UDS International Journal of Development [UDSIJD]
Volume 5 No. 1, June, 2018
http://www.udsijd.org
ISSN: 2026-5336

WHAT DRIVES PURCHASE DECISIONS OF CUT FLOWER CONSUMERS?

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Abstract
Notwithstanding the benefits of and prospects for consumption of cut flowers, the low consumption and the dearth in the literature on the drivers of cut flower purchase decisions in some developing countries, necessitated the identification of the reasons for non-purchase of cut flower and the drivers of cut flower purchase decisions. Using fractional regression modelling and selecting the cauchit link function based on battery of empirical tests some findings were made. Lack of interest, inadequate knowledge, and high prices of cut flowers are reasons for non-purchase of cut flowers. Monthly income, roses, redbronze and yellow coloured cut flowers drive cut flower purchase decisions. These results call for prioritising roses, with more red coloured flowers for sale. The need for producers and sellers to minimise production cost and put up competitive product prices are recommended. Finally, the selection of the cuachit link function in the binary choice modelling suggests the need to explore link functions other than probit and logit link functions.

Keywords: **Binary models, cuachit, cut flowers, ornamentals, purchase decision**

Introduction

Cut flowers such as roses, lilies, orchids and many more that have varied colours including redbronze, peach pink and yellow are for beautification purposes or given as an expression of love, friendship, gratitude, or appreciation (Palma & Ward, 2010; Palma *et al.*, 2011; Yue & Hall, 2010; Asiedu, 2014; Li *et al.* 2016). These uses are observed on social occasions, in places of worship, in homes, public places and streets, for decoration (Palma *et al.*, 2011; Steen, 2014). In all these, the principal value of cut flowers is derived from its aesthetic value (Palma *et al.*, 2011; Palma & Ward, 2010; Asiedu, 2014; Steen, 2014). The realisation of these benefits is contingent on use, arising from purchase, gift or cultivation (Huang & Yeh, 2009; Crittenden & Crittenden, 2014; Hálová, 2015; Li *et al.*, 2016). However, due to environmental conditions and other reasons, cut flowers are not available in every location where they are required. Marketing and trade thus provide customer value or utilities desirable by consumers.

The export of cut flowers from Ghana was valued at less than US$ 30,000 in 2010 with no appreciable growth as at 2016, whilst imports were more than ten times the export value (COMTRADE, 2017). Thus, total trade is driven by imports. The augmentation of imports for national consumption is a pointer to prospects for the consumption of cut flowers in Ghana. The prospects for cut flower consumption notwithstanding, consumption remains low (Asiedu, 2014; Deloitte, 2016; International Trade Centre, 2016; COMTRADE, 2017) with associated negative effects on the country. The low patronage deprives many inhabitants the benefits to be derived from cut flowers. There is loss of revenue to producers of cut flowers, loss of employment and consequently loss of tax revenue to central government. In the light of these, we pose the following questions; what reasons account for low consumption of cut flowers? How can the consumption of cut flowers be increased? To address these questions, we identify the reasons for non-purchase of cut flowers and the drivers of cut flower purchase decisions in Ghana. The importance of cut flowers to many countries has led researchers to investigate ways to increase cut flower consumption and trade (International Trade Centre, 2016). Asiedu (2014) examined the attitudes and habits of cut flowers purchasers in Accra, Ghana whilst Li *et al.* (2016) evaluated the drivers of purchases of cut flowers for gifting and personal use purposes in the USA. Although the former used descriptive statistics, the latter used binary probit analysis. The limitation in these studies is the lack of empirical analyses of drivers of cut flowers purchase using data on purchasers and non-purchasers of cut flowers. Also, Li *et al.* (2016) used binary probit without exploring the use of other link functions in binary choice (Djokoto & Afari-Sefa, 2017). In this article, we evaluate the drivers of cut flower purchase decisions by exploring link functions other than probit. Although determining the drivers of cut flower consumption may appear fundamental relative to studies in other economies, this article is necessitated partly due to the low consumption of cut flowers in the Ghanaian economy (Asiedu, 2014; Deloitte, 2016; COMTRADE, 2017). Moreover, understanding the drivers that influence consumers' choices regarding the purchases of flowers, such as to buy or not to buy, how much to buy, or what kind of flowers to buy, are relevant in increasing sales and consumption (Huang & Yeh, 2009; Crittenden & Crittenden, 2014; Halova, 2015). Whilst this article would be one of the first to address cut flower purchase decisions within the framework of binary choice multiple link functions, the results would be relevant for production, marketing strategy and trade policy. The rest of the article is sectioned into three. The next section presents the data and empirical models. Section three presents and discusses the results. Conclusions and recommendations constitute section four.

