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Abstract

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1 INTRODUCTION

More often than not, poverty and inequality measures are based on consumption expenditures of households but this does not represent the welfare of the individuals within the household and hence concern has been raised on policy formulation (Haddad and Kanbur 1990). The strong assumption for such data use has been that resources within a household are divided according to need but a growing body of literature has argued that this is not true and that consumption inequality exists within households (Sen 1984, Thomas 1990, Phipps and Burton 1995, Iversen 2003). These studies have shown that certain social configurations such as discriminations or norms against women, the earning capacity of individuals and power structure within the households (traditionally assigned or acquired through earnings) are causes of inequality within the household. When deprivations within the household are not accounted for and if these are aggregated for the whole population, the underestimation of inequality and poverty could be significant and result in gross policy neglect.

To our knowledge, the seminal study of Haddad and Kanbur (1990) used individual consumption data on calorie intake to study intra-household inequality in the Philippines while Pitt et al. (1990) studied determinants of calorie consumption in intra-household food distribution in Bangladesh. Most other studies such as Lise and Steinz (2004), Chiappori et al. (2002), Browning and Chiappori (1998), Findlay and Wright (1996), and Davis and Joshi (1994) used micro data simulation scenarios where intra-household allocation varies from low to high according to a number of sharing rules rather than gathering information from real data.

This paper thus uses real data (a specially designed recent survey on Fiji, see full survey in appendix) to construct an improved version of the adult equivalence index (AEI) to study intra-household inequality and poverty. First, unlike Haddad and Kanbur, here, the constructed index considers a broader criteria of both food and non-food expenditure.

Second, the constructed AEI goes beyond the adjustment for economies of scale to consider various demographic characteristics to better enable comparison between individuals. In the next section, the sample selection method, the appropriateness of the sample and some problems of the dataset are explained. Section three details the procedure for separating individual consumption from the household consumption and discusses the construction of the adult equivalent index. Section four concludes.

2 SAMPLE DESIGN

A sample size of 263 households with a total of 1193 individuals was extracted from a population of approximately 13 000 voters. The electoral roll listing for the 2001 elections was used to do the sampling. A random number table was used to pick the first household and then every 50^{th} voter was picked until the end of the electoral list was reached. The sample was therefore 2% of the total voter population. Applying the classical sampling theory, if the sample is to hold for at least 95% level of confidence on statistical inference for a given error tolerance, it must be of the size consistent with Equation 1 (Scheaffer et al. 1996).

$$n = p(1-p)\left(\frac{Z_{\alpha/2}}{e}\right)^2 \qquad (1)$$

The sample size is given by n in Equation 1 where $Z_{\alpha/2}$ = 1.96 for a 95% confidence interval. The value of p is the proportion of a trait to be observed in the study and is taken to be 0.5 as a maximization rule. That is, when p=0.5 the sample size n is maximized. The error tolerance e is taken as percent point error term and is often calculated for e=1%, e=2% and e=5%. Table 1 shows the sample size that is required for these three different error tolerance values at the confidence level of 90%, 95% and 99% for which $Z_{\alpha/2}$ = 1.645, $Z_{\alpha/2}$ = 1.960 and $Z_{\alpha/2}$ = 2.575 (see Bowerman et al. 2001). The figures in Table 1 were obtained by calculating the sample size substituting these values in Equation 1. The sample size of 263 is quite small but close to 271 for a reasonably accurate prediction with the error tolerance of 5% points and confidence interval of 90%.

Table 1 Minimum Sample Size for various Error Tolerance (for $p = 0.5$)

Confidence Interval (CI)	Error Tolerance (% point)	Required Sample Size
99% ($z_{\alpha/2}$ =2.575)	1	16577
99% ($z_{\alpha/2}$ =2.575)	2	4145
99% ($z_{\alpha/2}$ =2.575)	5	664
95% ($z_{\alpha/2}$ =1.96)	1	9604
95% ($z_{\alpha/2}$ =1.96)	2	2401
95% ($z_{\alpha/2}$ =1.96)	5	385
90% ($z_{\alpha/2}$ =1.645)	1	6766
90% ($z_{\alpha/2}$ =1.645)	2	1692
90% ($z_{\alpha/2}$ =1.645)	5	271

The concern for accuracy in this survey, however, is the non-sampling errors such as accuracy of figures provided by the interviewees, the interpretation and recording accuracy of the enumerators. The survey is based on the interviewees' ability to recall information, which can be inaccurate sometimes. The sample also has a few shortcomings as a representative sample of the current population composition. The 2001 electoral list was 4 years old in 2005 when the survey was carried out, which did not take into account the recent migrants into this area. This area is known to have a reasonably high mobility rate as people from other part of Fiji come to settle in this locality. This sampling method can bias poverty estimates upwards as the incoming migrants into this area are expected to be poor. A large number of Indo-Fijian migrants move into this area every year after being evicted from their agricultural native land. In many cases, the farmlands impounded by the Native Lands Trust Board or more frequently by the landowning units, leave the evicted farmers without their possessions.[1]

Also, all those persons who were close to or less than 21 years in 2001 would not be listed in the electoral roll. So those people who were just reaching the age of 25 years or less in 2005 would not appear in the list. So, effectively, all those households with household heads in this age group would be excluded from the sample. Another shortcoming of this sample is that unregistered voters are excluded from the sample, which could be as high as 10% of the population.[2] However, this omission (non-registration) is least likely to have any specific bias as there is no established relationship

[1] See Lal and Reddy (2003) for issues relating to land conflicts in Fiji.

between non-registration and income related traits of the households. A large percentage of these non-registrations are results of mistakes of the registration officials or the data entry personnel. So there is no serious implication of this on the randomness of the sample.

