

New Town, Old Diet?

Highlanders and the Demand for Staples in Urban Papua New Guinea

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Abstract

Rapid urbanization is a major cause of structural change in food demand but existing studies do not show how quickly and completely rural migrants change their diets. Evidence on this dietary change may help when forecasting the future market for traditional staples in urban areas and the foreign exchange requirements for food imports. This paper uses cross-sectional household survey data from urban areas of Papua New Guinea to estimate how quickly and completely migrants from the rural highlands switch their diets from traditional root crops to imported cereals. Preferences for the traditional staples appear to persist for many years.

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1. INTRODUCTION

Do migrants from the countryside completely, and instantaneously, change their diets once they arrive in the cities of developing countries? This question matters for at least three reasons: First, urban diets tend to rely more heavily on imports (von Braun and Paulino, 1990), so forecasting the speed of dietary change may be important to the management of foreign exchange reserves. Second, an incomplete or slow change in the diet creates a market for the supply of traditional foods into urban areas, and in this activity farmers in developing countries should have advantages over food suppliers from overseas, as long as the necessary infrastructure for internal marketing of staples is in place. Third, some of the larger rural-urban migration flows, such as in China, may put pressure on the world trading system because of the substantial shifts in national supply and demand balances for various crops caused by the change in diets (Huang, Rozelle and Rosegrant, 1999).

Existing studies of the effect of urbanization on food demand cannot say how quickly and completely migrants change their diets because these studies are based mostly on aggregate data, with urbanization effects captured by a single variable – the share of the population in cities (Huang and David, 1993; Rae, 1998). 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.¹ But natural increase and migration may have different effects on food demand because migration can be highly selective, in terms of age, gender, ethnicity and location (Williamson, 1988).

Location and ethnicity matter because cities in developing countries are often situated away from the major centres of the rural population, with colonialism and import-substituting industrialisation favouring coastal locations (Mabogunje, 1994). 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. For example, whether urbanization causes China's wheat demand to rise or fall partly depends on whether migrants come from the rice-eating south or the wheat-eating north (Huang, Rozelle and Rosegrant, 1999). But few food demand studies in developing countries include controls for ethnicity,² despite such variables being routinely included in food demand equations in rich countries (Heien and Pompelli, 1989).

This article analyses the effect of ethnicity on the demand for staple foods in urban areas of Papua New Guinea (PNG) and estimates the rate at which diets are adjusted as rural migrants from the Highlands region adapt to life in town. These Highlanders comprise 40% of the PNG population of approximately five million but were discovered by the outside world only in the 1930s and large parts of the Highlands remained closed to outside contact until the 1960s (Connelly and Anderson, 1987). 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 when their contracts ended (Levine and Levine, 1979). By the late 1980s, the share of the urban population that was of Highlands origin had risen to about 15%.³ Highlanders are likely to become more numerous in urban areas once the “trans-island Highway” linking the north and south coasts of New Guinea is completed, because Port Moresby – the capital and largest city with 40% of the urban population – will then be linked by road to the Highlands.

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. 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 by some commentators that consumers see rice and wheat as superior foods to the traditional root crop staples (Kannapiran, 1993). But despite repeated government efforts, local production of cereals in PNG is limited to a few hundred tonnes of rice and coarse grains (Blakeney and Clough, 2000). 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.⁴ 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, including Fiji (Gounis and Rutz, 1986), Malaysia (Cho, 1990), and southern Nigeria (Cohen, 1969). Migration of upland populations into coastal cities is also common, with one documented example the movement of Quecha Indians from the *Sierra* into Lima (Doughty, 1970), although the dietary changes during this particular migration were not reported. However, Witcher *et. al.* (1988) document the dietary changes for a small sample ($n=41$) of rural migrants in highland Ecuador whose diets did converge to the diets of the existing urban population (although three of the four foods that were exceptions to this pattern were staple grains). Contrary evidence comes from rural immigrants into a Mexican town who maintained some of their traditional dietary habits even after a period of many years, in spite of the high cost of not changing their diets (Allen,

1992). In view of these differing results in the literature, further evidence on the changes in diet associated with migration into cities may be useful.

