects the convenience of wheat products as daytime meals for school-age children. However, the impact of the 0-14 year-olds on wheat demand is much less apparent in Highlander households than in other households: each 10 percentage point increase in the share of the 0-14 group raises the wheat budget share by 1.5 points in lowlander households but by only 0.07 points in Highlander households (the difference is statistically significant at $p<0.05$). Thus, if there is a dietary shift to wheat products across the generations it is much less apparent amongst Highlanders.

VII. Conclusions

This paper examines the effect of ethnicity on staple food demand in urban areas of Papua New Guinea (PNG). Results suggest that the shifting ethnic mix in PNG urban areas will have important effects on the composition of staples demand, with a rise in the share of Highlanders raising the average urban consumption level of sweet potato, at the expense of the consumption of wheat products. Because sweet potato is locally produced, while wheat is imported, there are obvious implications of this shift in urban food demand for food policy in PNG. The results reported here may also be relevant to other countries, at least in demonstrating the importance of ethnicity to urban food demand.

Notes

[1] Examples include, Jikun Huang and Cristina David, "Demand for Cereal Grains in Asia: the Effect of Urbanization," *Agricultural Economics* 8 (1993): 107-124, and Allan Rae, "The Effect of Expenditure Growth and Urbanization on Food Consumption in Asia: a Note on Animal Products," *Agricultural Economics* 18 (1998): 291-299.

[2] For example, between 1975 and 1990, migration contributed 50 percent of urban growth in nine Asian countries, 75 percent in four African countries, and 49 percent in 11 Latin American countries. For details, see Sally Findlay, "The Third World City: Development Policy and Issues," chap. 1 in *Third World Cities: Problems, Policies and Prospects*, ed. John Kasarda and Allan Parnell (Newbury Park, Calif: Sage, 1993). Similar estimates are made by Nathan Keyfitz, "Do Cities Grow by Natural Increase or by Migration?," *Geographic Analysis* 12 (1980): 142-156.

[3] Jeffrey Williamson, "Migration and Urbanization," chap. 11 in *Handbook of Development Economics, Volume 1*, ed. Hollis Chenery and T.N. Srinavasan (New York: Elsevier, 1988).

[4] Akin Mabogunje, "Introduction: Cities and Africa's Economic Recovery," in *Urbanization in Africa: A Handbook*, ed. James Tarver (Westport, Conn: Greenwood Press, 1994).

[5] An exception is John Strauss, "Determinants of Food Consumption in Rural Sierra Leone," *Journal of Development Economics* 11, no. 3 (1982): 327-353. However, most estimates reported by Strauss use regional dummies, in place of the ethnic dummies with which they were highly correlated.

[6] For example, see Dale Heien and Greg Pompelli, "The Demand for Alcoholic Beverages: Economic and Demographic Effects," *Southern Economic Journal* 55, no. 3 (1989): 759-770 and Rodolfo Nayga, "Dietary Fibre Intake Away From Home and at-Home in the United States," *Food Policy* 21 (1996): 279-290.

[7] Bob Connolly and Robin Anderson, *First Contact: New Guinea's Highlanders Encounter the Outside World* (New York: Viking, 1987).

[8] Hal Levine and Marlene Wolfzahn Levine, *Urbanization in Papua New Guinea: A Study of Ambivalent Townsmen* (Cambridge: Cambridge University Press, 1979).

[9] This estimate is derived from the proportion of the population in each urban area living in households headed by a Highlander in the Urban Household Survey (see n.21 below), with these proportions weighted according to the population of each urban area in the 1990 Census. It is notable that there are some small towns in the Highlands (with a significant share of non-Highlanders), but more of the Highlanders who live in urban areas are found in the lowland cities.

[10] Nicholas Fereday, "The Changing Cost of Food in Urban Areas of Papua New Guinea," *Policy Working Paper* no. 3, (Port Moresby: Planning, Programming and Budgeting Division, Department of Agriculture and Livestock, 1993). Cereals demand rose sharply in 1997-98, with rice imports 60,000 tonnes higher than the previous year, because a combination of drought and frost (due to the *El Nino* effect) affected the food supplies of 1.2 million people. For details, see R. Michael Bourke, "Impact of the 1997 Drought and Frosts in Papua New Guinea," (Department of Human Geography, Australian National University: 1998).

[11] Channa Kannapiran, "Food Security: Rice Production Policy in Papua New Guinea," *Policy Discussion Paper* (Port Moresby, Department of Agriculture and Livestock, 1993).