Table 2 shows a fairly equal proportion of males and females across ages and the number of married individuals in the 36-55 age group are at least twice of that in the 19-29 age group. It is not surprising that only 30% of the households are headed by females.

Table 2 Summary Statistics on Survey Sample

Age (years)	No of females	No of males	No of married persons	No of male household heads	No of female household heads
Below 6	40	42	0	0	0
6-14	93	92	0	0	0
15-18	38	40	4	0	0
19-29	147	172	145	26	9
30-55	204	197	356	135	25
Above 56	68	62	83	42	26

2.1 QUESTIONNAIRE DESIGN AND DATA COLLECTION

Data collection for the survey was not staggered as is normally done in the case of Household Income and Expenditure Surveys (HIES) to capture seasonal variations. Although staggering gives more accurate and representative dataset, for the purpose of the analysis in this thesis, it was not done due to resource constraints. This survey was designed to extract consumption data for each individual. The month of September was chosen for the survey to avoid any spurt in expenditure as normally there are no festivals during this month in Fiji. Consumption expenditures normally increase significantly on occasions such as religious, cultural or national celebrations, which may cause biases in consumption patterns. Such biases in consumption were avoided by choosing the month of September for the survey.

[2] This is the average rate of non-registration of voters in Fiji elections.

Information on income data was also extracted during the interview as income is one of the determinants of consumption and income share is considered to be one of the main power vectors in the decision-making process within the household. The questionnaire used for the extraction of information was 32 pages long with a total of approximately 483 questions. A copy of the questionnaire is provided in the Appendix.

There were a total of eight sections in the questionnaire. In Section A of the questionnaire, the interviewee details were obtained so that return visit or contact could be made in case if there was missing information. Section B of the question extracted personal information such as age, sex, marital status, level of education, employment status, profession, height and weight of each individual in the household. Section C of the questionnaire extracts income details about the household, which is disaggregated into wage and non-wage earnings (such as house rent and earning from business owned) of each individual in the household. In Section D of the questionnaire, the assets of the family are determined. The assets include, house, land, vehicle, household assets (white goods) and financial assets (superannuation and insurance savings policies).

In Section E, all individualized consumption details are obtained. These include food consumption, health, educational, shelter, clothing, energy consumption, individual entertainment, and transport. The house rent information is obtained in some detail as it is a significant expenditure for urban households.[3] Those who pay rental for the dwellings, the rental was recorded as expenditure. Those who own houses or lived in rent-free dwellings, the equivalent of their rent was added to the household income. Those who own houses, need to meet mortgage commitments (repayment of loans) and the cost of maintenance. Those rent-free imputations that are attached to institutions/businesses the people work for can be easily taken as income but that in most cases are taxed. So adjustments for taxes have to be made.

[3] For the survey households, the rental expenditure was found to be 24.4% of the total household expenditures.

The information on health and clothing expenditures were also extracted in the same way as food expenditures although in general, households do not spend on these items regularly. While health spending is more a need-based consumption, clothing expenditure is a seasonal one. In Section G, information on social benefits is extracted. These include donations from the family, friends, non-governmental organizations and the government. Social donations made by the households are also obtained and the benefits are added to the net income of the household. The incomes of the households in this questionnaire, therefore, include all the wages earned, value of subsistence production, rental earnings (minus cost of asset), net business earnings and net social benefits.

3 ADULT EQUIVALENT INDEX

The current economic literature is riddled with disagreements on the issue of adult equivalence scale (Nelson 1993; Coulter et al. 1992b) to enable welfare comparisons but without such a construction, comparison is impossible. Here, first, the needs of the individuals are determined using the suggested methods by Lanjouw and Ravallion (1995). As widely known, not all characteristics of the individuals can be factored-in to derive the index that reveals their needs and only the obvious and visible variables are considered. Since visible characteristics of individuals (that are explicitly considered) differ and households are comprised of individuals, each household must be unique. Therefore, each household must have a different equivalent index. This index is used to quantify the consumptions of all individuals in a way that is comparable.

The method adopted here is that of Cowell's (1984) 'personalised equivalent needs normalised incomes' where each person is represented as a proportion of the ideal person whose index is 1 (see Banks and Johnson 1994 and Buhmann et al. 1988). Our data segregation here is a step forward. Following Ebert's (1997), each individual is allotted income according to the index he/she assumes and person's expenditure is divided by the index to give a per capita adult equivalent expenditure. In this way, each person's expenditure, regardless of age, physical size or functionality, becomes comparable on a level basis. The method adopted here captures expenditures attributable to individuals of different characteristics and converts those expenditures into equivalent expenditures,

taking into consideration the variations of their needs (Ebert 1997). To overcome the mismatch of persons such as 15-year old school-going child, a 25-year old employed person, a 5-year old infant, the idea of adult equivalent expenditure is used. Such comparisons need careful evaluations of needs and circumstance within the household.