In addition to demonstrating the importance of ethnicity and migration for studies that aim to forecast the composition of future food demand, this paper also makes a methodological contribution. The results show how dietary change can be studied even in the absence of longitudinal data, which is typically considered necessary for unravelling the dynamic effects of changes in urban residence on diets (Popkin, 1999). But an important caveat to the paper must also be highlighted at the outset; concentrating on staples demand ignores other important dietary changes associated with urbanisation, such as the rise in the consumption of meat, milk, and processed foods, which raises intakes of saturated fats and sugars and lowers fibre intakes (Ruel, Haddad, and Garrett, 1999). Because this demand for fattier foods and sweetness may reflect factors other than just changed incomes associated with urban migration – such as the effect on preferences of marketing and the mass media (Popkin, 1999) – studies of the persistence of dietary preferences could usefully be done on sugars and fats, as well as on the staple foods studied here.

The next section of the paper provides some background information on the Papua New Guinean Highlanders, and contrasts their traditional diets with the diets of the lowlands and urban areas of PNG. The data and food consumption measures used for the case study are described in Section 3 while the demand model that the results are based on is set out in Section 4. The empirical results, including static elasticities and budget shares as well as estimates of the dynamics of dietary change, are reported in Section 5, while the final section concludes.

2. HIGHLANDERS, LOWLANDERS AND DIETS IN PAPUA NEW GUINEA

There are considerable ethnic differences between the lowlands population of PNG and the Highlanders, who appear to have descended from a small number of earlier ancestral arrivals to New Guinea. 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 (Sergeantson and Hill, 1989).⁵ 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 (Watson, 1965). 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.

According to information from a recent household survey, 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).⁶ There are also other important differences in diets, both between the rural Highlands and urban areas, and between high and low elevation areas within the rural sector. In common with evidence from other developing countries (see, for example, Popkin, 1999), urban residents appear to consume more cereals, meat, dairy, sugar and fats, and less fruit, vegetables and root crops. Although urban residents consume a much lower quantity of staples, at only 60% of the rural average, once adjustment is made for the higher calorie content of cereals, the consumption of calories

from traditional staples and cereal grains in urban areas is 85% of the rural average. Despite the many differences in diets documented in Table 1, the clearest distinctions between rural (and especially Highlands) and urban diets are for the consumption of traditional root crop staples and cereals.

(Table 1 about here)

Much of this variation in diet reflects economising choices in the face of relative price differences, which themselves are caused by environmental variation (for example, sago cannot grow above a certain elevation) 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 (Gibson and Rozelle, 1998). To further explore how responses to price differences are likely to affect the diets of Highlanders who migrate to lowland cities, the difference in consumption between the rural Highlands and urban areas that is reported in Table 1 was compared with the predicted changes in consumption for sweet potato, banana, rice and wheat products that result from the price difference between the Highlands and urban areas.⁷ The predicted reduction in sweet potato consumption that is just due to price effects is 320 kg per person per year, which is over three-quarters of the actual difference of 405 kg. Price effects also explained a large share of the difference in rice consumption, which is predicted to rise by 25 kg per person per year (55% of the actual difference between the rural Highlands and urban areas). However, only small changes in consumption (< 5 kg per person) were predicted for both banana and wheat products as a result of the difference in prices between rural Highlands and urban areas.

In light of this comparison of actual and predicted consumption differences, it seems likely that while price effects are a dominant cause of dietary change, there may also be changes associated with income effects and changes in preferences or adjustments due to changes in

the opportunity cost of time and the amount of labour available for food preparation. Nevertheless, it also appears that some dietary preferences persist, as can be seen from the last two columns of Table 1 which compare the diets of Highlander and lowlander headed households *within* urban areas. Because these two groups of households should face similar prices and availability of foods, the higher consumption of sweet potato and lower consumption of banana, sago and wheat products may reflect persistent preferences for a traditional diet. More formal evidence on whether the diets of urban Highlanders differ from those of other urban dwellers, after controlling for prices, incomes and other household characteristics can be seen only with a system of food demand equations. The data and methods used to estimate these equations are discussed below.

