Socio-Economic Determinants of Rural Household Food Expenditure: A Quantile Regression Analysis

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Abstract: This paper provides an analysis of factors that influence rural household expenditure on food using a quantile regression analysis. The objective was to investigate if there are any relationships to discern between household expenditure on food and a number of other socio-economic factors in addition to household income and household size as stipulated in Engel's law. The results indicate that indeed there are relationships that could be discerned between household food expenditure and gender, education, occupation, household income, number of people depending on household income, gender distribution by age groups and number of livestock sales per annum. However, household income has a relatively smaller effect in magnitude as compared to the rest of these factors. Furthermore, the results show that the relationships differ along the quantiles. In other words, some factors had a significant and higher effect in the lower quantile compared to the higher quantile. On the basis of such results, the study suggests that tailor-made interventions should be considered in the development initiatives that are targeting rural households as different factors affect these households differently.

Introduction

This study is based on the theory of consumer behaviour, which entails the decision-making of individuals spending their own resources such as time, money and efforts in order to obtain items associated with consumption (Horakova, 2015). According to Schiffman & Kanuk (1997), consumer behaviour was developed from multi disciplines such as psychology (the study of the individual), sociology (the study of groups), social psychology (the study of how individuals operate in groups), anthropology (the influence of society on the individual) and economics.

Gould (1979) suggested that it is difficult to uncover the reasons why people buy as this is subject to many influences. However, one reason for sure is that people are influenced by their psyche. Even so, the basic economic models tell us that individual buyers will spend their income on goods that will yield the maximum satisfaction (utility), depending on tastes and relative prices of goods. Schiffman & Kanuk (1997) argued that consumers are also informed by the levels of human needs, where they would seek to first satisfy basic needs before attending to luxury needs. One of the examples of basic needs is food and this item is the focus of this study. Regarding expenditure on food, Engel's law postulates that food expenditure is influenced by household income and family size, but the budget shares decline with increase in income (Donkoh *et al*. 2014). The studies that have attempted to build up from the Engel's law to determine the socio-economic factors that influence household expenditure on income have not attempted to compare different segments of the households (ranging from those that spend less on food to those that spend a higher amount). This is where this study comes in to compare between segments of the households to find out what factors have a significant influence and to find out if there are any differences between the households.

Analytical framework

The analysis employed in this study is based on the food expenditure theory, which entails Engel's law and John Maynard Keynes consumption theory as outlined in Donkoh *et al*.(2014), where the authors studied the determinants of household food expenditure. According to the Engel's law, food expenditure increases as income and household size increase, but the food budget share declines as income rises (Donkoh *et al*., 2014). Hence, it is argued that low-income households spend a larger share of their income on food, compared to higher-income households. The effect of the household size comes in when income rises, but the food needs are already satiated (Deaton & Paxson, 1998). However, Kirkpatrick & Tarasuk (2003) noted that although they are allocating a larger share of their income on food, low-income households tend to purchase fewer servings of

milk, fruits and vegetables than higher-income households. In effect, this has an impact on the nutritional status of the low-income households, thereby also affecting their food security status. Hence, the effect of income could not be measured in isolation from other household socio-economic characteristics given the many factors that could influence the food security status of the rural households. Therefore, all the socio-economic characteristics that were assumed to have some level of influence on food expenditure patterns of rural households had to be incorporated into the analysis. Within the context of this study, a household is viewed as a single organizational unit in which food expenditure behaviour can be explained using the following general functional form:

Expenditure on food = F (Gender, Age, Occupation, Education, Household income, Household size, Number of males between the age of 0-14 years, Number of males between the age of 15-35 years, Number of males between 36-60 years, Number of males above 60 years, Number of females between the age of 0-14 years, Number of females between the age of 15-35 years, Number of females between 36-60 years, Number of females above 60 years, Number of dependents, Land size, Number of Cattle, Number of sales).

The selection of variables was informed by several authors such as Davis *et al*., 1983; Deaton & Paxson, 1998; Kirkpatrick & Tarasuk, 2003; Meng *et al*., 2012; Healy, 2014; Donkoh *et al*., 2014; Kostakis, 2014.