In this paper, we are concerned with comparing the expenditures (consumptions) of persons of different primary characteristics (age, gender, height, weight as functionality) which requires construction of a meaningful equivalence scale to bring the expenditures on a single plane on which they can be compared with each other. Thus, a 'Sex', 'Age', 'Weight' and 'Height', 'Functionality' (SAWHAF) based equivalence scale is expected to work well since the scope of this population is narrowly based on the Indo-Fijian population in a small electoral constituency. For this reason, less violations of comparisons rule are anticipated and thus minimisation of undue controversies and disagreements.

There are various perspectives to the equivalence scale apart from the general disagreement on how to scale consumption expenditures. One perspective is that the equivalence scale should address the physical aspect of human wellbeing (Cotter and Rappoport 1984). In this perspective, the needs are defined as deficiencies in meeting the needs of physical health, thus interpersonal comparison is not seen as a problem. Nelson (1993) argues that based on this perspective, Ernest Engel (in 1895) drew an analogy between the size and weight of a person and height diameter of a cylinder and invented the scale of "quets", which gave an infant the value of 1 and every other member takes certain multiples of "quets".[4] This concept is related to the idea of dietary requirements, that is relative food needs of households based on the household composition.

The method of using weight and height ratio fit this perspective quite well as it is overtly a physical measure of needs based on the height and weight of the person. So to complement the height and weight index there needs to be some other index that

[4] Also, see contribution of Gronau (1988) and Deaton and Muellbauer (1986) on the construct of the equivalence scale.

compensate for factors such as sex and age as functionality. While the choice of the demographic characteristics is debatable, it was nevertheless considered reasonable on the following grounds. First, Cotter and Rappoport's (1984) perspective on the importance of physical well-being measured by height and weight in relation to dietary requirements was taken on board. Second, Sydenstricker and King's (1921) argued that the cost of some non-food items might be divided among persons according to age and sex in much the same proportions as is food. This provides us with a practical lead to construct the SAWHAF index for each individual using Equation 2.

This index includes adjustment coefficient, I_{AS}, for age and sex and height and weight variations. The I_{AS} component of the index is determined by the age and sex of the individual and 0.4 and 0.6 are arbitrarily chosen, giving 40% weighting to weight variations and 60% weighting to height variations from average. The average heights and weights given in Table 4 are extracted from the population data provided in Table 3 with slight adjustments in reference to the survey data.

$$AE\ Index = (I_{AS})\left[0.4\left(\frac{weight}{Average\ weight}\right) + 0.6\left(\frac{height}{Average\ height}\right)\right] \qquad (2)$$

The shares given to height and weight are based on value judgement. [5] However, the rationale to give more weight (60%) to the 'height' variation is based on the idea that 'height' is a more natural determinant of consumption than a person's 'weight' as 'weight' is an acquired physical dimension resulting from asymmetric shift in consumption. The age and sex index, I_{AS}, is equal to 1 for a normal adult of age 18 years and over for both males and females. The height and weight averages for males and females are used in Equation 2 with some adjustments to the figures shown in Tables 5 and 6.

[5] Ravallion (1994) argues that in measurement practice, value judgment is unavoidable.

Table 3 Average Heights and Weights as per 1991 Food and Nutrition Survey

Age Groups	Males		Females	
	Average Weight	Average Height	Average Weight	Average Height
5-9	20.3	119.1	19.2	118.3
10-14	29.0	140.8	35.8	148.1
15-19	48.3	165.8	45.9	154.6
20-29	62.4	169.9	50.1	154.4
30-39	71.1	166.7	57.2	152.5
40-49	67.0	166.7	60.3	157.2
50-59	62.3	166.9	59.0	152.5
60+	71.7	164.1	51.7	155.2

Source: Jansen (1991).

Table 4 Male and Female Average Heights and Weights

Characteristics	Male (over 18 yrs)	Female (over 18 yrs)	Male (15-18 yrs)	Female (15-18 yrs)	Child (6-14 yrs)	Child (>5 ys)
Height (Metres)	1.7	1.6	1.6	1.5	1.35	0.8
Weight (Kg)	72Kg	62Kg	47Kg	42Kg	25Kg	12Kg

Equation 3 is used to calculate the index for adult males with the reference weight of 72kg and height of 1.7 metres (see Table 5). According to this index, a male person of age over 18 years and who weighs 72 kg, and is of height 1.7 metres, has an index of 1 in terms of his consumption requirements. According to this characteristic, a male of this physical stature is a normal person. Any variation of weight or height from these stated values would vary the index accordingly. A weight greater than 72kg or height greater than 1.7 metres would yield an index that is greater than 1, implying more than normal requirements for the same level of satisfaction for the individuals, given all other functionalities are equal.[6]

$$AE\ (Male\ Adult) = 1.0\left[0.4\left(\frac{weight}{72kg}\right) + 0.6\left(\frac{height}{1.7}\right)\right] \qquad (3)$$

[6] Note that the average weight and height of 71kg and 1.7m in Equation 3 are higher than the average heights shown in Table 4. A slight upward adjustment has been made as it was felt that the figures given in the source document were slightly underestimated. The survey data confirms this to be true as shown in Table 5. However, it is not likely that these adjustments will have a drastic effect on intra-household comparisons as verified by some sensitivity analysis.