3. DATA AND FOOD CONSUMPTION MEASURES

The data for this study were collected by the Papua New Guinea Urban Household Survey, which was carried out in six (of 20) provinces in 1985-87, with field work in each area staggered over 12 months to capture any seasonal effects. Over 1300 households were surveyed but the available sample is smaller ($n=1091$) because of the removal of non-private dwellings and of households with missing data. 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. 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% of calories for urban residents. 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” (Deaton, 1988). 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.⁸ 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. One weakness of the survey is that it did not collect any information on the parents of the household head so it is not possible to contrast the diets of households headed by the urban-born children of Highlands migrants with the diets of first generation migrants. But with the relatively recent movement of Highlanders into urban areas, there were unlikely

to be many household heads at the time of the survey in the mid-1980s who were the urban-born children of Highlands migrants.

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, although the coefficient of variation for each of the four prices is rather low compared with the other variables in the model.

(Table 2 about here)

Households headed by Highlanders comprise 21% of the sample,⁹ 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 were 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 is a rural area.

A comparison of the means for some of the variables in Table 2 between households headed by Highlanders and those headed by lowlanders reveals interesting patterns which will be more formally explored with the demand model. Both groups of households allocate about 44% of their staples budgets to rice and about 10% to bananas, but there are big differences for the other two foods, with Highlanders allocating an average of 25% of their staples budget to

sweet potato and 21% to wheat products while the households headed by lowlanders allocate 33% to wheat products and only 11% to sweet potato. These different allocations also translate into different consumption quantities, with Highlander-headed households consuming an average of 24 kg of sweet potato per fortnight compared with only 9 kg for the other households while the fortnightly consumption of wheat products is only 4 kg in the Highlander households and 8 kg in the other households. These differences also reflect disparities in household size (lowlander-headed households are 22% larger on average) and income levels, which are approximately 10% higher in per capita terms for lowlander-headed households.

4. 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:

$$w_{ih} = \mathbf{a}_i + \mathbf{b}_i \ln(x_h / P_{kt}) + \sum_{j=1}^4 \mathbf{g}_{ij} \ln p_{jkt} + \mathbf{q}'\mathbf{z} + u_{ih} \quad (1)$$

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 j th 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:

$$\ln P_{kt} = \sum_{j=1}^4 \bar{w}_{jk} \ln p_{jkt} \quad (2)$$

where \bar{w}_{jk} is the average budget share for food j in the k th town. The parameters to be estimated in equation (1) are \mathbf{a}_i , \mathbf{b}_i , \mathbf{g}_j ($j=1,\dots,4$), and the vector \mathbf{q} , 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 \mathbf{q} 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), 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. 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 (Deaton, 1997). 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:

$$\sum_{i=1}^4 \mathbf{a}_i = 1, \quad \sum_{i=1}^4 \mathbf{b}_i = 0, \quad \sum_{i=1}^4 \mathbf{g}_{ij} = 0, \quad \sum_{i=1}^4 \mathbf{q}_{ij} = 0 \quad \text{adding – up} \quad (3)$$

$$\sum_{j=1}^4 \mathbf{g}_{ij} = 0 \quad \text{homogeneity} \quad (4)$$

$$\mathbf{g}_{ij} = \mathbf{g}_{ji} \quad \text{Slutsky symmetry.} \quad (5)$$

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

$$\mathbf{h}_i = \frac{\mathbf{b}_i}{w_i} + 1 \quad (6)$$

$$\mathbf{e}_{ii} = -1 + \frac{\mathbf{g}_{ii}}{w_i} - \mathbf{b}_i \quad (7)$$

$$\mathbf{e}_{ij} = \frac{\mathbf{g}_{ij}}{w_i} - \mathbf{b}_i \left(\frac{w_j}{w_i} \right) \quad (8)$$

where \mathbf{h} denotes the expenditure elasticities and \mathbf{e} 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 $d \ln P_{kt} / d \ln p_{jkt} = \bar{w}_{jk}$.¹⁰ The elasticities vary with budget shares, and hence will differ between ethnic groups 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, \mathbf{b}_i for staples group expenditure is also investigated.

