Research Article

Analysis of the Determinants of Household Expenditures in Rwanda

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Abstract

Economists use two different approaches, unitary and collective, to analyze household decisions. The unitary approach ignores the differences between single-person and multi-person households, whereas the collective approach states that each person in the household must be characterized by specific preferences. The household's decisions concern mainly the allocation of their income to current consumption or for savings and future consumer expenditures. This study uses the Comprehensive Food Security and Vulnerability Analysis (CFSVA) data collected from a random sample in 2015 in Rwanda. The ordinary least squares (OLS) method was applied to a linear regression model to estimate the household demand functions (total household consumption expenditures, household food consumption expenditures and household nonfood consumption expenditures). The results show that the socioeconomic characteristics of the household, the possession of productive assets and wealth conditions as well as the household locational controls are among the primary drivers of its consumption expenditures. The findings highlight the policy efforts that improve household human capital (education, health), access to and capitalization of productive assets and financial capital, continuous urbanization of rural areas, and sustained provision of quality infrastructure, to achieve high standards of household welfare.

Keywords: Household Consumption, Income, Demand, Multivariate Model, Rwanda.

1. Introduction

Consumption expenditure has been for long the preferred measure of household living standards, inequality, and poverty in the developing world (Deaton, 1997). Households act in housing and allocate their disposable income to current consumption or for savings and future consumer needs (Cismas et al., 2010). Using consumption growth to measure material wealth follows the argument that income likely underestimates the material wealth of households in the context of developing countries (Deaton & Zaidi, 2002). At the household level, the total expenditure expresses the use of revenues, which are normally used for consumption or for household savings. Total expenditures include money spending regardless of its destination (consumption, taxes and binding payments, birds and animals acquisitions, buildings and land, other investment costs, etc.), the value of benefits (goods and services) free or reduced price evaluated at the sale price of the bidding part, as well as the value of food and non-food consumption from own resources determined from the monthly average prices of those products (Cismas et al., 2010). Consumption has been chosen as a good indicator of household wealth because the current income is typically vulnerable to temporary

fluctuations due to factors such as layoffs or changes in family status which cause current income to vary more than consumption (Cutler & Katz, 1991). The main components of household consumption expenditures are food or non-food items, services, and transfers to public and private administration and to social security budgets in the form of taxes, levies, contributions, and coverage of domestic production related needs. Another component is an expenditure incurred for the portion of food and drink purchased for consumption, which are not consumed in the reference period, which remain in stock, which are being processed or are processed as animal feed (Cismaş et al., 2010).

According to economic theory, consumer income is the primary determinant of consumption (Keynes, 1937; Vaish, 2010), but at microeconomic level, other factors may influence the demand for goods and services such as the price of the good or service, the prices of the related commodities, the consumer's own tastes, the number of buyers, the information about the use of the commodity, government rules and policies, expectations, age, weather conditions, and the reference group. The relationship between these factors and the demand is described by a demand function (McConnell & Bruce, 2005; Dwivedi, 2006; Schiller, 2006; Nicholson & Snyder, 2011; Perloff, 2008; Varian, 2010; Besanko & Braeutigam, 2011; Griffiths & Wall, 2011; Samuelson & Marks, 2012). Specifically for households, their demand is influenced by several factors such as income, education, age, gender (of the household head and other household members), weather conditions, location, tastes and preferences as well as the household size (among other factors).

The size of food expenditures can be used as a welfare indicator (Zimmerman, 1932). It has been observed that in poor households, the share of household income allocated to food stuffs increases with the increase in income (Maki & Ohira, 2014; Maki & Kamwe, 2012). A household is food secure when the Engel coefficient for food reaches its peak and starts declining (Maki & Ohira, 2014). It was also observed that when the standard of living is still low, the household's need is to satisfy the most urgent needs of living, namely food, clothing and home, and in this line, households will focus on non-essential goods such as leisure, transport, communication and vacations when they decide to improve living standards (Cismaş et al., 2010).