This index is quite simplistic as pointed out earlier but holds some logical reasoning in terms of consumption of commodities which is in consonance with the current welfarist approach to poverty analysis as described by Ravallion (1994). The welfarist approach is based on a reasonable yardstick that provides a comparative ordinal or cardinal measure of poverty. Here, a cardinal approach is adopted where it is assumed that the subjects are rational beings who are maximising their utilities from exercising/exploiting their functionalities and consumptions of commodities. The approach adopted here is practically viable as argued by Duclos and Araar (2006) who point out that:

> "…….comparisons of poverty almost invariably use imperfect but objectively observable proxies for utilities, such as income or consumption. The "working" definition of poverty for the welfarist approach is therefore a *lack of command over commodities*, measured by low income or consumption. These money-metric indicators are often adjusted for differences in needs, prices, and household sizes and compositions, but they clearly represent far-from-perfect indicators of utility and well-being. Indeed, economic theory tells us little about how to use consumption or income to make consistent interpersonal comparisons of well-being. Besides, the consumption and income proxies are rarely able to take full account of the role for well-being of public goods and non-market commodities, such as safety, liberty, peace, health. In principle, such commodities can be valued using reference or "shadow" prices. In practice, this is difficult to do accurately and consistently."

Thus, any reasonable choice of reference weight and height, as far as they are applied uniformly should not distort results. In general, it is expected that the index will not deviate far too much into extremes as functionalities vary only marginally. The mean of the index using Equation 3 is 1.0062, which is quite close to unity and the standard deviation is 0.081. This implies that considering a normal distribution of weight and height, it is expected that 95% of the calculated indexes fall in the range of 0.846 and 1.168.

If the AEI is greater than 1, it implies that the basic needs of the person are greater than normal. For instance, if the expenditure allocated to the person is $150 per month and if the person's consumption index is 1.09, then the person's consumption of $150 per month has an adult equivalent value of $137.61. Similarly, if a person's index is less than 1, then the adult equivalent value of the same consumption of $150 per month will be greater than $150. For example, if the AEI is 0.95, then the $150 per month consumption would have an adult equivalent value of $157.89. This implies that if a person needs less (AEI<1) due to his/her natural requirements, than for a given expenditure (assuming all other functionalities equal) his/her level of satisfaction from consumption would be greater, and vice versa.

The female index shown by Equation 4 is based on the same principle as the male adult index but with the height reference of 1.6 m and weight reference of 62kg (see Table 5).

$$AE\,(Female\ Adult) = 1.0\left[0.4\left(\frac{weight}{62kg}\right) + 0.6\left(\frac{height}{1.6}\right)\right] \tag{4}$$

The female household members are expected to be nearly the same as their male counterparts in terms of consumption. In the Indo-Fijian case for the given locality, where the survey is done, women are mostly housekeepers and confine themselves to family activities. According to common knowledge and the survey data, none of the women have wine and dine sessions or expensive outings away from the family. The men however, indulge in club or social drinking parties out of home. But men and women would balance out quite fairly as women purchase more expensive cloths and other personal items for exclusive consumption while men socialise out of homes that incur exclusive expenditures. This balancing of consumption behaviour is explained by Becker (1981) and Browning et al. (1994). Therefore, there is no justification in allocating an index less than unity to a normal female housekeeper.

Equation 5 represents the equivalence scale for males in the age bracket of 15 to 18 years. In most cases, those in this age bracket are secondary school students or are employed in

low wage sector and still live with the extended family with confined activities. The secondary school students are often very close to adult persons in terms of daily consumption. These age group students are expected to be very active physically and also spend thrift during coming-off age. Therefore, the sex and age index for this category is 0.8, which is very close to the normal index of 1. The other variations for the index are determined by variations in height and weight of the individuals. The average weight is 47kg and height is 1.6m (see Table 4). The females of the same age group are given the same index values but with slight difference in the average weight and height. The requirements of females in the age category of 15-18 years are similar to the boys. There are some biases against females of this age category amongst Indo-Fijians such as restrictions to night life and social activities generally, but on the whole, these biases tend to balance out as there are certain biases in favour of females. For instance, females are often granted greater choice for clothing and jewellery expenditures within the family. Female clothing commodities are normally more pricy than those for males and in this way it is generally argued that there is no significant difference between the needs of females and males of that age, particularly in monetary terms.