Literature Review

In this section, we provide an overview of the cut flower industry, covering the global, African and the Ghanaian context. Owing to the dearth in the literature on drivers of cut flower purchase decisions, the empirical review section focuses on the studies on cut flowers in Ghana (Asiedu, 2014), from a descriptive perspective and that on the drivers of cut flower purchases for different purposes in the State of Washington, in the US (Li *et al.*, 2016).

Global Floral Industry

The floral market composed of producers, traders and consumers, is an enormous industry with global production of cut flowers estimated at US$ 55bn (Rabobank, 2016). The lucrative floral industry is driven by countries such as the Netherlands, United States, UK, France, Greece and Germany, in which the industry contributes significantly to the agricultural sector (International Trade Centre, 2017). The Dutch floral market is known to be a market leader in the world, operating on a global scale with an increasing number of turnovers based on international activities. Total export grew by 4.1% from 5.7 billion euros in 2002 to 5.9 billion euros in 2004. Netherlands controlled 50% of the export market in 2005 (COMTRADE, 2017; Royal FloraHolland, 2016; Rabobank, 2016). By 2015 however, Netherlands had lost as much as 7% of its share of the export market to countries such as Columbia, Kenya, Ecuador and Ethiopia. These 'rising four' now control 44% of the global cut flower exports, surpassing Netherlands in 2015, and rising from 25% in 2005.

Regarding types of cut flowers, COMTRADE (2017), Royal FloraHolland (2016) and Rabobank (2016), noted that while roses are the main cut flower traded by these four countries, Colombia has a relatively diversified product range and is also the largest exporter of chrysanthemum and the second largest global exporter of carnations in the world. Further, despite low production costs, a favourable climate, large farm size, and increasing efficiency and quality, it remains challenging to grow cut flowers in these countries.

Africa's Floral Industry

Two African countries are among the 'rising four' noted earlier; Kenya and Ethiopia (COMTRADE, 2017; Royal FloraHolland, 2016; Rabobank, 2016). Kenya's cut-flower industry has been praised as an economic success as it contributed an annual average of US$ 141 million in foreign exchange (7 % of Kenya's export value) over the period 1996–2005 and about US$ 352 million in 2005 alone. The industry also provides employment, income and infrastructure such as schools and hospitals for a large population around Lake Naivasha (Mekonnen *et al.*, 2012). As most African countries are exporters of agricultural products (COMTRADE, 2017), the growing exports of Kenya and Ethiopia are fuelled by production. Kenya Flower Council (KFC), an umbrella body of corporate flower producers boasts of 150 companies that produce 120,000 tonnes of flowers a year (Mulupi, 2012). There are however, out-growers with one company in partnership with more than 2,500 small-scale growers, who grow field flowers. The flower industry employs 90,000 people directly and about 500,000 indirectly. In 2011, the industry fetched US$ 540m (Mulupi, 2012). The major flower varieties grown and exported from Kenya are roses, carnation, alstroemeria, lisianthus, statice and cut foliage. Rose flower dominates the export market, accounting for over 70 % of the export volume (HCDA, 2007; Mekonnen *et al.*, 2012). The main flower growing regions are Lake Naivasha, Thika and Kiambu/Limuru (EPZA, 2005), with Lake Naivasha accounting for about 95 % of the cultivated area. The operators in these flower growing areas are mostly corporate firms. The small-scale farmers grow other types of flowers that do not require capital intensive investments and the kind of technology corporate firms need. These smallholders are also key in supplying the local market (Mulupi, 2012).

Ethiopia's cut flower export was negligible until 2003, but it has drastically increased since 2004, from an export value of US$ 2 million to US$ 104 million in 2008. In 2011/12, the country earned around US$ 170 million by exporting more than 1.7 billion cut flowers, produced by 80 flower farms (Hassen, 2016). At the close of 2016, Ethiopia which accounts for 9% of global flower exports, is the second largest exporter of cut flowers in Africa, and has great prospects for increased export volumes (Mano *et al.*, 2011; Rivers, 2015; Rabobank, 2016; Mengistie *et al.*, 2017).