Data and methodology

The total sample consisted of 31 rural households from Mount Frere and Umtata areas of the Eastern Cape. The sample was conveniently drawn from the Smallholder Market Access Tracker (SMAT) survey that focused on communal cattle farmers. The survey was carried out between October 2017 and February 2018 in three provinces, namely Eastern Cape, KwaZulu Natal and North West provinces. Of the 109 farmers interviewed in these provinces, only 31 farmers (all from the Eastern Cape) were comfortable to share information on key variables, which included household monthly income and the amount of money spent on food per month. Therefore, the sample size limits the extent to which empirical findings are representative of the rural households from the Eastern Cape, but they should be viewed merely as a suggestion of the food expenditure patterns of the sampled population.

This study employs a quantile regression analysis to discern the relationship between a dependent variable and several independent variables. The reason for using a quantile regression analysis is that two of the most important variables in this analysis i.e. food expenditure and household income are skewed. In other words, they do not have a normal distribution. As indicated by (Hung *et al*., 2010), quantile regression coefficients are not sensitive to outliers. This makes this analysis to be more appropriate, in this case, compared to an Ordinal Least Squares (OLS). In addition, this study seeks to discern the relationship between the food expenditure and several predictor variables and compare these relationships for different categories of food expenditure, ranging from households who fall under the lower quantile (25^{th} quantile) to those that fall under the higher quantile (75^{th} quantile). OLS fails under this condition because it only allows for analysis of the conditional mean and median located at the centre of the distribution (Hung *et al*., 2010). Mathematically, the quantile regression can be expressed as follows;

$y_i = x'_i\beta_\theta + u_{\theta i}$ with $Quant_\theta(y_i|x_i) = x_i\beta_\theta$ ..... (1)

Where x'_I denotes a vector of regressors, β_θ represents the vector of parameters to be estimated, and $u_{\theta i}$ is a vector of residuals. $Quant_\theta (y_i|x_i)$ represents the θ^{th} conditional quantile of y_i given x'_i. However, the basic model was expressed as follows;

Food exp = $\alpha + \beta_1$ Gender + β_2 Age + β_3 Occupation + β_4 Education……+ β_{19} Number of sales + ε ……. (2)

The list of the predictor variables is presented in Table 1. In doing so, the study attempts to discern determinants that influence rural household food expenditure patterns. The Spearman test was used to test for correlation between the independent variables. The results are attached as Appendix A.

Results

The results present the estimated coefficients and their P-Values in three different categories, namely the 25^{th}, 50^{th} and 75^{th} quantiles. This implies that the effect of a set of predictor variables is estimated for households with a lower expenditure on food, those with a medium expenditure and those with higher expenditure, respectively. The quantile regression shows that the number of significant variables reduces from a lower quantile to the higher quantile. This implies that predictor variables tend to have different effects as we move to the higher quantile. Table 2 below presents the quantile regression results.

Table 1: List of variables and their expected direction of effect on food expenditure

	Variable name	**Description**	**Type of variable**	**Impact on Income expenditure**
Y	Expenditure on food	Household's monthly expenditure on food	Numerical	N/A
X_1	Gender	Sex of the household head	Binary	-
X_2	Age	Age of the household head	Numerical	(+/-)
X_3	Occupation	Employment status of the household head	Binary	+
X_4	Education	Highest level of education attended	Categorical	+
X_5	Household income	Aggregate household monthly income	Numerical	+
X_6	Household size	Number of people living together	Numerical	+
X_7	Number of males between the age of 0-14 years	Number of males in the household (by age group)	Numerical	+
X_8	Number of males between the age of 15-35 years	Number of males in the household (by age group)	Numerical	+
X_9	Number of males between 36-60 years	Number of males in the household (by age group)	Numerical	+
X_{10}	Number of males between 36-60 years	Number of males in the household (by age group)	Numerical	+
X_{11}	Number of males above 60 years	Number of males in the household (by age group)	Numerical	+
X_{12}	Number of females between the age of 0-14 years	Number of females in the household (by age group)	Numerical	+
X_{13}	Number of females between the age of 15-35 years	Number of females in the household (by age group)	Numerical	+
X_{14}	Number of females between 36-60 years	Number of females in the household (by age group)	Numerical	+
X_{15}	Number of females above 60 years	Number of females in the household (by age group)	Numerical	+
X_{16}	Number of dependents	Number of people depending on the household income	Numerical	+
X_{17}	Land size	Amount of arable land used for agricultural production	Numerical	-
X_{18}	Number of Cattle	Number of cattle owned	Numerical	+
X_{19}	Number of sales	Number of cattle sales per annum	Numerical	+