$$AE\,(15-18\ \text{years Male}) = 0.8\left[0.4\left(\frac{weight}{47kg}\right) + 0.6\left(\frac{height}{1.6}\right)\right] \tag{5}$$

$$AE\,(15-18\ \text{years Female}) = 0.8\left[0.4\left(\frac{weight}{42kg}\right) + 0.6\left(\frac{height}{1.5}\right)\right] \tag{6}$$

Two other categories of individuals are those aged between 6-14 years and those below 5 years. The category 6-14 years is the primary school age and those below the age of 5 years are children in mothers' care. There is no sex-specific weight and height reference points for these age categories as no significant difference is expected between the sexes. The indexes for these two categories are represented by Equation 7 and Equation 8 respectively. The primary school students are given a weight of 0.6, that is, 60% of a normal adult. The normal index for a child below 5 years is 0.35. The average weight and

height are given in the Equations 7 and 8. For details on height and weight averages, see Table 4.

$$AEI\ (6-14 \text{ years male and female}) = 0.6\left[0.4\left(\frac{weight}{25kg}\right)+0.6\left(\frac{height}{1.35}\right)\right] \quad (7)$$

$$AEI\ (5 \text{ or less}) = 0.35\left[0.4\left(\frac{weight}{12kg}\right)+0.6\left(\frac{height}{0.8}\right)\right] \quad (8)$$

The SAWHAF index is further adjusted for economies of scale as discussed in the next subsection. It is normally expected that when persons (males/females) work for earnings, their requirements become greater. This functionality variation is not captured by the height and weight indices (see Blackorby and Donaldson 1991; Lelli 2005). Therefore, further improvement to the SAWHAF index is possible.

3.1 THE ROBUSTNESS OF THE SAWHAF INDEX

In general, any AEI should obey the basic characteristics of individuals (Buhmann et al. 1988, Nelson 1993). For instance, a person who needs lesser resources than another for a comparative (or same) state of welfare should have a lower AEI (as lower AEI means lower requirements). This implies that if two persons receive the same money value of resources for a given price level, then it is expected that the person whose requirements are lesser, would have a higher state of welfare than the one whose requirements are greater. The same logic runs for household with different compositions (Coutler et al. 1992; Pollak and Wales 1979). The weight and height dimensions have a part in this as far as food consumption and other physical requirements are concerned, but it is expected that the economic and social functioning have a major contribution in consumption requirements as well (Lelli 2005). The difficulty lies in fully capturing the variations in functioning by the construct of the equivalence scale.

A typical comparison of consumption and state of welfare is described in this section. A few households are picked from the survey data to show whether the AEI performs well with regards to its basic functions. In the forgoing discussion, we have not specifically

discussed the issue of economies of scale for consumption by households, as raised by Banks and Johnson (1994), Coulter et al. (1992b) and Buhmann et al. (1988) and many others. This is essential for the survey data since the household size varies quite substantially from 1 to 12. Scale is particularly significant in the consumption expenditures in relation to overhead costs like house or transport vehicle as well as other types of consumptions such as food and entertainment (Nelson 1988; Coulter et al. 1992a). Importantly, economies of scale in consumption affect the measurements of inequality and poverty indices. These indices are argued to form 'J' and 'U' relationships to the choice of the scale, that is, they decline initially but rise after some point along the domain (Jenkins and Cowell 1994). But the literature does not provide convincing evidence or arguments for considering particular option/s for using economies of scales but to rely on rigorous sensitivity test instead (Coulter et al. 1992a; 1992b).

Some analysts use the rule of thumb such as assigning a ratio for an additional household member and adjusting for the composition of the family (Buhmann et al. 1988). It is assumed that making adjustment for each person will by itself represent the true needs of the household when those needs are aggregated. In our construct, each person's consumption is adjusted independently. The aggregation of the AEI for the individuals to obtain the household adult equivalent index, it could exceed the number of persons in the household. In larger households, it is expected that more members would be of lower age, hence the household aggregate indexes are likely to be downward biased as age and AEI have strong correlation coefficient of 0.82.[7]

To examine the robustness of the SAWHAF index, let us compare two persons within the same household. Consider comparison between the needs of a father (household head) and his 15 year-old son, and simultaneously making a comparison with the 70 year-old mother of the household head. One might say that the comparison between the father and the son on the basis of weight ratio is alright if the functionality index (1 for the household head and 0.8 for the 15-year old) adequately cover for the variations in their non-food needs. But on the other hand, the comparison between the household head and

[7] This strong correlation is an obvious result as the index is partly based on the age variable.

his 70-year old mother may be a problem. The 70-year old mother stays home, and needs medical attention while the household head is a healthy person working for an earning. Their comparison will be quite difficult since their adult functionality indexes are the same (1.0 for both). The question then is, how can such comparison be made possible? Does weight and height have any resemblance of such consumption needs? The answer to this is admittedly no. While Nelson (1993) and Seneca and Taussig (1971) suggest using food share, share of income saved or share of income spent on necessities to minimise the problem, the pertinent question is, how much difference would this make in the bigger scheme of things? This is purely an empirical matter as there is no guarantee that the adjusted indexes would perform any better than the one constructed here for comparisons like these.