It must be noted that, the State farms of Ethiopia started to export cut flowers to Europe in 1980 (Embassy of Japan in Ethiopia, 2008), but the rapid development of this sector is originally due to the attempts by several private cut flower farms, which began operation in the early 1990's (Gebreeyesus & Iizuka, 2012). These farms included both foreign and domestic farms. The flower industry in particular increased employment for many in the labour market whilst women account for 75 percent of the workforce in Ethiopian flower farms (Beyene, 2014).

Ghana's Floral Industry

The floral industry has been widely acclaimed and popularised in most western countries. However, unlike the culture and traditions of the Western countries, the concept of purchasing flowers is less appreciated in Ghana, hence, consumption of flowers by the Ghanaian can be said to be low (Asiedu, 2014; Deloitte, 2016). Nevertheless, cut flowers are becoming important in Ghana's economy. Deloitte (2016) notes that exports of cut flowers and fresh vegetables were practically non-existent in 2003 but appeared in the top five exports of the country by 2012. Based on data from COMTRADE (2017), Ghana exports far less than she imports cut flowers. Hence, unlike in Columbia, Ecuador, Kenya and Ethiopia, total cut flowers trade is largely influenced by huge imports (COMTRADE, 2017; Royal FloraHolland, 2016; Rabobank, 2016). Not only does the trade deficit in favour of imports shows that local cut flower producers have a large market opportunity, it also signals potential for cut flower vendors. The key players in the domestic trade of cut flowers in Ghana are Unique Floral, Jandel, Alpha Beta Flowers and New Dawn Floral Shop (Asiedu, 2014). These companies tend to focus on a target group of consumers who can afford to buy flowers; be it for personal use or gifting. Prospects for cut flower looks good, as Ghana is considered as one of the growing African countries with a growing middle-income class (Deloitte, 2012; Asiedu, 2014). The attendant exposure to western concepts especially regarding the purchase and use of natural floral products i.e. cut flowers and ultimately being able to back their purchases with money, holds promise for cut flower consumption. Further, the growing middle-class also offers market and sales opportunities for cut flower vendors (Deloitte, 2012).

Empirical Review

Asiedu (2014) studied the attitude and habits of the middle-income persons to buying cut flowers in Accra, Ghana. Fifty-nine percent of the respondents were aged between 25 and 50 years. Whilst 79% purchased cut flowers, the other 21% did not purchase cut flowers. The preferred types of flowers were Lilly, Roses, Orchid, Tulips and others. Respondents were deterred from purchasing cut flowers because of poor product quality, less knowledge in caring for product, poor product packaging, lack of proximity to floral shops and high pricing (Asiedu, 2014). It is worth noting, that those who were deterred by price constituted only 8% of the respondents.

Li *et al.* (2016) identified factors influencing Washington State consumers' purchase decisions for cut flowers, separating the analyses into flowers purchased for personal use and for gifting. The data on the 466 respondents collected in 2012 showed that 60% of the respondents were aged between 18 and 50 years, 26% were male whilst 68% had at least high school education. Fifty-three percent of respondents earned annual income below US$ 50, 000. Li *et al.* (2016) found that respondents who purchased cut flowers for use as gifts were more likely to be males, had higher educational levels, used direct access to food products and valued uniqueness of cut flowers. In the case of the purchases of cut flowers for personal use however, these were found more likely to be married people who had comprehensive knowledge about how to make cut flowers last longer. The evaluation of consumer cut flower purchase decisions, for personal and gift use resulted in information useful in identifying market opportunities for cut flower use, as well as barriers for Washington producers. It is important to note, that, Li *et al.* (2016) used binary probit analysis in their empirical model with data on buyers of cut flowers only.