Table 2: Results of the quantile regression analysis

Predictor variables	25th quantile		50th quantile		75th quantile	
	Coefficient	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
Constant	744.8085	0.070***	477.6428	0.576	1460.895	0.032**
Gender	-84.68345	0.503	-859.2127	0.008*	-415.2906	0.057***
Age	-7.264353	0.115	-3.234119	0.739	-4.06254	0.565
Occupation	259.2323	0.004*	370.2396	0.041**	85.79253	0.478
Education	-709.9911	0.000*	-344.0961	0.269	-668.9686	0.009*
Household income	0.083907	0.000*	0.0470832	0.027**	0.0910419	0.000*
Household size	10.14446	0.313	11.33648	0.606	-10.61157	0.507
Number of males between the age of 0-14 years	-571.3903	0.000*	-667.2649	0.000*	-530.5032	0.000*
Number of males between the age of 15-35 years	-189.2048	0.001*	-273.0786	0.010*	-106.9149	0.123
Number of males between 36-60 years	191.5273	0.005*	204.7652	0.123	116.9705	0.214
Number of males above 60 years	-180.1808	0.112	83.65656	0.727	-212.4974	0.233
Number of females between the age of 0-14 years	-186.8605	0.010*	-412.9243	0.010*	-332.2279	0.005*
Number of females between the age of 15-35 years	-151.8684	0.002*	-219.7752	0.028**	8.557366	0.895
Number of females between 36-60 years	-370.974	0.000*	-294.9431	0.115	-338.394	0.020**
Number of females above 60 years	-507.2715	0.005*	-373.1166	0.282	-147.9367	0.548
Number of dependents	386.5917	0.000*	514.1493	0.000*	348.8418	0.000*
Land size	-18.84077	0.296	3.892727	0.921	-9.350346	0.742
Number of Cattle	3.003211	0.737	-24.70875	0.227	-17.64933	0.232
Number of sales	-81.92179	0.049**	34.58544	0.684	4.534573	0.941

*Significant at 1%, **Significant at 5%, ***Significant at 10%

25th quantile. The results of the 25th quantile regression show that the employment status (Occupation), household income, number of males between 36 and 60 years of age as well as the number of dependents on the household income have a significant positive effect on the expenditure pattern of the household on food. This means that a unit increase in one of these predictor variables tends to increase the household expenditure on food by a certain amount. For example, if the household head is employed in the lower quantile, the expenditure on food tends to increase by R259, 23 and this is significant at 1% significance level. Household income has a small, but significant effect at 1% significance level. A unit increase in household income increases the household expenditure on food by R0, 08. A unit increase in the number of males between 36 and 60 years of age and the number of dependents tends to increase the household expenditure on food by R191, 53 and R386, 59 respectively and both relationships were significant at 5% and 1% significance levels respectively.

Education, number of sales, number of males between the age groups of 0-14 and 15-35 years and females in all age groups tend to have a negative but significant effect on the household income. This implies that a unit increase in one of the predictor variables tends to reduce household expenditure on food by a certain amount. As the household head acquires a higher education, the expenditure on food tends to be reduced by R709, 99 and this is significant at 1% significance level. A unit increase in the number of males between the age groups of 0-14 and 15-35 years tends to reduce the household food expenditure by R571, 39 and R189, 20, both significant at 1%. A unit increase in the number of females in all age groups tends to have a negative effect on the household expenditure, all significant at 1%. A unit increase in the number of cattle sales tends to reduce the expenditure on food by R81, 92, significant at 5%. The rest of the predictor variables did not have a significant effect on the dependent variable, therefore are not worth describing in this analysis.

50th quantile. Occupation, household income and number of dependents tend to have a positive and a significant effect on the household expenditure on food. These relationships are similar to the results of the 25th quantile regression. The differences lie in the magnitude of the effect and the significance level. For example, when a household head is employed, the household food expenditure tends to increase by R370, 24 at 5% significance level. The effect of the household income on household expenditure is reduced by R0, 03 compared to the quantile regression of the 25th quantile. This means a unit increase in the household income tends to reduce the household food expenditure by R0, 05 at 5% significance level. A unit increase in the number of dependents tends to increase the amount of money spent on food by R514, 15 at 1% significance level. The number of males between 36 and 60 years of age did not have a significant effect in this quantile as compare to the previous one.
Similarly, education, number of sales, number of females between the age groups of 36-60 and above 60 years of age did not have a significant effect on the household income as compared to the previous quantile. Only the first two age groups for both males and females had a significant, but negative effect on the household food expenditure. Compared to the previous quantile, the magnitude of the effect of these variables was higher. Only the number of females between the ages of 15-35 years had a significant effect at 5%, the rest were significant at 1% significance level. Gender has a higher and significant magnitude of effect on household income as compared to the 25th quantile. Here, when a household head is a male the household expenditure tends to be reduced by R859, 21, significant at 1%.

