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Estimating Demand Elasticities for a Small Island Economy: Fiji

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Abstract

An understanding of the responsiveness of food demand to price changes is critical to decision making in the area of food policy. The estimation of these elasticities is difficult in developing countries, such as Fiji, due to a lack of reliable data. We review the existing data on food demand elasticities in Fiji and examine alternative approaches to their estimation given the data constraints present. We use a stated preference approach to provide a new set of estimates of food demand elasticities for Fiji using cross section data. [3] [4]

Key Words

Demand, Food and Agriculture, Stated Preference, Survey

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Estimating Demand Elasticities for a Small Island Economy: Fiji

1. Introduction

Good policy making in the area of food policy requires an understanding of the responsiveness of both food producers and consumers to changes in food prices. For example, the current debate on food policy to deal with obesity in the South Pacific rests, at least in part, on policy makers understanding the price elasticities of demand for a range of food items as well as the responsiveness of domestic food producers to relative output price changes. There seems to be some consensus that consumers need to be educated regarding the worth of *good food* and that domestic production of that food needs to be expanded to replace the existing reliance on imported *bad food*. As well as an understanding of how and why people choose particular food types, an assessment of the likely success of this policy requires an understanding of both the sorts of price increases that would be necessary, at the farm gate, to call forth the increased level of production of good food and the extent to which those necessary price increases will influence consumer food choices.

Unfortunately, there is a dearth of information on the magnitude of food demand and supply elasticities in the South Pacific region. Specific information about price responsiveness in the region, and even particular countries, may be worthwhile as there are local market differences that could mean the true coefficients could differ in an economically significant way between regions and between countries in the region. For example, food choices are driven by a complex amalgam of cultural and economic conditions that can differ markedly between countries. Similarly, responsiveness on the production side rests on the perceived opportunity cost of resources and on the institutional structures with respect to factors such as land markets. Given the above, it would be surprising if the set of elasticities for Fiji today was close to those that were evident for, say, an Asian country of comparable income five or ten years ago.

There appears to be only one study that has estimated demand elasticities for food in Fiji. Seale *et al* (2003) reported unconditional Frisch own price elasticities of demand for food ranging from -0.297 for bread and cereals up to -0.671 for beverages and tobacco. The own price elasticities for the groups meat, fish and fruit and vegetables were -0.526, -0.587 and -0.42 respectively. These estimates are based on the between-country variation in prices and consumption using 1996 data for 114 countries. Similarly, the expenditure elasticities of demand for food varied from 0.83 for beverages and tobacco down to 0.367 for breads and cereals. The expenditure elasticity for fruit and vegetables was 0.52 and was 0.651 and 0.727 for meat and fish respectively.

There appear to be no other published studies of food demand in Fiji upon which to validate these results. From a theoretical perspective, the Seale et al (2003) estimates support the conventional notion that food own price elasticities tend to vary inversely with household incomes. Consumers with low incomes spend a higher proportion of their income on basic foods than richer consumers and so their food demand tends to be more sensitive to price and income changes. Fiji, as a middle income country, is characterised by elasticity estimates that lie between those of rich countries, such as the USA and Australia, and low income countries like Sierra Leone, Vietnam and Indonesia.

While it is possible to compare the Seale *et al* estimates for other countries, the relevance of these comparisons for the validity of the Fiji estimates is not clear. Having said that, Deaton (1997) reports own price elasticities of demand for beef in Cote d' Ivoire of -0.504 compared to the Seale *et al* estimate of -0.62 for all meat as a whole for the same country. However, the estimates relate to different food categories (beef compared with meat) and are based on different time periods (1996 data for Seale compared with 1979 for Deaton). Similarly, Hutasuhut et al (2001) found that the own price elasticity for beef in Indonesia was -0.92 compared to the -0.59 published by Seale et al. For rice in Indonesia, Riethmuller and Stroppiana (1999) found that the own price elasticity of demand was -0.08, substantially below the -0.304 for cereals and breads in Indonesia reported by Seale. In this case the data period was similar, but again the commodity group specification did not match perfectly.

PNG is the only country in the Pacific region for which empirical estimates of the own price elasticity of demand for food items have been published. Gibson and Rozelle (200*) estimated own price elasticities for rice, fruit and vegetable items that are far higher than those reported by Seale for Fiji. The Gibson and Rozelle estimates range

from -1.77 for rice down to -0.70 for bananas. The marked difference between the Seale and Gibson and Rozelle estimates may reflect the comparatively low income of PNG consumers and the comparatively broad categorisation of food used by Seale.