In the studies reviewed; Asiedu (2014) and Li *et al.* (2016), focused on a city, Accra in Ghana, and the State of Washington in USA, respectively. The former examined attitudes and habits of purchasers using data on purchasers and non-purchasers whilst the latter identified the determinants of choice between gift use and personal use of purchased cut flowers. In terms of analysis, the former used descriptive statistics whilst the latter used binary probit model in addition to the descriptive statistics. The gaps in these studies are an empirical analysis of drivers of cut flower purchases using data on purchasers and non-purchasers of cut flowers. Also, Li *et al.* (2016) used binary probit without exploring the use of other link functions in binary choice. To make up for these gaps, we draw our data from purchasers and non-purchasers of cut flowers in Accra, the capital city of Ghana, and explore link functions other than probit link function, in evaluating the drivers of cut flowers purchases. The need to explore alternative link functions is important as Djokoto & Afari-Sefa (2017) have recently shown that the alternative link functions may be more appropriate than the usual logit or probit.

Materials and Methods

Research Area and Data Collection

Accra, the capital city of Ghana, the first African country south of the Sahara to attain political independence, has a total land area of 173 km^2. Located 5°33′ N and 0°12′ W. Farvacque-Vitkovic *et al.* (2008) put the total GDP of Accra at US$3b. The population is estimated at 2.28m according to Central Intelligence Agency (2015) who engage in many economic activities. Being the capital city, Accra hosts all foreign missions, country and regional offices of international organisations such as the United Nations. Given its capital status, Accra is inhabited by persons of all income classes, although the low and middle income classes dominate.

A sample size of 385 was determined based on the population of Accra in 2012 using sample size calculator[1]. This was grossed up by 10% to make up for possible non-response. The city was segmented into four; east, west, north and central. For each segment, four most busy locations of persons including at least one car park area were chosen. The car park locations ensured that vehicle owners/users who may be 'good' income earners may not be skipped. Through quota sampling, 106 respondents were contacted per the four divisions of Accra. For each division three most busy streets were selected. By each of these, every fourth passer-by was asked to be interviewed or complete a questionnaire that is, using systematic sampling. In all, 400 usable questionnaires were returned.

[1] https://www.surveymonkey.com/mp/sample-size-calculator/

Empirical Model

The decision to purchase or not, consume or not, adopt technology or not and similar problems, are often analysed within the framework of utility theory (Mzoughi, 2011; Greene, 2012; Djokoto *et al.*, 2016; Li *et al.*, 2016; Djokoto and Afari-Sefa, 2017). So, we built our empirical model using utility theory.

The expected utility of consumer *i* from purchasing cut flowers can be represented by a random utility model such that:

$$U_i\,(T) = U_i(1) - U_i(0) \qquad 1$$

Where the utility of not purchasing cut flowers is represented by U (0), the utility gained by purchasing cut flowers is U_i (1) and U_i (T) is the difference between the expected utility for purchasing and not purchasing cut flowers. Although U_i (T) is an unobservable latent variable, the decision to purchase cut flowers is observable.

$$y_i = \begin{cases} 1 & if \quad U_i(T) > 0 \\ 0 & if \quad U_i(T) \le 0 \end{cases} \qquad 2$$

Where y_i = 1 is the consumers' decision to purchase cut flowers. However, the consumer's decision is not independent, rather, it is dependent on some factors; the attributes of the consumer as well as the characteristics of the product (cut flowers, in this case). The cut flower purchase decision can thus be connected to these factors as in equation 3;

$$y_i = x_i\theta + \varepsilon_i \qquad 3$$

Where x_i is a vector of the factors that influence cut flower purchase, θ is vector of parameters to be estimated and ε_i is an error term. The observable variable y_i, is binary; 0 and 1. The transformations of y_i that makes equation 3 estimable are called link functions (Greene, 2012; Ramalho *et al.*, 2011; 2014). It is common to use probit or logit as link functions in binary choice problems. However, Djokoto & Afari-Sefa (2017) have shown that link functions such as loglog, cloglog and cauchit perform better than logit and probit. Consequently, we specify y_i with all five links functions as below, in order to explore all of them. Prior to the specification of the link functions, let

$$E(y\,|\,x) = G(x\theta) \qquad 4$$

where *y* is the dependent variable (binary choice) and *x* are factors that influence cut flower purchase. The conditional expected mean of *y* given *x*, is $E(y|x)$. The link function, G(.), is some nonlinear function satisfying G(.) = 0 or 1. And θ is a vector of parameters to be estimated. The names of the link function, distributions, functional forms with their respective partial effects, as well as estimable forms are specified in Table 1.