Most countries in Sub-Saharan Africa (SSA) score very low saving rates and per capita gross domestic product. The main issue in Rwanda is that the spectacular imbalances between income per capita and expenditure per capita are observed as described in Figure 1. Even though the difference between income per capita and expenditure per capita is significantly low, this difference is predominantly negative (see World Development Indicators for Rwanda). Besides, Heshmati and Rashidghalam (2018) identified the differences between consumption and income measures of poverty in Rwanda. By means of income, head count absolute poverty is above 0.80 in all districts, whereas the absolute poverty by means of consumption is 0.531 on average. The question comes hereby to know the sources of different trends in income and consumption and their implications for food security across districts and regions in Rwanda.

It is expected that the results of this study will be used by policy makers, the heads of households while planning for household expenditures, and social workers while sensitizing communities on welfare improvements. Knowing the main determinants of household expenditures, decision makers know where more efforts are needed to improve household welfare conditions. Similarly, households are informed about the factors that affect their consumption decisions and how they learn how to deal with each factor to achieve high standards of living. In regards to researchers, this study contributes to the set of knowledge related to household welfare economics in Rwanda.

This study aims specifically to identify the factors that are associated with consumption expenditures among households. Even though the demand analysis among households has attracted many researchers across the world, this was not the case in Rwanda. This study is very important because documentation on the determinants of consumption expenditures among Rwandan households is scarce. It therefore avails the knowledge on the factors affecting the decisions of households on their expenditures.

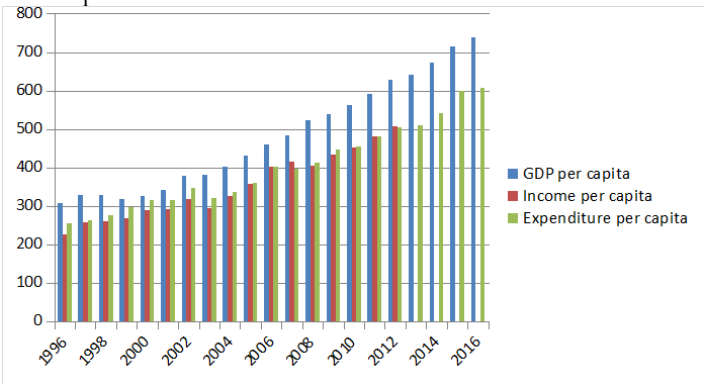

Figure 1. Comparison between GDP per capita, income per capita, and expenditure per capita in Rwanda (1996-2016).

2. Research Method

This study used the Comprehensive Food Security and Vulnerability Analysis (CFSVA) survey data collected from a random sample of 7,500 households at national level in 2015 in Rwanda.[1] The EICV4 was used to estimate the price of basic food items at the district level. Fresh beans, fresh maize, banana for cooking, banana fruits, green vegetables, cassava for cooking, cassava for flour, cassava leaves, and avocado are among the nine food products herewith considered. Since a large number of variables were being dealt with, a principal component indices to minimize data dimensions and cope with multicollinearity without losing any variables was computed: the socioeconomic index was calculated using household socioeconomic characteristics (age, gender, education, household size, marital status, and polygamy status), land index calculated from variables related to land and agriculture (land size, land consolidation, number of crops, maize, vegetable garden, and farm cooperative membership), and distance index calculated to account for the distance between the household and community facility (distance to all-weather road, distance to nearest market, and distance to nearest health facility), with all other variables in the model remaining constant. For analytical purposes, an ordinary least squares estimator was applied with robust standard errors to account for potential heteroskedasticity that is common in most cross-sectional data (Wooldridge, 2013). The linear regression model for examining household spending was developed according to Gujarati and Porter (2010) as per the Equation (1).

$$C_i = \alpha + \sum \beta_k X_{ki} + \varepsilon_i \qquad (1)$$

where *C* stands for the monthly household expenditures while the subscript *I* indexes a sampled household; j is the number of observations of an individual household *I* for each dependent variable; *Xs* denote the vectors of independent variables; *β* represents the vector coefficients; the intercept *a* represents the expected value of *C* when the effect of observed variables is equal to zero.

For the purposes of this study, three household demand functions have been estimated: total consumption expenditure function, food expenditure function, and non-food expenditure function. Given that, the three dependent variables depended on one set of independent variables, a multivariate regression approach was used to estimate the coefficients of these functions (Johnson & Wichern, 2004; 2015) using the ordinary least squares (OLS) method. The results are reported in Table 2 in the section on Results and Discussion.