The objective of this paper is to derive an alternative set of food demand elasticities for the Fiji Islands to compare with those estimated by Seale et al (2003). This exercise is worthwhile because the existing literature outlined above provides only weak evidence on the likely magnitude of the elasticities in Fiji. Further empirical work is necessary as the plausible range of values consistent with this existing body of literature raises the spectre of economically significant errors in the analysis of agricultural policies.

In the next section of this paper the alternative approaches that can be used are assessed along with the nature of the data available to support the estimates. The estimation of the models and derived elasticity coefficients are discussed in Section 3. The results are summarised in the concluding section and implications are drawn for policy work in Fiji.

2. Alternative Approaches to Estimation

Table 1 provides a summary categorisation of the alternative approaches to the estimation of demand relationships and some examples of each approach. The selection of any one method rests largely on the objectives of the study and the nature of the available data..

Table 1: A Taxonomy of Approaches to Demand Estimation

Data Type	**Estimation Technique – Selected Studies**	
	Parametric	**Non-Parametric**
Time-Series		
Transaction	Riethmuller & Stroppiana (1999)	Blundell, Browning, Crawford (2005)
Stated Preference		
Cross-Section		
Transaction	Deaton (1997) – consumers Gibson & Rozelle (2002) – consumers Seale, Regmi, & Berstein (2003) –countries	
Stated Preference	Bennett and Carter	This study (2007) – consumers

The Data

In the context of estimating own and cross price elasticities of demand, data are often drawn from time series studies. This provides the scope to measure market price changes over some extended period of time and the consequent consumption response at some average or aggregated level. In the case of developing countries, these time-series data are often either not available or are of dubious reliability. As a consequence, relatively few empirical time-series demand studies have been undertaken, and those that have are generally based on cross section data.

In the case of Fiji, consistent and reliable times series on consumption and prices are not available. Data on production and consumption do exist, but are suspected to be subject to measurement errors in relation to the value of production and consumption in the smallholder sector. Moreover, data collection procedures have changed and improved markedly over time so it would be difficult to establish close comparability between more recent and earlier data sets.. Therefore, in this case the use of cross section data seems the obvious choice.

Cross-section and time-series data yield differently defined parameter estimates. A particular issue is the measurement and interpretation of price variations. Price variations can be measured in some regional or spatial sense given access to local market prices. Alternatively, an implicit price or unit value can be derived from consumption surveys by dividing expenditure on a food category by quantity consumed in that category. While each of the approaches has its own problems, they both imply that food markets are characterised by impediments to trade between regions that result in consumers confronting economically meaningful differences in prices depending on where they live.

Where they do exist, these impediments most likely take the form of transport costs that reflect problems in transport infrastructure in rural areas in developing countries or restricted access to storage technology, such as refrigeration. Price variability could also reflect imperfections in information flows between producers in one area and consumers in another that restrict the opportunity for profitable arbitrage that would result in supplies being shifted from one region to another in response to price differences.

These market imperfections or market characteristics could well be present in Fiji. a Fiji comprises a large number of islands that are serviced by transport of variable reliability. This inter-island transport is restricted by problems associated with small population sizes, low incomes and poor infrastructure. Even on the main islands Viti Levu and Vanua Levu transport of food from rural areas to market centres, can be difficult due to limited road access away from the coast and small production units. Informational efficiency on price difference is less than perfect as reports on the prices at the major municipal markets are currently not widely published and are not broadcast[5]. In any event, the communication systems are restricted due to low incomes and a difficult local terrain that makes the provision of communication services relatively costly.

One of the problems with using cross sectional price differences is that the official data are generally collected only at major regional market centres and at high degrees of aggregation. The degree of aggregation may not match the nature of the consumption data. Moreover, the consumption data will normally be derived from a sample of households that may, or may not, have confronted the reported prices – perhaps because they purchased other than the average quality or because they bought at a roadside market where prices differed from those at official municipal markets and at supermarkets.