Explanatory Variables

The vector *x* are consumer characteristics, and types and colour of cut flowers. Consumer characteristics are *EDUCATION, EMPLOYMENT STATUS, OVERSEAS VISIT, AGE, INCOME* and *GENDER*. Cut flower types are *ROSES, LILIES* and *ORCHID*, whilst colours are *REDBRONZE, PEACHPINK, BLUEPURPLE* and *YELLOW*. *EDUCATION* refers to the level of academic attainment, which are ordinal measures; none = 1, basic = 2, secondary = 3 and tertiary = 4. More formally educated persons are more likely to purchase cut flowers, as they might have learnt about these from schooling, aside of environmental observation. Thus, the sign of the coefficient is expected to be positive. It is expected that gainfully employed persons have additional set of social interaction, thus may have additional persons to appreciate with cut flowers and possibly purchase cut flowers for gifts. Therefore, *a priori,* the sign of the coefficient of *EMPLOYMENT STATUS* should be positive. Respondent ever travelling overseas equals 1 and 0 otherwise. Overseas travel creates exposure to lifestyles including appreciation of cut flowers. Therefore, the sign of the coefficient of *OVERSEAS VISIT* is expected to be positive. *AGE* is defined as number of years since birth, and we coded this as below 18 years =1, 18-25 years = 2, 26-50 years = 3 and above 50 = 4. We expected that the older the respondent, the more likely cut flowers will be purchased. Thus, the coefficient is expected to be positively signed.

We defined *INCOME* as monthly income of respondents. More income means more resources to spend and the respondents are more likely to purchase cut flowers. Thus, we expect the sign of the coefficient of *INCOME* to be positive. *GENDER* is defined as male =1 and 0 otherwise. We expect females to appreciate cut flowers more than males, and are more likely to make purchases more than males. However, males could also purchase cut flowers as gifting to females. Thus, we were unable to make *a priori* specification for the sign of the coefficient of *GENDER*.

Table 1: Alternative Nonlinear Conditional Mean Specifications for Binary Response Variables

Model	Distribution function	$G(x\theta)$	$g(x\theta)=\frac{\partial G(x\theta)}{\partial x\theta}$	*Partial derivative*
Logit	Logistic	$\frac{e^{x\theta}}{1+e^{x\theta}}$	$G(x\theta)[1-G(x\theta)]$	$\ln G(x\theta)-\ln[1-G(x\theta)]$
Probit	Standard normal	$\Phi(x\theta)$	$\Phi(x\theta)$	$\Phi^{-1}(G(x\theta))$
Loglog	Extreme maximum	$e^{-e^{-x\theta}}$	$e^{-x\theta}G(x\theta)$	$-\ln[-\ln(G(x\theta))]$
Complementary loglog	Extreme minimum	$1-e^{e^{x\theta}}$	$e^{x\theta}[1-G(x\theta)]$	$\ln[-\ln(1-G(x\theta))]$
Cauchit	Cauchy	$\frac{1}{2}+\frac{1}{\pi}\arctan(x\theta)$	$\frac{1}{\pi}\frac{1}{(x\theta)^2+1}$	$\tan[\pi(G(x\theta)-0.5]$

Source: ***Papke & Wooldridge (1996) and Ramalho et al. (2010)***

We assigned 1 each time the cut flower type most preferred was *ROSES* (*Rosa spp.*)*, LILIES* (*Lilium spp.*) or *ORCHID* (*Bulbophyllum spp.; Epidendrum spp.; Dendrobium spp.; Pleurothallis spp.*) and 0 otherwise.
The reference types were others; namely, *CHRYSANTHEMUMS* (*Chrysanthemum spp.*), *CARNATIONS* (*Dianthus spp.*), *BEAR GRASS* (*Xerophyllum spp*) together. The preference could swing in any direction; thus we did not assign any sign *a priori*. A respondent that preferred *REDBRONZE, PEACHPINK, BLUEPURPLE* and *YELLOW* was assigned 1 and 0 otherwise. The reference colour was *WHITE*. As in the case of cut flower type, the preference could swing in either direction, thus we did not assign any sign to the coefficient *a priori*.