Household expenditures were selected as the dependent variable of the models because consumption is considered in economic literature as the main indicator of wealth and food security for households, specifically in developing countries (Dercon et al., 2009; Islam & Maitra, 2012). All variables selected for this study are described in Table 1.

Table 1. Definitions and descriptive statistics of study variables.

Variables	Obs.	Mean (Std. Dev.)	Description
Household total expenditures	7500	72,770.2 (186,305.7)	Household monthly per capita expenditures in Rwandan francs
Household food expenditures	7500	27,476.7 (44,738.75)	Household monthly per capita food expenditures in Rwandan francs
Household non-food expenditures	7500	45,293.5 (157,748.7)	Household monthly per capita non-food expenditures in Rwandan francs
Household size	7500	4.9304 (2.19291)	Number of the household members
Age	7500	47.26907 (15.23251)	Age of the household head in years
Gender	7500	0.26933 (0.44364)	Gender of the household head (equals 1 if female, and 0 otherwise)
Education level of the head	7482	2.35352 (1.48485)	Education level of the household head

See NISR (2016) for full information about the detailed sampling procedure of the Comprehensive Food Security and Vulnerability Analysis of 2015 (CFSVA, 2015).

Marital status	7500	0.5608 (0.49632)	Marital status of the household head (1 if married, 0 otherwise)
Polygamy	5173	0.04408 (0.20528)	Polygamous household head (1=yes, 0=no)
Livelihood sources	7500	1.71267 (0.67154)	Number of livelihood activities done by the household
Livestock	7500	0.49061 (0.94167)	Number of animals measured in TLU (Tropical Livestock Units)
Poverty status	5847	0.86095 (0.34602)	Poverty category (equals 1 if poor, 0 otherwise)
House occupancy	7500	0.90373 (0.29498)	House ownership (equals 1 if owner of the house occupied, 0 otherwise)
Loan access	7481	0.20225 (0.40170)	Household's access to credits (1=yes, 0=otherwise)
Remittances	7500	1.572759 (11.5945)	Transfers in US dollars received from other nations
Non-farm income	7500	10.03024 (21.42805)	Proportion of total income (percentage of the total income)
Price	7500	165.074 (23.42267)	Selected food items' average price (at the district level)
Land size	7500	2.26213 (1.86469)	Cultivated land in acres
Consolidation	5450	0.19780 (0.39838)	Land consolidation (equals 1 if part of total land is consolidated, 0 otherwise)
Crops	7500	2.17813 (1.44767)	Numbers of crops reported by the household
Maize	7500	0.35867 (0.47964)	Equals 1 if the household grow maize, 0 otherwise
Vegetables garden	7500	0.62280 (0.48472)	Equals 1 if the household owns a vegetables garden, 0 otherwise
Land ownership	7500	0.72773 (0.44516)	Land ownership (equals 1 if the household owns land, 0 otherwise)
Membership	5986	0.15586 (0.36276)	Membership of an agricultural cooperative (equals 1 if member)
Livelihood zone	7500	4.97733 (3.31818)	Agro-ecological zone (agro-climatic conditions and production of specific crops)
Urban	7500	0.17200 (0.37741)	Location (1 if urban, 0 if otherwise)
District	7500	320.4333 (131.9971)	District
Distance to all weather road	7500	1.52133 (0.74585)	Distance from the village to all weather road (in kilometres)
Market distance	7490	2.79439 (0.91598)	Distance from the village to the nearest market (in minutes)
Health facility distance	7490	2.57944 (0.84167)	Distance from the village to the nearest health facility (in minutes).

Source: Computed by the authors using CFSVA 2015 data.