The most widely used alternative to official transaction prices is to rely on unit values implied from household expenditure surveys. This unit value can vary between households reflecting their location and access to markets, shopping decisions and choices with respect to quality. The quality aspect of the unit value creates problems for statistical measurement as an increase in price for any product may not be fully reflected in unit values as consumers switch to relatively lower priced goods within the category rather than just changing quantities purchased. This means that measured responses to “price” changes could well over-estimate the true response. That is, the measured price change is likely to be smaller than the true price change.

Deaton (1997) has suggested a quality adjustment approach to reveal the true price response from implicit unit values. His is a two-step procedure with value corrected price and quantity variables derived from estimated relationships between income and consumption and unit values. The corrected variables are then used to estimate the final demand model yielding quality response coefficients as well as price response coefficients. The most obvious problem with this approach relates to the quality correction process. The corrected, or adjusted, prices and quantities are only approximations of the true prices and quantities. The extent of the approximation rests largely on the nature of the data available to support this correction. Again, the data are often fraught with problems – so approximations and proxy variables are common.

Another approach to dealing with poor data is to estimate elasticities based on price differences across countries. This is a highly aggregated approach and is the one used by Seale *et al*. In effect a meta demand function is estimated across all countries and after controlling for specific factors associated with different groups of countries, the underlying price response is identified for each country. Given the complex inter-relations between

[5] Personal communication, Paul Waqa, FijiAgTrade, Ministry of Agriculture, Suva, December 2006.

demand and country and culture specific factors, the reliability of this sort of aggregated work will always be open to question.

An alternative to dealing with unreliable transaction data in demand analysis is to collect stated preference data. This is not widely used in published food demand work, but it has become common dealing with the demand for non-market goods, such as environmental public goods. Structured surveys are used to elicit responses from participants regarding their willingness to pay for particular goods or, in the case of choice modelling, particular characteristics of goods. Conceptually there are no inherent problems with this approach – the problems are practical and empirical. In essence, it is difficult to get people to provide meaningful and reliable data on transaction intentions through surveys. Respondents are confronted by hypothetical scenarios that they may not be able to fully comprehend. In addition, there is an obvious risk of non-sampling error associated with the questionnaire design and participants may respond in a strategic fashion with a view to influencing the data analysis.

Estimation technique

The basic choice in estimation techniques lies between parametric and non-parametric with the former by far the most common. The parametric estimation of demand functions using linear and non-linear regression techniques is conventional practise. While non-parametric estimation is uncommon, a key advantage of going down this route is that the analysis requires no a priori specification of a functional form but still allows analysts to impose theoretical constraints on the data. Blundell et al (2005) demonstrate the application of a non-parametric approach to the estimation of demand relationships using British household expenditure data. By using a programming algorithm that effectively imposes the axioms of revealed preference they estimate Engel curves from a large panel data set. However, the technique is computationally demanding and restricting in terms of the information that can be obtained.

An alternative non-parametric approach is to implicitly derive individual demand elasticities from stated preference data gathered in consumer surveys. The general form of the own price elasticity of demand is given by the following

$$\varepsilon = \frac{\partial Q}{\partial P} * \frac{P}{Q} \qquad (1)$$

where

ε = own price elasticity of demand for some good x

Q = quantity of good x demanded

P = price of good x

Expressing the demand curve in its inverse form and rearranging (1) gives the elasticity in terms of prices

$$\varepsilon = \frac{P}{\frac{\partial P}{\partial Q} * Q} = \frac{P}{\Delta P} \qquad (2)$$

where

ΔP = the difference between the current market price and the choke price or price intercept of the demand curve.

Under the assumption of approximate linearity the individual consumer's own price demand elasticity can be completely identified given knowledge of the exiting market price and the change in price that would be necessary to induce the consumer to cease purchases of the good. The choke price, which is effectively the limit of a consumer's maximum willingness to pay for a good, can be obtained directly in a stated preference sense by surveying consumers. The market price is usually easily obtainable from official data or collected from each respondent. Asking consumers to recall and list market prices relevant to them has the effect of correcting for quality differences in purchases between consumers.

This survey approach requires no price differences between consumers, no time series data sets, and uses contingent valuation techniques widely used in the environmental economics literature. However, it relies on the assumption of linearity for individual demand curves and suffers from all the well known reservations attached to the CVM approach to valuation. (See Hanemann, 1994 for a discussion of these issues.)

In this paper we demonstrate the application of the stated preference technique in the estimation of food demand elasticities for Fiji.