Let us consider another type of comparison where change occurs to the weight of a person. How does the SAWHAF index perform in such comparisons? Consider a male adult who has AEI of 1 and is regarded as a normal adult. This is the case if he weighs 72kg and has a height of 1.7m. Consider a situation of change where his weight varies say by 10% from his normal weight and assume that all other factors are unchanged. The AE index for this person will change by 0.04, which is 4% over the normal adult equivalence of 1, and his new index would now be 1.04. The question is, does this measure exactly how the needs of a person may change if his/her weight undergoes a 10% change? This is again a difficult question to answer and there is nothing in the literature that answers this question. One might ask whether change is weight is expected to have a corresponding effect on the needs of the person but the extent of this effect is quite uncertain even when the direction of change may be known. There are various reasons for increase in physical weight. If the weight is acquired due to lack of activity, then it is possible that the needs would decline as economic and social functionalities declined. On the other hand, if the change in weight is due to increase in affluence, then it is possible that the needs increase as a result of increase in the scope of opportunities and economic and social freedom (Anand and Sen 1997 and Sen 1999). The SAWHAF index fails to perform in such comparisons.

The question then is, for what comparisons does the SAWHAF index perform better? The answer to this is quite straightforward. Despite all the weaknesses of the SAWHAF index, it should work reasonably better for comparing the needs of normally functioning person who have no special needs, which excludes comparison in a changing environment weight variation over time. It should perform better than other indexes in comparing the needs of normal persons within a household. This is shown to be the case in the discussions ahead.

In order to compare households, the SAWHAF index has to be adjusted for economies of scale but there exist a multitude of contributions on the problems of comparing welfare states between households (Nelson 1993; Bojer and Nelson 1998; Ebert 1999). Here, the adjustment is done using the method suggested by Lanjouw and Ravallion (1995) where using the economies of scale adjusted per capita consumption expenditure defined as:

$$x_i \equiv \frac{X_i}{n_i^{\theta}} \qquad (9)$$

where θ is the equivalence elasticity of 0.8,[8] X_i is the total household expenditure for household i and n is the number of members in the household. The data in Table 5 shows the adjusted AEI for four cases from the survey data.

Table 5 Economies of Scale Index

HH Number	Gender of household members	Number in HH	SAWHAF Index (without economies of scale Adjustment)	Economies of Scale		AEI (adjusted for economies of scale)	
				e =0.9	e =0.8	e =0.8	e =0.9
1	M F M M M	5	4.96	4.26	3.62	3.60	4.23
3	M F M F F	5	4.59	4.26	3.62	3.38	3.94
4	M F M F	4	3.87	3.48	3.03	2.95	3.38
5	M F M F M	5	5.28	4.26	3.62	3.79	4.47

Source: Survey Data

Note: HH stands for household.

[8] The AEI used here was checked for robustness using 0.85 and 0.9 but neither value showed any significant difference in the results.

The economies of scale calculated using Equation (9) gives a variety of value depending upon the elasticity *e*, which in Table 5 are given two arbitrary values of 0.8 and 0.9 as used in most previous studies. The last two broad columns show four sets of figures in two sub-columns each. The last broad column (with 2 sub-columns) shows the SAWHAF index adjusted for economies of scale and the second last broad column (with 2 sub-columns), show indexes that used only the economies of scale. The last two sub-columns are related to the fourth column, which shows SAWHAF index without economies of scale adjustment. The last two sub-columns show SAWHAF index adjusted for economies of scale with e=0.8 and e=0.9 respectively. The economies of scale index shown in the second last broad column does not incorporate SAWHAF index is seems simplistic and it does not discriminate between different characteristics of households. For instance, the adjustment index for household number 1, 3 and 5 are the same as those households have the same number of people. Those households have different characteristics in terms of age, and gender. However, the economies of scale adjusted SAWHAF index seems to discriminate between different household types quite significantly (see the last two columns). While the unadjusted SAWHAF also discriminates between households quite well, it does not adjust for the economies that exist for larger sized households. The economies of scale adjusted SAWHAF index are relatively smaller for larger households (compare the last sub-column of Table 6 with the fourth column).

Taking this analysis further towards welfare comparison, the three households are considered to have identical incomes of $280 to see how they fare in relative welfare comparison. It is interesting to observe whether there is any logical ordering of the welfare of these households on the basis of income distribution.

Table 6 Welfare Ordering using the indices adjusted for Economies of Scale

HH Number	Gender	Age	Number in HH	Welfare Ordering				
				AEI	e = 0.9	e = 0.8	AEI (0.8)	AEI (0.9)
1	M F M M M	45 43 22 20 14	5	$56.45	$65.78	$77.26	$77.76	$66.26
3	M F M F F	45 40 19 17 5	5	$61.00	$65.78	$77.26	$82.74	$71.04
4	M F M F	52 51 27 21	4	$72.35	$80.41	$92.37	$94.84	$82.84
5	M F M F M	59 57 25 22 25	5	$53.03	$65.78	$77.26	$73.97	$62.63

Source: Survey Data

According to the age and number of household members, household 4 has least requirements. Therefore, it must have the highest welfare derived according to the calculated per capita adult equivalent consumption. This differentiation is observed for all the columns in Table 6. According to the household configurations (sex and age), household 3 comes second, household 1 is third and household 5 should have the lowest level of welfare on the basis of per capita adult equivalent consumption. This ordering is clearly the case for last two columns, that is, economies of scale adjusted SAWHAF index shows this clearly. The unadjusted SAWHAF index also does well on this. The sub-columns labelled e = 0.8 and e = 0.9 do not show this ordering. That is, economies of scale indexes alone do not discriminate between households 1, 3 and 5, which is clear indication that economies of scale alone is not good enough.