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 price indices for each of the major commodity groups. This restriction should not be too serious because existing studies of the effect of urbanization on food demand have also restricted their attention to particular food groups (e.g., cereals, meat products).

5. EMPIRICAL RESULTS

(a) Estimation methods

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. 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 covariance matrices were used for the calculation of all reported standard errors and hypothesis tests.

(b) Estimation results

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 other characteristics (Table 3). According to these results, 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 Highlanders do not completely change their diets once they leave the rural areas, with a continued preference for sweet potato.

(Table 3 about here)

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. 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. Further hypothesis tests indicated that many of the coefficients on the prices of the four staples in the demand system were imprecisely estimated and in fact the group of 16 coefficients on the price variables were not jointly statistically significant ($p < 0.16$). This imprecision most likely reflects the limited spatial variation in the sample, which was drawn only from major urban areas in six of 20 provinces. Given this imprecision of the estimated price effects, attention is restricted to the expenditure elasticities, which are more precisely estimated.

(Table 4 about here)

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, \mathbf{b}_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 ($p < 0.21$). 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 (Kennedy and Reardon, 1994). 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 ($p < 0.13$). Both of these schooling variables were highly correlated with the household head's years of schooling, so it was considered sufficient for the model to

just use the household head's years of schooling. Moreover, the gender of the household head had no effect on the pattern of staples demand ($p < 0.62$).

(c) Elasticities

The (conditional) expenditure elasticities and predicted average and marginal budget shares from the model are shown in Table 5. The highest expenditure elasticities are for banana and wheat products, so these two foods will capture a larger share of the staples budget as staples expenditure rises. Rice has the lowest expenditure elasticity, so the view underpinning rice self-sufficiency attempts, that consumers see rice as a superior food to the traditional staples, is not supported – at least for urban consumers. The expenditure elasticity for wheat products is slightly higher in households headed by Highlanders, but the average and marginal budget shares are almost nine percentage points lower than for other households. Conversely, the average and marginal budget shares for sweet potato are almost seven percentage points higher for households headed by Highlanders than for other households.

(Table 5 about here)

The elasticities in Table 5 are conditional on staples group expenditure so they are not directly comparable to other, unconditional, estimates in the literature. The elasticity with respect to total expenditure can only be derived with a model of the first-stage budget allocation of expenditures to major commodity groups but this is not available because of the lack of price indices for some of the major commodity groups. However, at least an indication of the relevant first stage elasticity can be gained from the use of (log) total expenditure as an instrument for (log) staples group expenditure. The first stage regression predicting staples expenditure in the Three Stage Least Squares procedure gives a coefficient of 0.42 on total expenditure, and this can serve as an estimate of the required elasticity, albeit in the absence of

commodity group price variables. Combining this elasticity with the conditional ones in Table 5 gives unconditional expenditure elasticities for rice of approximately 0.3, for sweet potato of 0.4, and for banana and wheat products of approximately 0.6.

The ethnic differences in the elasticity 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, average per capita quantities of each staple for each ethnic group were derived from the predicted average budget shares in Table 5. The average urban consumption level of each staple 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.

(Figure 1 about here)

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. Hence, changes in the ethnic mix in towns brought about by migration may be an important influence on future staples demand in urban areas of PNG. This also implies an important income-earning opportunity for rural producers because even though the urban population comprises only 16% of the national total, they contribute almost one-third of the market purchases of sweet potato (Gibson and Rozelle, 1998).

However, whether this effect of urban Highlanders on future sweet potato demand comes to pass may depend on whether the ethnic differences in the allocation of staples budgets reported in Table 5 persist 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.