3. Estimation of Elasticities for Fiji

The data used in this analysis were drawn from a survey of a random sample of households in Fiji in November/December 2006. The sample of 713 households represented a sampling ratio of 1.0 per cent, and was stratified by location, income and ethnicity. (See Table 2.): In all there were 45 sampling cells made up as follows:

- Location – Central, Western and Northern divisions;
- Household total expenditure – stratified according to quintiles; and
- Ethnicity – Fijian, Indian and Other.

The Eastern Division was excluded. Apart from Levuka on Ovalau island, Eastern Division holds relatively few urban households and it's relative remoteness means that even Levuka households would represent relatively high cost sample points. The Provinces of Ra in the Western Division and Bua in the Northern Division were excluded for similar reasons.

Table 2: Sample Characteristics (No.)

Item	Ethnicity			Total
	Fijian	Indo-Fijian	All Others	
Population	26,169	39,964	4,989	71,812
Full Sample	268	394	51	713
Preliminary Sample	129	103	25	257

Sources: Fiji Islands Bureau of Statistics; Study estimates.

The sample was drawn entirely from urban areas and was concentrated in the main population centres of Suva, Nausori, Lautoka, Nadi and Labasa It was restricted to the two main islands of Viti Levu and Vanua Levu. Despite these restrictions, the sample was designed to be representative of 97 per cent of the urban population. At this stage only a sub-set of the sample is available – from the general area of Suva, by far Fiji's major population centre. Because of that and because the data have not been edited we consider the present results as preliminary and subject to verification in the context of the full data set.

The questionnaire was administered through face-to-face interviews conducted by field staff from the Ministry of Agriculture and the Fiji Islands Bureau of Statistics. The objective of the survey was to produce the information necessary to derive a set of own-price, cross-price and income elasticities of demand for the main food items in Fiji. The individual items food groups covered in the survey were chosen to represent the normal consumption patterns of households in the Fiji Islands and to reflect the specific policy interests of the Ministry of Agriculture.

The survey process led respondents through a structured analysis of their current purchasing pattern and their likely responses to a series of hypothetical events. Respondents were asked to indicate the food items they normally purchased and the most recent prices they paid. They were then asked a series of questions to identify

their choke prices for items they currently buy and the "start" prices that would induce them to buy products they currently do not buy. When choke prices were identified consumers were then ask to identify substitute or replacement foods.

Consumers were then asked to consider how income changes influenced food purchase decisions. They were asked how substantial changes in household income would change their food purchase decisions for each of the specified food items.

Under the assumptions of strict linearity and using the non-parametric approach outline in Section 3, a set of own-price elasticities of demand for food were estimated for the Suva region of Fiji. (See Table 3.)

The magnitudes of the own-price elasticities of demand reported in Table 3 accord with basic theory. For example, the staple item bele (edible hibiscus leaves), has a markedly lower average elasticity than discretionary items, such as the group Red Meat.

Table 3: Own price Elasticities of Demand for Food in Suva: Preliminary Estimates

Item	Bele	Cassava	Dalo	Red Meat	Canned Meat and Fish
Mean	-1.6	-2.8	-3.3	-4.0	-3.9
Std Dev	1.6	1.8	3.1	3.0	4.8
Median	-1.0	-3.0	-2.5	-3.5	-2.0
Mode	-1.0	-3.0	-2.0	-4.0	-8.1
Min	-0.3	-0.3	-0.5	-0.4	-0.1
Max	-10.0	-15.0	-30.0	-17.8	-20.4
Number	88	179	162	119	208

The average estimates derived using this approach are markedly higher than those from other studies reported earlier in this paper. Importantly, our estimates could be interpreted as lower bound estimates of the true short-run elasticities. That is, as long as the true demand curve passes through the reported intercept term and the current price quantity point, and the curve is either strictly linear or convex, the true elasticity cannot be less than the reported values at the current market price. The extent of the downward bias in the reported results will depend on the degree of non-linearity in the implicit demand set.

The surprisingly high value of the average elasticities found in this study can probably be explained largely by the highly disaggregated food groups used. For example, there are few substitutes for food, more for fruit and even more for pineapples. Our study disaggregated fruit into five items and vegetables into nine items which allows for a very high degree of substitution between food items.