The lesson from the above analysis is that if the 'economies of scale' adjustment proposed by Lanjouw and Ravallion (1995) is correct, then using the procedure to adjust the SAWHAF index in this way is a step forward. The combined index captures most of the usual variations between households and thus the resulting index has been shown to be reasonably good.

3.2 INCOME AND EXPENDITURE CALCULATIONS

The economic and social welfare of households depend on the net income of the households and their needs. In this research, we are concerned with the well-being of the individuals, thus the incomes and expenditures for each individual within the household are determined. The income is determined by the earnings of the individual and the earning of the household is determined by aggregating all the earnings of the members of the household. The earnings include wage earnings, non-wage earnings, subsistence and social benefits. The expenditure of each individual is determined by aggregating the specific expenditures on various items such as food, housing, health, education, clothing and various other consumption requirements.

To model the allocation of resources within the household four issues need to be taken into consideration according to Browning et al. (1994). They are: i) the partitioning of

goods as public and private; ii) the nature of preferences; iii) the mechanism to reach the household decision; and iv) factors that can be observed and estimated. As explained by Browning et al. (1994), the goods need to be described on the basis of whether they are public or private and beyond private where the good may be exclusive, for example, cigarettes and alcohol (or to some extent food) that are consumed by some members exclusively. This conceptualization is about which goods are collectively consumed by the household members and which are consumed by individual members. It is argued that while there are goods that are clearly public or private, there are some categories of goods that are hard to categorize in this way. Goods such as heating or shelter clearly have a very strong public element but often, their use is not evenly distributed amongst all the members of the household. For instance, children have to share beds and blankets or in some cases there may not be enough heating available for certain household members or it may be provided on restrictive basis. So, where to draw the line between public and private goods, is not easy.

As Browning et al. (1994) argue, food is private in the sense that only one person can eat any piece of food and once taken by one, it is not available to the others in the household. But there is clearly some public element in the preparation of food. Therefore, food can quite defensibly be assumed to be either private or public. Food has been treated as private consumption in this survey. However, this may not be entirely true for all classes of households. While food consumption in higher income households is least supervised, the case of poor household is far different where food is often rationed. The food regime in poor households is quite strictly controlled by the adults, usually by the female head. This is generally the case for the community in which the survey was carried out, where food distribution is normally under strict regime. Food consumption in such households is purely private and consumption is based on some decision criteria.

In this survey, the expenditure for each individual is calculated from the primary data source using various techniques. The questionnaire was designed in such a way as to separate the expenditures into various segments, such as ‘Food Expenditure’,

‘Education’, ‘Health’, ‘Shelter’, ‘Energy’ and other public expenditures such as ‘Telephone’, ‘Entertainment’, and ‘Transport’.

The food expenditure was calculated from the food sharing criteria. The food consumption was divided into three categories: breakfast, lunch and dinner. The consumption for breakfast was determined by the average number of bread slices taken by each member of the household. Similarly, the lunch and dinner costs were divided into shares for each member. The separation of cost for dinner was done on the basis of number of ‘rotis’ (Indian bread) consumed by each member. Number of ‘rotis’ is a good estimate of consumption amongst Indo-Fijian households. Once this proportion was worked out, the total expenditure on food was divided amongst the members of the household. Normally, food is distributed without much discrimination between household members. Information was also collected on the lunch and dinner paid and consumed outside the home by the household members. However, this expenditure was found to be very low as most Indo-Fijian households eat at home and even carry lunch to work. The school children carry their parcels of food to school in most cases. However, snack money is accounted for separately and those few who buy food at school indicate greater expenditure under snack category. All other entertainment expenditures for school children are also accounted for separately.

The education expenditure was divided into three parts: primary, secondary and tertiary schooling. These expenditures included tuition fee, travelling, stationery, and miscellaneous costs. These costs were imputed to individuals within the household. The health expenditure was also similarly separated using proportions. For instance, the total health expenditure for the last three months was recorded. In many cases, the health expenditures could be imputed to only a few of the household members such as the older members or the ones who were frequently sick. So, some asymmetry is expected in the distribution of health expenditures.

Clothing expenditures were extracted in the same way, but more in the like of health expenditures as people buy clothes only occasionally or seasonally. Many households had

their clothing entry as zero expenditure since most poor households do not buy clothes for several months. There is, therefore, a possibility of some underestimation in clothing expenditures. However, expenditures on school uniforms were separated under educational expenditures.