(d) The dynamics of dietary change

Although the data are cross-sectional, rather than the ideal longitudinal data covering an urban-to-rural move (Huang and Bouis, 1995), 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, according to the results from a model where the number of years spent in the urban area is interacted with the indicator variable for Highlands ethnicity (Table 6).¹¹ In fact, the tendency for Highlanders to allocate a greater share of their staples budget to sweet potato than do other Papua New Guineans, appears to increase as they spend more years living in the urban area ($p < 0.05$). The budget share of wheat products in Highlander households also appears to increase over time -- implying some convergence towards the wheat budget share in the households of other ethnic groups -- although this effect is less precisely estimated ($p < 0.09$). 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 greater the number of years they spend in the urban area.

(Table 6 about here)

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, creating separate intercepts for those households headed by Highlanders who have lived in their current town 0-10 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 (as compared with other Papua New Guineans) 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 0-10 years in the urban area (Figure 2).¹² 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. The other interesting pattern in Figure 2 concerns 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 11-20 years in the urban area have rice budget shares which are indistinguishable from the rice

budget shares of other ethnic groups, while Highlanders who are longer-term urban residents (i.e., more than 20 years) allocate a smaller share of their budget to rice than do lowlanders.

(Figure 2 about here)

One possible explanation for the pattern in Figure 2 is that recent migrants have small households but enlargement through the subsequent arrival of other family members lowers the cost of consuming sweet potato because of the extra female labour that is available for preparation and cooking. However, the households of the long-term urban Highlanders are smaller than those of the recent arrivals (4.8 vs 5.1) so this explanation is not supported. Similarly, there are not clear trends in the pattern of per capita expenditures and wages between the households headed by Highlanders who are recent, medium, and long-term residents of the urban area. Another possibility is that recent urban arrivals from the Highlands ‘over-react’ to the different expenditure and price conditions 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 re-establish themselves. Alternatively, the patterns in Figure 2 may reflect factors, such as relative prices, specific to the time when households first arrived in the urban area, and the initial reaction to these time-specific factors may still be reflected in dietary behaviour at the time of the survey. It would take longitudinal data to disentangle these various effects.

The final analysis of whether diets change over time considers 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.

6. CONCLUSIONS

The evidence reported in this paper suggests that migrants from the rural Highlands of Papua New Guinea neither completely, nor instantaneously, change their diets once they arrive in urban areas. Urban households headed by a Highlander maintain significantly higher budget shares for sweet potato and lower shares for wheat products, relative to households headed by other Papua New Guineans, even after controlling for staples group expenditures, prices, household size, composition and location, and for other characteristics of the household head. The distinctive diet of urban Highlanders exists even amongst those households where the head has lived in the urban area for more than 20 years.

This evidence for the persistence of traditional diets has come from cross-sectional household survey data, whereas aggregate, time-series data have more typically been used for the study of urbanization effects on food demand (Huang and David, 1993). But even aggregate evidence from Papua New Guinea appears to support the results found in this case study: In 1997-98 PNG experienced food shortages following a major drought (and frost in the Highlands) caused by the *El Nino* conditions. Households responded to these shortages by increasing consumption of cereals, causing rice imports to increase by 66,000 tonnes (approximately 13kg per person averaged over the whole population).¹³ However, there was

no ‘beachhead effect’ where this higher consumption of rice caused a permanent shift in the diet because aggregate rice consumption in the years following the drought has been around 10% lower than what it was in the years before the drought (Whitecross and Franklin, 2000).

There are a number of implications of these results for food policy in Papua New Guinea. First, the shifting ethnic mix in urban areas will have important effects on the composition of staples demand, with a rise in the share of Highlanders likely to raise 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, this shift in the composition of urban food demand will ensure that a market continues to exist for the local producers of the traditional root crop staples even as urbanization proceeds. Moreover, the evidence reported here that urban consumers do not view rice as superior to root crops – as demonstrated by the low expenditure elasticity for rice – suggests that more attention could be paid to the infrastructure needed for the marketing of traditional staples. There may be more success at substituting for imports in this manner than there has been in the attempts at growing rice and other cereals in PNG (Blakeney and Clough, 2000).