[12] George Cho, *The Malaysian Economy: Spatial Perspectives* (London: Routledge, 1990): 170-176.

[13] Constantinos Gounis and Henry Rutz, "Urban Fijians and the Problem of Unemployment," chap. 4 in *Fijians in Town*, ed. Chris Griffin and Mike Monsell-Davis (Suva: University of the South Pacific, 1986).

[14] P.L. Doughty, "Behind the Back of the City: 'Provincial' Life in Lima, Peru," chap. 2 in *Peasants in Cities: Readings in the Anthropology of Urbanization*, ed. William Mangin (Boston: Houghton Mifflin, 1970).

[15] Abner Cohen, *Custom and Politics in Urban Africa: A Study of Hausa Migrants in Yoruba Towns* (London: Routledge and Kegan Paul, 1969).

[16] Okwudiba Nnoli, *Ethnicity and Development in Nigeria* (Aldershot: Avebury, 1995), p. 29-30.

[17] Susan Serjeantson and Adrian Hill, "The Colonization of the Pacific: The Genetic Evidence," chap. 8 in *The Colonization of the Pacific: A Genetic Trail*, ed. Adrian Hill and Susan Serjeantson (Oxford: Clarendon Press, 1989).

[18] Ibid., p.291.

[19] Peter Heywood, Nicola Singleton and Jay Ross, "Nutritional Status of Young Children: The 1981/82 National Nutrition Survey," *Papua New Guinea Medical Journal* 33 (1988): 91-101.

[20] James Wilson, "The Significance of a Recent Ecological Change in the Central Highlands of New Guinea," *Journal of the Polynesian Society* 74, no. 4 (1965): 438-450. It appears that sweet potato was introduced into

Malaysia and the Philippines by either the Spanish or the Portuguese and then reached New Guinea through bird-of-paradise hunters and traders.

[21] National Statistical Office, *Information Paper No. 2: Urban Household Survey 1985-87* (Port Moresby: 1987).

[22] No evidence exists on how many illiterate households needed enumerators to record details for them but in the 1996 survey of living standards in Papua New Guinea, only one percent of urban households had no adults who could read. For details, see John Gibson and Scott Rozelle, "Results of the Household Survey Component of the 1996 Poverty Assessment for Papua New Guinea," *mimeo* (Stanford University: Food Research Institute, 1998).

[23] Food quantities were calculated as each household's expenditure on a food divided by the monthly average price of that food in the town the household resided in, and converted into calories using the Pacific Islands Food Composition Database, *Diet/1* (Palmerston North: Crop and Food Research Ltd, 1995).

[24] Details of the biases caused by 'unit values' are provided by Angus Deaton, "Quality, Quantity, and Spatial Variation of Price," *American Economic Review* 78 (1988): 418-430.

[25] In Papua New Guinea, the term *Wantoks* is used for non-relatives who live in the household. These Wantoks come from the same language group ("one talk"), which restricts them to a small geographical area given the 700 language groups in PNG.

[26] Angus Deaton, *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy* (Baltimore: Johns Hopkins, 1997), p. 304.

[27] Ibid, p. 304.

[28] These elasticity formulas have also been shown to produce good results in Monte Carlo comparisons with the other elasticity formulas commonly used for the LA/AIDS model. For details, see Julian Alston, Kenneth Foster and Richard Green, "Estimating Elasticities With the Linear Approximate Almost Ideal Demand System: Some Monte Carlo Results," *Review of Economics and Statistics* 76 (1994): 351-356.

[29] This estimation approach is also used, in a different context, by Angus Deaton, "Looking for Boy-Girl Discrimination in Household Expenditure Data," *World Bank Economic Review* 3 (1989): 1-15.

[30] See, for example, Eileen Kennedy and Thomas Reardon, "Shifts to Non-traditional Grains in the Diets of East and West Africa: Role of Women's Opportunity Cost of Time," *Food Policy* 19 (1994): 45-56.

[31] See Jikun Huang and Howarth Bouis, "Structural Changes in Demand for Food in Asia," mimeographed (Washington: International Food Policy Research Institute, 1995) p. 7.

[32] Differences in banana budget shares are not shown because they are always statistically insignificant.

[33] An alternative explanation is that the patterns in Figure 2 reflect factors that were relevant to specific time periods in the 10 or 20 years prior to the survey which still influenced dietary behaviour at the time of the survey. Longitudinal data is needed to distinguish this explanation from the other one.