Elasticities for groups of food items can be calculated from the full set of elasticities from our system. The aggregate group elasticity is simply the weighted row sums of each item's own-price elasticity (usually negative) and its cross-price elasticities (generally positive). So in a type of inverse restatement of the standard relationship, the greater the individual product own-price elasticities and the larger the number of the substitute products within the group, the smaller in absolute terms should be the related aggregate group own-price elasticity.
It seems likely, therefore, that allowance for the cross-price elasticities would make our parameter estimates much more comparable with group elasticities published elsewhere.

Apart from the degree of aggregation involved, the high values are a reflection of the short adjustment period implied in the approach. Respondents were effectively asked to say how they would respond to a substantial price rise when they went to purchase food. It is very likely that this very high degree of responsiveness in the very short run response is moderated over time as people become accustomed to price changes and traditional preferences re-exert their influence on consumers' decisions.

Another way of thinking about the levels of the own-price elasticities is to think of them operating when prices fall sharply. In that context the estimated responses would be quite consistent with consumers responding to a short-term price drop by buying for both storage and current consumption. That is effectively the same as stockpiling supermarket specials.

The preceding discussion has focused on estimated average elasticities. These averages hide very substantial differences in price responsiveness between households. The distributions of the household own-price elasticities of demand for some key foods are reported in Table 3. In the case of dalo – or taro – while the average own-price elasticity was -3.3, the individual household values ranges from -5 to -30. Noticeably, there are statistically significant differences between Fijians and Indo-Fijians in their responsiveness to changes in dalo prices with the latter tending to be far more price responsive[6]. (See Table 4.)

Table 4: Elasticity of Demand for Dalo by Ethnicity

Item	Fijian	Indo-Fijian	Item	Fijian	Indo-Fijian
Mean	2.769928	4.158772	Skewness	2.703404	4.08204
Standard Error	0.287034	0.819452	Range	11.5	29
Median	2	3	Minimum	0.5	1
Mode	2	5	Maximum	12	30
Standard Deviation	1.946759	5.051444	Sum	127.4167	158.0333
Sample Variance	3.789872	25.51708	Count	46	38
Kurtosis	10.39228	19.28164	Confidence Level(95.0%)	0.578116	1.660367

4. Concluding Comments

Knowing the values of supply and demand elasticities for food is critical to good policy making everywhere, but especially so in developing countries where food accounts for relatively large shares of consumer budgets. Unfortunately, reliable data on these parameters is often not available, especially in smaller countries like those in the South Pacific region. The estimation of these parameters is made difficult due to the lack of reliable time-series data sets on food prices and food consumption. In this paper we have explored a cross-sectional approach to estimating food elasticities based on stated preference information from a consumer survey.

The results from this case study of urban consumers in Fiji are encouraging. The average results reported from this study appear high – all food items had average elasticities of 1 or more. This reflects the highly disaggregated nature of the food groups and the short adjustment period implicit in the estimates. However, it is difficult to formally validate our results due to the lack of comparable estimates. Importantly, both the relativities between different food items and the relativities between the elasticities for the two main ethnic groups accord with the relationships that theory would suggest would hold given their known dietary patterns.

There are a number of assumptions underpinning these estimates so the results need to be treated with some caution. Most important among these are the assumption of linearity and the robustness of the consumer responses to hypothetical and abstract questions. In terms of the reliability of consumer survey responses, the

[6] The difference between Indo-Fijian and Fijian consumers is statistically significant at the 10% level. The difference between "Other" and Fijians was not statistically significant.

consistency of the results across different food types supports the notion that consumers did understand the questions they were asked. Moreover, the nature of the questions asked here would appear to rule out strategic bias and vehicle bias as serious problems in this sample. In addition, the scenarios posed were very similar to day-to-day events with which all respondents would be familiar.

The availability of wider sample data from the rest of Fiji and more data editing will test the reliability of the results reported for this sub-sample from Suva. The wider sample will be weighted by consumption and survey weights to produce weighted national average coefficients for each food type. In addition, aggregate elasticities for wider food groups such as fruit and vegetables will be calculated. These broader averages will be more comparable to the conventionally reported elasticities. Cross-price elasticities and income elasticities will also be derived at the national level. An analysis of these wider food systems parameters as a group will provide some further insight into the nature of the results using the stated preference technique we have outlined in this paper.

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