75th quantile. This time, the employment status of the household head did not have significant effect on the household income as compared to the 25th and 50th quantiles. However, the number of dependents continues to have a positive and significant effect, with the highest magnitude. For example, a unit increase in the number of dependents increases the household food expenditure by R0, 09.
The number of males and females between the ages of 15-35 years did not have a significant effect on household income as compared to the 25th and 50th quantiles. The number of sales also continued to have a non-significant effect. Education continues to have a significant but negative effect, accompanied by the number of males and females between the ages of 0-14 years and females between the ages of 36-60 years. If the household head obtains a higher education, the household food expenditure tends to be reduced by R668, 97, significant at 1%. A unit increase in the number of males and females between the ages of 0-14 years tends to reduce the household food expenditure by R530, 50 and R332, 23 respectively, both significant at 1%. A unit increase in the number of females between 36 and 60 years of age tends to reduce the household food expenditure by R338, 39, significant at 5%. Gender continues to have a significant but negative effect on the household income in the 75th quantile. When a household head is a male the household expenditure on food is reduced by R415, 29, significant at 10%. The rest of the predictor variables did not have a significant effect on the dependent variable.

Discussion and conclusion

The study supports Engel's law and food expenditure theory in the sense that food expenditure increases as income and household size increase. However, the study shows that for rural households the household size alone does not necessarily have a significant influence on the household food expenditure. Hence, the number of people who actually depend on the household income as well as their gender distribution by age groups must be taken into consideration. Gender on its own did not have a significant effect in the lower quantile. However, in the mid and higher quantile gender was significant, showing that male-headed households were likely to spend less on food compared to female-headed households. In spite having females in certain age groups having a negative influence on food expenditure, the leading females still manage to have a bigger budget for food. This calls for the inclusion of women on households' decision making units, particularly with regards to household budget. This is a suggestion against the patriarchy system that manifests in rural households.

The number of people between the ages of 0-14 years, regardless of gender, had a significant negative effect on food expenditure across all three quantiles. This may imply that the child support grant does not increase the household food expenditure. Instead, the grant money (and some of the money from the normal food expenditure) goes to buy other non-food items, tightening the budget for food. This further implies limited flexibility for expenditure on non-food items and savings. As such, rural households tend to be vulnerable to shocks and also tend to make lower investments on property and education.

The households with a lower and medium expenditure on food carry the burden until the members of the household get to 36 years of age, whereas those with a higher expenditure tend to have females between the ages of 36-60 years reducing the food expenditure. This shows that females have higher needs compared to male members of the household. Hence the suggestion that, at least, an elderly female should form part, if not lead, in the decisions regarding the allocation of household income. This is because she would understand the needs of females in the households better and would allocate the income accordingly.
The results of the lower quantile show that the number of cattle sold per annum significantly reduces the expenditure on food. This could mean that cattle sales serve as a buffer against shocks as compared to generating extra income for households in the lower quantile. Although not significant, but the same factor seems to have a positive effect on food expenditure, meaning that for households in the medium and higher quantiles selling cattle serves to generate extra income.

Overall, the study has shown that different socio-economic factors influence rural household expenditure patterns on food differently at different levels. Therefore, based on the results, the authors emphasize that policy interventions that seek to reduce the effect of poverty and food insecurity in rural areas must be tailor made to different categories of households and different income groups to improve their effectiveness. In addition, there is a need to understand deeper dynamics within the gender and age distributions as shown in the study. Further research could investigate the food expenditure patterns by food types to find out the nutritional values of the food purchased between the three segments of households.