3. Results and Discussion

3.1. Results from the econometric analysis

Table 2 shows the econometric estimates of linear regression analysis for the three models utilizing total consumption expenditures, food expenditures, and non-food expenditures as dependent variables. The findings revealed that a household's socioeconomic characteristics, the number of sources of income, the number of animals kept (livestock), access to credit, non-farm income, land factors, and locational factors (urban, and district) all have a significant but

positive impact on household expenditures. This means that as these parameters, indices, and variables rise, household expenditures rise as well. Poverty and the distance index, on the other hand, have a negative but significant impact on household spending. The results reveal that while price has a positive and substantial impact on household food expenditures, it has a negative but substantial impact on non-food expenditures. Surprisingly, remittances have a negative and large impact on household expenses.

Table 2. Estimates from linear regression: Total household expenditures, household food expenditures and household non-food expenditures are dependent variables.

Variables	Estimates of regression					
	Total expenditures		Food expenditures		Non-food expenditures	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
Socioeconomic index	0.149***	0.014	0.125***	0.014	0.172***	0.018
Livelihood sources	0.068***	0.022	0.135***	0.021	-0.006	0.028
Livestock	0.144***	0.016	0.051***	0.013	0.221***	0.021
Poverty	-0.696***	0.029	-0.561***	0.029	-0.874***	0.038
House occupancy	0.122	0.079	0.044	0.074	0.188*	0.102
Loan access	0.618***	0.031	0.369***	0.030	0.860***	0.042
Remittances	-0.009***	0.003	-0.008***	0.003	-0.008**	0.003
Non-farm income (share)	0.009***	0.001	0.006***	0.001	0.013***	0.001
Price	-0.00001	0.001	0.001**	0.001	-0.002**	0.001
Land index	0.075***	0.014	0.026*	0.014	0.125***	0.018
Distance index	-0.055***	0.014	-0.052***	0.014	-0.068***	0.017
Livelihood zone	0.004	0.006	0.007	0.006	-0.002	0.008
Urban	0.704***	0.057	0.647***	0.053	0.714***	0.074
District	0.001***	0.000	0.0004**	0.0002	0.001***	0.000
Constant	9.621***	0.138	8.722***	0.133	8.915***	0.181
Observations	5426		5403		5412	
R-square	0.34 [a]		0.23[a]		0.34[a]	
F-statistic	202.42		121.61		206.31	
Prob > F-statictic	0.00		0.00		0.00	

*Note: *, **, and *** mean significance level at 10 per cent, 5 per cent, and 1 per cent, respectively. [a] As cross-section data are herewith used, R-square is considered significant (Wooldridge, 2002). The dependent variables -- household expenditures -- are log transformed. The standard errors presented are robust.*

In a similar way, household demand functions were calculated using disaggregated determinants but not principal component indices (see the econometric estimations in the Table A1 in Appendix A). For the total demand function, the results allowed for the identification of household size, household head's education level, livestock units, house occupancy, loan access, non-farm income, land size, land consolidation, maize, cooperative membership, and location (livelihood zone, urban, district) as the most important positive factors of family expenditures, whereas the age, the gender (female), the poverty status, the remittances, the possession of a vegetables garden, and the distance to basic facilities (road, health facility) have significant but negative effect on total household expenditures. The results of econometric estimations for the food demand function revealed that household size, the household head's education level, livestock units, access to credit, non-farm income, the price of major food products, land size, and location (livelihood zone, urban, district) are the main determinant factors affecting household food expenditures. In contrast, the age and gender of the household head, poverty status, and distance to the nearest essential amenities (all-weather road, health facility) were revealed to be important negative variables. The household size, the household head's education level, the livestock units, the house occupancy, the access to loan, the non-farm income, the land size, the land consolidation, the number of crops grown by the household, maize, cooperative membership, and the location (urban, district) were all factors in the demand function for non-food products. The gender of the household head, the livelihood sources, the poverty status, the price of main food products, and the distance to the

community facilities (road, health facility) were reported among the primary determinants with negative effect on household non-food expenditures.

3.2. Tests for robustness of econometric estimates

By modelling demand functions for poor and non-poor families, the results were assessed and found to remain consistent (see the results in Table 3). The socioeconomic index (a composite index of land and agricultural aspects), the number of livelihood sources, the number of animals held (livestock), the access to loan, non-farm income, land index (a composite index of land and agricultural aspects), and locational factors (urban, district) were all found to be significant determinant factors of the household total demand function. The findings revealed that disadvantaged households in some regions are better able to smooth their spending than in others.