The results reported here may also be relevant to other countries, in demonstrating the importance of ethnicity as an explanatory variable in food demand studies. Moreover, according to the results reported here, studies that forecast the composition of future food demand may need to consider more than just increases in the level of urbanization, they should also pay attention to shifts in the ethnic mix of the cities. The methodology used here may also be relevant to other countries because even in the absence of the ideal longitudinal data it has been possible to gain some insights into the dynamics of dietary change by using questions that are commonly included on cross-sectional household surveys.

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Table 1. Average consumption of staples and other foods in Papua New Guinea^a

	Rural Areas		Urban Areas		
	Highlands	Lowlands	All	Household Head ^b	
				Highlander	Lowlander
<i>kg per person per year</i>					
<u>Staples</u>					
Sweet potato	440	100	35	70	25
Banana	60	95	45	25	50
Other root crops ^c	60	150	40	15	45
Sago	3	40	30	3	35
Rice	20	30	67	75	65
Wheat products ^d	10	15	50	42	53
<u>Other foods</u>					
Meat and diary	32	33	57	51	58
Fruit and vegetables	135	85	46	46	45
Sugar and fats	5	4	11	10	11
<i>calories per person per year (000's)^e</i>					
<u>Staples</u>					
Sweet potato	500	110	40	80	30
Banana	50	80	35	20	40
Other root crops	70	170	45	20	50
Sago	10	120	100	10	110
Rice	70	110	250	280	240
Wheat products	20	30	95	82	98
<u>Other foods</u>					
Meat and diary	90	70	125	133	123
Fruit and vegetables	75	50	23	25	22
Sugar and fats	25	20	58	50	60

^a Calculated from food consumption data collected as part of a national poverty assessment survey (Gibson and Rozelle, 1998). The sample includes 830 rural households (376 from the Highlands and 454 from the Lowlands) and 314 urban households (53 headed by persons born in the Highlands and 261 headed by persons born in other areas).

^b Ethnicity of the household head is established from the province of birth so some second generation of migrants to lowland urban areas may be misclassified because no information is available on the province of birth of their parents.

^c Includes cassava, potatoes, taro, and yams.

^d Includes biscuits, bread, and flour (all in wheat-equivalents based on a conversion ratio of wheat to flour of 0.62).

^e The calorie estimates are aggregations of estimates calculated from more disaggregated commodities so the conversion factor from kilograms to calories at the aggregate level is not necessarily constant across the population groups because the shares and calorie contents of the disaggregated commodities may differ.

Table 2. *Description of variables used in the staples demand models*

	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.

Table 3. *Three Stage Least Squares budget share regression results*

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

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.

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
<i>Households headed by Highlanders</i>			
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)
<i>Households headed by Lowlanders</i>			
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 ().

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	<i>p</i> -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 and the full results are reported in Appendix Table 1. Standard errors and hypothesis tests use heteroscedastically-consistent covariance matrix.

Appendix Table 1. *Three Stage Least Squares budget share regression results with interaction between Highlands ethnicity and number of years in the current town*

	Share of Staples Expenditure Allocated to:		
	<i>Rice</i>	<i>Wheat products</i>	<i>Sweet potato</i>
Staples expenditure (log) ^a	-0.131 ^{***} (0.030)	0.094 ^{***} (0.027)	-0.004 (0.019)
Household size (log)	0.094 ^{***} (0.025)	-0.060 ^{***} (0.022)	-0.004 (0.017)
Proportion of household members:			
Female, 15 years and above	-0.110 ^{**} (0.045)	-0.034 (0.042)	0.086 ^{***} (0.033)
Male, 0-14 years	-0.080 [*] (0.045)	0.115 ^{***} (0.041)	-0.024 (0.031)
Female, 0-14 years	-0.090 ^{**} (0.044)	0.087 ^{**} (0.041)	-0.023 (0.032)
Household head is:			
Highlander	0.074 ^{***} (0.026)	-0.108 ^{***} (0.019)	0.038 ^{**} (0.019)
Expatriate	-0.142 ^{***} (0.037)	0.279 ^{***} (0.038)	-0.094 ^{***} (0.019)
Highlander × years in the town	-0.004 ^{***} (0.001)	0.001 [*] (0.000)	0.002 ^{**} (0.001)
Years of education of HH head	-0.007 ^{***} (0.002)	0.009 ^{***} (0.002)	-0.001 (0.001)
Age of household head	-0.001 ^{**} (0.001)	0.000 (0.000)	0.001 [*] (0.000)
Household head has wage job	0.009 (0.018)	0.041 ^{***} (0.016)	-0.038 ^{***} (0.013)
Price of rice (log)	-0.177 (0.297)	0.283 (0.273)	-0.191 (0.186)
Price of wheat products (log)	-0.839 (1.447)	-0.813 (1.204)	3.147 ^{***} (0.979)
Price of sweet potato (log)	0.062 (0.100)	-0.110 (0.089)	0.013 (0.063)
Price of banana (log)	0.007 (0.058)	-0.028 (0.054)	0.023 (0.041)
Household located in:			
Goroka	0.343 (0.348)	-0.044 (0.294)	-0.657 ^{***} (0.236)
Ambunti	0.059 (0.151)	-0.165 (0.138)	0.020 (0.107)
Wewak	0.172 ^{**} (0.072)	-0.265 ^{***} (0.082)	0.145 ^{***} (0.045)