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Appendix A

	Gender	Age	Educat~n	Occupa~n	Hincome	Hsize	MG1	MG2	MG3	MG4
Gender	1.0000									
Age	-0.0173 0.9265	1.0000								
Education	-0.1981 0.2854	-0.4620 0.0089	1.0000							
Occupation	-0.2445 0.1850	0.2642 0.1509	0.0315 0.8665	1.0000						
Hincome	-0.1799 0.3327	-0.1479 0.4273	0.3530 0.0515	0.1994 0.2821	1.0000					
Hsize	0.1648 0.3757	-0.0742 0.6915	0.0815 0.6630	-0.1971 0.2880	0.4292 0.0160	1.0000				
MG1	0.2316 0.2100	-0.4205 0.0185	0.2001 0.2805	-0.3464 0.0563	0.3377 0.0632	0.4942 0.0047	1.0000			
MG2	0.1631 0.3806	-0.0330 0.8600	0.2356 0.2020	-0.1657 0.3731	0.3494 0.0540	0.6870 0.0000	0.3269 0.0726	1.0000		
MG3	-0.1786 0.3364	-0.4306 0.0156	0.2866 0.1180	-0.3943 0.0282	0.1356 0.4670	0.2788 0.1288	0.5093 0.0034	0.2815 0.1251	1.0000	
MG4	-0.0607 0.7455	0.2916 0.1115	-0.1438 0.4403	0.3185 0.0807	0.1438 0.4404	-0.1770 0.3407	-0.1642 0.3773	0.1154 0.5365	-0.2360 0.2012	1.0000
FG1	0.1737 0.3500	-0.0132 0.9437	0.2448 0.1844	-0.0801 0.6683	0.1874 0.3127	0.4217 0.0181	0.3153 0.0840	0.2888 0.1150	0.1398 0.4533	-0.3821 0.0339
FG2	0.0739 0.6927	0.2850 0.1202	-0.1947 0.2940	-0.0172 0.9267	0.2232 0.2275	0.5036 0.0039	0.2739 0.1359	0.3269 0.0727	-0.0451 0.8098	0.0089 0.9620
FG3	-0.0749 0.6888	-0.0953 0.6101	-0.1152 0.5373	0.2095 0.2580	0.2152 0.2449	0.1689 0.3637	0.0287 0.8782	0.0884 0.6362	0.2159 0.2434	-0.0107 0.9545
FG4	0.1225 0.5117	0.2627 0.1533	0.0322 0.8634	0.2233 0.2272	-0.1649 0.3754	-0.1241 0.5059	-0.0677 0.7174	-0.0868 0.6426	-0.4751 0.0069	0.1358 0.4662
Ndepend	0.3684 0.0414	0.0126 0.9464	0.0122 0.9482	-0.3106 0.0891	0.2687 0.1438	0.7123 0.0000	0.6161 0.0002	0.6826 0.0000	0.2873 0.1171	-0.1291 0.4887
LSize	-0.3866 0.0317	0.2682 0.1446	-0.0816 0.6627	0.2917 0.1113	0.4004 0.0256	0.2628 0.1531	-0.0291 0.8767	0.1689 0.3637	-0.1533 0.4103	0.0427 0.8197
NCattle	-0.3500 0.0536	0.1381 0.4589	0.2419 0.1899	0.0604 0.7468	0.4061 0.0234	0.2387 0.1959	-0.0617 0.7414	0.2307 0.2117	0.1960 0.2906	0.3514 0.0526
NSales	-0.4646 0.0085	0.1376 0.4603	0.2020 0.2757	0.1005 0.5906	0.4876 0.0054	0.0347 0.8530	-0.1879 0.3115	-0.0013 0.9944	-0.0178 0.9242	0.2620 0.1545

	FG1	FG2	FG3	FG4	Ndepend	LSize	NCattle	NSales
FG1	1.0000							
FG2	0.3011	1.0000						
	0.0998							
FG3	0.2274	0.4323	1.0000					
	0.2186	0.0152						
FG4	0.2115	0.1102	-0.4110	1.0000				
	0.2534	0.5551	0.0216					
Ndepend	0.5454	0.5867	0.2764	-0.0426	1.0000			
	0.0015	0.0005	0.1323	0.8198				
LSize	0.2824	0.4559	0.2556	0.2515	0.1718	1.0000		
	0.1238	0.0099	0.1651	0.1724	0.3554			
NCattle	0.0348	0.0593	0.1299	-0.1894	0.1091	0.2151	1.0000	
	0.8525	0.7513	0.4860	0.3076	0.5591	0.2452		
NSales	-0.1989	-0.0084	-0.0261	-0.1728	-0.1432	0.3018	0.5974	1.0000
	0.2835	0.9644	0.8890	0.3526	0.4423	0.0989	0.0004	