Table 3. Robustness test. The OLS estimates.

The dependent variable is the total household expenditures for poor and non-poor households, respectively.

Variables	**Estimates of linear regression (Poor households)**	**Estimates of linear regression (Non-poor households)**
Socioeconomic index	0.137*** (0.019)	0.169*** (0.022)
Livelihood sources	0.104*** (0.030)	0.050* (0.030)
Livestock	0.158*** (0.036)	0.139*** (0.018)
Poverty	--	--
House occupancy	0.163 (0.106)	0.040 (0.115)
Loan access	0.558*** (0.046)	0.650*** (0.041)
Remittances	-0.011*** (0.003)	-0.004 (0.007)
Non-farm income (share)	0.005*** (0.002)	0.011*** (0.001)
Price	0.0001 (0.001)	-0.001 (0.001)
Land index	0.085*** (0.019)	0.073*** (0.020)
Distance index	-0.026 (0.019)	-0.083*** (0.019)
Livelihood zone	0.008 (0.009)	0.003 (0.009)
Urban	0.319*** (0.091)	0.788*** (0.068)
District	0.001*** (0.000)	0.0002 (0.0002)
Constant	8.671*** (0.183)	9.933*** (0.204)
Observations	2659	2767
R -square	0.15	0.25[a]
F-statistic	31.91	70.71
Prob > F-statistic	0.00	0.00

*Note: *, **, and *** mean that the estimated coefficient is significant at the level of 10 per cent, 5 per cent, and 1 per cent, respectively. The dependent variable is log transformed. [a] The reported R-square is considered significant as cross-section data are used (Wooldridge, 2002). The standard errors presented are robust.*

The estimation of protein consumption was used as an extra test for robustness (see Table 4). This was driven by the fact that protein is rarely found in poor people's diets (Rawlins et al., 2014). The estimates show that the socioeconomic

index (age, gender, education, household size, marital situation, and polygamy status), the number of livestock units, the share of non-farm income, and the livelihood zone where the household operates all have a positive impact on the likelihood of a household consuming protein. The household's poverty status, as well as the distance to basic infrastructure, have a negative impact on this probability.

Table 4. Additional robustness test.

The binary logit estimates. The dependent variable is the consumption of protein.

Variables	**Coefficients (Std. errors)**	**Odd ratios (Std. errors)**
Socioeconomic index	0.198*** (0.066)	1.219*** (0.080)
Livelihood sources	-0.235** (0.105)	0.791** (0.083)
Livestock	1.049*** (0.181)	2.855*** (0.516)
Poverty	-1.244*** (0.171)	0.288*** (0.049)
House occupancy	-0.330 (0.358)	0.719 (0.257)
Loan access	0.029 (0.177)	1.030 (0.182)
Remittances	0.010 (0.008)	1.010 (0.008)
Non-farm income (share)	0.018** (0.007)	1.018** (0.008)
Price	0.005 (0.004)	1.005 (0.004)
Land index	0.001 (0.066)	1.001 (0.066)
Distance index	-0.145** (0.065)	0.865** (0.056)
Livelihood zone	0.202*** (0.029)	1.224*** (0.036)
Urban	0.476 (0.340)	1.610 (0.547)
District	-0.002*** (0.001)	0.998*** (0.001)
Constant	2.995*** (0.760)	19.981*** (15.191)
Observations	5434	
LR chi2	313.37	
Prob > chi2	0.00	

, **, and * mean that the estimated coefficient is significant at the level of 10 per cent, 5 per cent, and 1 per cent, respectively.*

3.3. Discussion of the findings

The main results from econometric estimations in Tables 2 and A1 show that the socioeconomic characteristics are very important drivers of household expenditures (here the household size, the age of the household head, and education level of the household head). This finding is in line with the findings of Donkoh and Amikuzuno (2011), Umeh and Asogwa (2012) and Nilsson et al. (2019) who reported the age and education of the household head as well as the household size[2] among the determinants of household expenditures but is in contrast with Davis et al.'s (1983) finding that the education has no significant impact on household education expenditure. These results are reflective of the vital importance of household control factors in their demand decisions.