	(0.081)	(0.072)	(0.053)
Kieta	0.062	-0.107*	-0.022
	(0.066)	(0.060)	(0.044)
Rabaul	0.282	-0.051	-0.477***
	(0.270)	(0.233)	(0.183)
Lae	0.159	-0.021	-0.312***
	(0.180)	(0.157)	(0.122)
Intercept	5.077	3.106	-13.499***
	(6.118)	(5.166)	(4.103)
χ^2 (slopes=zero) test	186.13***	448.93***	263.09***
R^2	0.11	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.

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

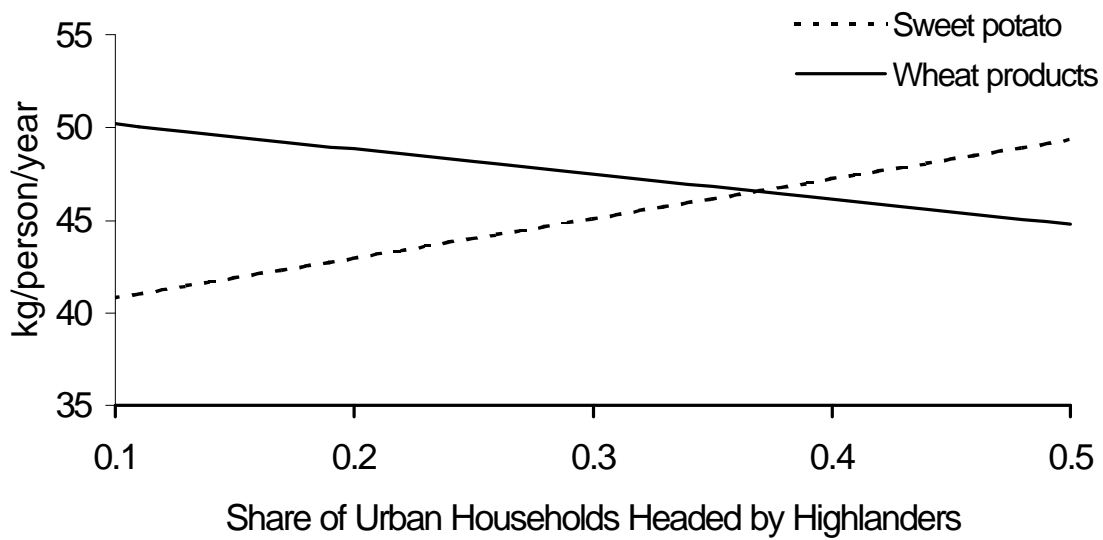
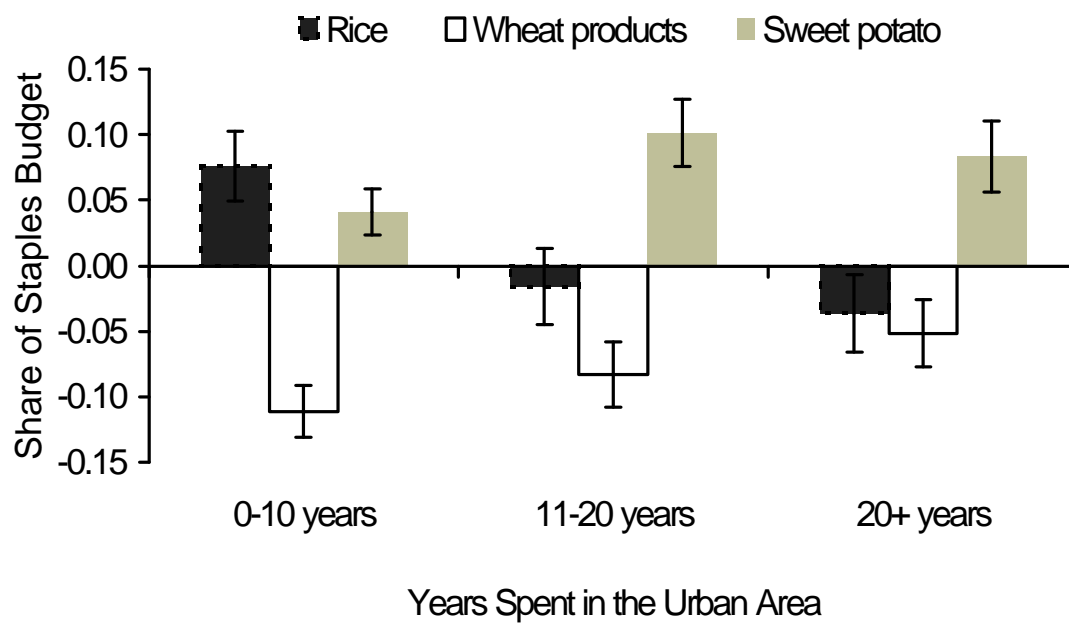