To a large extent, ‘shelter expenditure’, which is house rent or cost of owning a house, is a public expenditure and disregarding housing cost underestimates poverty. To separate the housing and energy expenditures, ‘weight and height’ index was used due to a lack of a better alternative. However, telephone use among individuals within the household was determined with specific questions. It is found that for majority of the households only the income earners had the permission within the household rules to dial out from the home. The younger generation now has more access to mobile phone services which is accounted for separately.

The transport expenditures were distributed on slightly different criteria. Where own vehicle was used by the household members, 75% of the costs were allocated to the working members on the basis of their income shares and the rest of the cost were distributed equally amongst the other household members. As in the case of telephone expenditure, minors within the household make limited use of the household transport for their exclusive purposes. In some cases the schooling minors use the family vehicle to travel to school. But often, this type of usage is not exclusively for that purpose, and often constitutes normal runs for the family’s working members. For instance, the working members drop the children on the way to their work. For many families this is a cost saving behaviour. In such cases, the travel cost for school-going members will not be shown as education specific cost, but as separate transport cost. The non-earning members do not use transport for travel except for collective family activities such as visiting families, visiting hospital, shopping or entertainment such as family picnic. In most cases, 70-90% of the family transport vehicle expenditure is imputed on the earning members.

Entertainment costs extracted by the questionnaire are of two kinds. One is collective entertainment where the whole family (literally or implicitly) is involved and derive utility, and the other is exclusive entertainment where only individuals derive utility. The benefits from expenditure on family entertainment are assumed to be evenly distributed to all the members of the household, even though the decision-making for household consumption is not characteristically collective. These expenditures for the sample households have been separated in regards to each individual. For the adults, expenditures such as alcohol, tobacco and kava have been separated and allotted to each person that consumes the goods, where as, for the non-adults recreation such as, sports, movie entertainment etc., have also been separated.

In Fiji, Kava drinking is a major expense for poor households, as it is the main source of entertainment for male household members. In cases where male household heads are unemployed, low-wage working women have to cater for the kava consumed by the males who drink them. This phenomenon is very common in the area where the survey was done. Where the male heads are alcohol drinkers the demand can be more devastating to the family's welfare. However, this behaviour is not so common amongst the Indo-Fijian community.

The extent and nature of exclusive entertainment of the household income earners often defines the underlining cause of intra-household inequality. Considering decision-makers within the household is a power vector for the maximisation of personal utility, such decisions, particularly those taken under severe resources constraint, may lead to intra-household deprivation of the less privileged within the family. Expenditure such as tobacco, alcohol, personal care and other adult goods and services are the key types that could give rise to asymmetries in consumption and thus partial deprivation of other members (Deaton and Muellbauer 1986; Gronau 1991). These expenditures are separated for each individual in the household. The expenditures for each individual are then aggregated and adjusted using their respective equivalence scale, which is termed as individual, per capita adult equivalent consumption.

The separation and aggregation of the household earnings require similar attention as that for the consumption. Careful calculations are necessary so that the actual disposable earnings of the households and the individuals are correctly determined. The wage earnings of all the working individuals were obtained through the questionnaire. In majority of the cases, only two or three persons earned income, but in some cases, four or five people earned income in the household. Information on subsistence income was also obtained by using data on input costs as well as including capital depreciation cost (Grosh and Glewwe 2000). In this way, the net earnings that accrue to the households from businesses were obtained. The subsistence sector earnings were confined to backyard farming which is quite common in Fiji, where it forms a survival mechanism for the poor households (Naidu 2001; Walsh 2002). The output for subsistence earnings was recorded and valued in terms of market prices less input costs. The other non-wage earnings that accrue to households and is common to Indo-Fijian households, is the rental income. Quite a large number of poor households (even those who squatter) rent out dwellings for income.[9] To a large extent, the cheap dwellings offered for rent are a great contribution to poor low-wage earners, as many such workers are migrants who come to these areas in search of job and have no assess to housing. The equivalent cost (price) of free dwelling rentals or own home were added to the household earnings following Melpezzi (2000).

The social benefits of households have also been added to the household income, however, this could not be allotted to specific person as households were too reluctant to provide that information due to fear of loosing the benefit from the government welfare department. Social contributions that come to households from friends and families often come to households and not specific persons and where it did, it would be very difficult to trace it to the specific person.

Apart from the earnings, information was also sought on household assets. This includes dwellings, vehicles, white goods, superannuation funds, insurance assets (savings funds) and savings at banks. Extracting information of tangible assets posed no problems. In

[9] Some underreporting is expected for this income source since some people expressed apprehension about tax implications.

most cases information regarding the superannuation funds was easily obtained, but it is possible that people did not provide true information on personal savings and business earnings. The information on household assets was necessary to determine the state of welfare of the households and their characterisation to determine the effect of asset holding on intra-household inequality. Information on household liabilities such as bank loans and other purchase liabilities were also obtained.

4 CONCLUSION

The data collected in the survey is extensive enough to separate the expenditures for each individual within the household so that intra-household inequality and poverty can be studied using an appropriately constructed AEI. This paper shows the ‘economies of scale’ adjusted SAWHAF index is a viable method to compare welfare of individuals within the same household and by aggregation, to make comparison across households as well.

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Appendix

Full Survey