The family size has been identified as the main determinant of the household consumption expenditure on electricity (see Hussain & Asad, 2012).

The findings also revealed that having productive assets (livestock units, land size) and financial resources (access to credit, non-farm income share) have a substantial impact on household demand. This result supports the findings that the land size (Umeh & Asogwa, 2012), possession of durable assets (Donkoh & Amikuzuno, 2011), the house size (Hussain and Asad, 2012), the household income and wealth (Davis et al., 1983; Khan & Abdullah, 2010; Umeh & Asogwa, 2012; Wang et al., 2016) and the number of livestock units (Nilsson et al., 2019) are among the factors that significantly affect household expenditures. This is reflective of the importance of possession of productive assets, financial capital, productive and high wage employment, and income and wealth status to household demand behaviour.

This study found that locational factors are very important determinants of household expenditures. This finding supports Donkoh and Amikuzuno (2011) who underlined that locality is among the factors that significantly underlie the household expenditures on education. It is also in line with Hussain and Asad's (2012) finding that urban households expend more on electricity than rural ones and that of Bopape and Myers (2007) who reported that food consumption decisions differ remarkably between rural and urban households. This reflects that the urbanization process of rural areas and the provision of basic infrastructure are very important to improve the welfare conditions of households.

The results show that as the average price of food products rise, household food expenditures rise as well, a finding that is consistent with Cismaş et al.'s (2010) assertion that the average price is one of the primary factors determining the value of food and non-food products consumed in households. The negative effect of average food prices on non-food expenditures is explained by cross price elasticity (Schotter, 2008; Varian, 2010; Besanko & Braeutigam, 2011), which states that an increase in food products (or necessities) causes households to reduce non-food product consumption to maintain the same level of food consumption.

Another critical finding is the effect of locational factors specifically the distance to a health facility, distance to a market and the household location in an urban area on the household consumption decisions. This follows the finding of Maniriho and Nilsson (2018) that proved positive and significant effect of the urbanization process of urban areas on the diversification of livelihood sources, and Nilsson et al. (2019) who underlined the negative and significant effect of the distance to asphalt road on household consumption expenditures.

4. Conclusion

Consumption expenditure has been a good indicator of household wealth and welfare conditions especially in developing countries. The salient argument behind this is that income measures tend to underestimate the material wealth of households. The analysis of household consumption expenditures has interested a significant number of researchers all around the world, but it has not been the case in Rwanda where the documentation on the factors impacting household consumption decisions is still limited. This study attempted to identify the determinants of household consumption expenditures in Rwanda. A multivariate regressions model was specified, and three demand functions were hereby estimated -- total household demand function, food demand function and non-food demand function -- using ordinary least squares (OLS) method.

The results indicate that an increase in household size and education level of the household head lead to an increase in household consumption expenditures, while the increase in age of the household head makes the household expenditures decrease (Tables 2 and A1). For household wealth indicators and possession of productive assets, the higher the number of livestock units, the land size, and the access to credits, and the share of non-farm income, the higher the level of household consumption expenditures.

For locational control factors, the results highlight that being in urban areas affects positively and significantly household expenditures, while the distance to improved road, a market and a health facility negatively affects the household expenditures, which means that household consumption is higher in urban rather than in rural areas. In addition to this, it was reported that the number of livelihood activities done by household members, land consolidation and maize production affect positively household demand decisions, while the distance to all weather roads and a health facility have negative effects on household consumption expenditures.

The findings show that the most significant factors affecting household demand decisions are household size, the age of the household head, the education level of the head, the number of livestock units, poverty situation, the access to credits and the size of cultivated land. In addition, the results revealed that most of these factors apply to both poor and non-poor households, as well as for households in both rural and urban areas. The logit estimates revealed that household socioeconomic characteristics, livestock ownership, and non-farm income share are among the key variables that may enhance the likelihood of families consuming protein-rich foods.

Bearing in mind, the effect of each individual factor discussed above, the econometric estimations are reliable for policy review or formulation. Therefore, it is recommended that policy design or review to scale up the wealth and welfare conditions of a household should refer to the effects of the socioeconomic indicators, wealth and market factors, productive assets as well as the locational factors on household demand decisions.

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