Figure 2: Staples Shares for Highlanders versus Lowlanders (Conditional on Demographics, Expenditure and Prices)



NOTES

¹ For example, between 1975 and 1990, migration contributed 50% of urban growth in nine Asian countries, 75% in four African countries, and 49% in 11 Latin American countries (Findlay, 1993).

² An exception is Strauss (1982) but most of the estimates reported in this paper use regional dummies, in place of the ethnic dummies with which they were highly correlated.

³ 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 (described below), with these proportions weighted according to the population of each urban area in the 1990 Census. While there are some small towns in the Highlands (with a significant share of non-Highlanders) most of the Highlanders who live in urban areas are found in the lowland cities.

⁴ Bang and Kanua (2000) report that between 1989 and 1999 there was a six-fold increase in the quantity of sweet potato shipped from the Highlands to Port Moresby.

⁵ 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 (Heywood, Singleton and Ross, 1988).

⁶ This survey is not used for the main part of the paper because it only has a small urban sample, especially of households headed by those born in the Highlands. Moreover, it does not provide any data on the number of years each household has spent in urban areas, which is used below as one of the key explanatory variables to capture the changes in diet as a function of the length of time since migration. Despite these drawbacks, this survey does contain the only comparative information on food consumption patterns in urban and rural areas of Papua New Guinea.

⁷ The predicted change in consumption uses a matrix of price elasticities reported by Gibson (1995) and regional prices reported by Gibson and Rozelle (1998), where the price in the National Capital District is treated as a proxy for all urban areas. The matrix of price elasticities is estimated from the same data that is used in the remaining sections of this paper, although it must be stressed that these data only refer to urban areas and there are no available estimates of food price elasticities for the rural sector of Papua New Guinea.

⁸ 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.

⁹ Households headed by Highlanders tend to be smaller than average, so these households contain only 18% of the sampled population.

¹⁰ 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 (Alston, Foster and Green, 1994).

¹¹ The full results from this model are reported in Appendix Table 1.

¹² The error bars show heteroscedastically-consistent standard errors. Differences in banana budget shares are not shown because they are always statistically insignificant.

¹³ This includes 8,000 tonnes of rice obtained from foreign aid sources.