Estimation
As noted earlier, Logit and probit link functions have been used in choice modelling problems. However, Djokoto & Afari-Sefa (2017) have shown that other link functions may perform better than logit and probit. Thus, in this study, we select from five link functions including logit and probit. We used Fractional Regression Modelling (FRM) to estimate the equations as the dependent variable is at boundary of the unit interval; 0 and 1. Although the FRM could be estimated by Quasi Maximum Likelihood (QML) (Papke & Wooldridge, 1996), Ramalho *et al.* (2010) proposed the use of Nonlinear Least Squares (NLS) or Maximum Likelihood Estimation (MLE), noting that the NLS was less efficient than QML estimation whilst the MLE was more efficient than both the QML and NLS. We used *frm* code for the estimations (Ramalho, 2014).

Tests and functional form selection
As noted earlier, although logit or probit was chosen *a priori* in binary choice modelling, opportunities existed for selecting between the two. Indeed, since in this article we explored three additional link functions, statistical methods of selection offered a viable means of selecting from among the five link functions. We accomplished this selection using three tests; Ramsey (1969) RESET test, goodness-of-functional form tests (generalised goodness-of-functional form test- GGOFF) (Ramalho *et al*, 2014) and non-nested *P* test (Davidson & MacKinnon, 1981). It is important to note that, although the RESET test was originally developed for use with linear functions, it is also applicable to any type of index models (Pagan & Vella, 1989; Ramalho *et al.*, 2010, 2011; Cameron & Trivedi, 2013:52). The RESET test examined the presence of misspecification in the model, principally, whether or not power terms were required in the model. The GGOFF test; tested the 'goodness' (appropriateness) of the link function. Unlike the usual hypothesis test, the RESET and GGOFF tests noted that the model was free of misspecification if the null hypothesis could not be rejected. It was possible that more than one link function could be selected by the RESET and GGOFF tests. Therefore, the *P* - test

provided an opportunity for one-on-one tests using the selected link function (s) from the first two stages as alternative hypotheses.

Three key hypotheses that revolved around link function selection were tested. These were misspecification, goodness-of-functional-form and pairwise selection.

Misspecification

H_0: there are no power terms in the model.
H_A: there are power terms in the model.
This was tested with the RESET test statistic.

Goodness-of-functional-form
H_0: $G(x\theta)$ is the correct specification
H_A: $G(x\theta)$ is not the correct specification
This was tested with the GOFF1, GOFF2 and GGOFF tests.

Pairwise selection
H_0: $G(x\theta)$ is a better representation of $E(y|x)$ than say $T(x|^{\gamma})$, an alternative link function
H_A: $G(x\theta)$ is not a better representation of $E(y|x)$ than say $T(x|^{\gamma})$, an alternative link function
The P test statistic was applicable in testing this hypothesis.

Results and Discussions

Descriptive statistics

More than 80% of the respondents were aged between 18 and 49 years; the economically active age-group (Table 2). This is higher than the about 60% reported by Asiedu (2014) and Li *et al.* (2016). More than 80% had at least secondary education (Table 3). Again, this percentage exceeded that of Li *et al.* (2016). Despite this large educated and economically active age-group, less than 50% were gainfully employed (Table 4).

Table 2: Age of Respondents

	Frequency	Percent
Below 18	42	10.5
18 – 25	162	40.5
26 – 50	160	40.0
50 and above	36	9.0
Total	400	100

Source: Field data

Table 3: Highest Level of Education

Level	Frequency	Percent
None	14	3.5
Basic education	54	13.5
Secondary education	106	26.5
Tertiary education	226	56.5
Total	400	100

Source: Field data

Table 4: Descriptive Statistics of Employment and Travel Status

	Employed		Travelled outside Ghana	
Response	Count	Percent	Count	Percent
Yes	196	49.0	166	41.5
No	204	51.0	234	58.5
Total	400	100	400	100

Source: Field data

This may have implications for capacity to purchase cut flowers, even if a preference is expressed. This finding also has implications for the general purchasing power within the city, the discussion of which is outside the scope of this article. The foreign origin and dominance of the cut flower industry have resulted in the low appreciation of cut flowers (Deloitte, 2012; Asiedu, 2014). Thus, visits outside the 'home country' to countries where cut flower is appreciated more, may influence purchase decisions.

Thus, we identified the respondents that had ever travelled outside Ghana. Almost 60% of our respondents have not travelled outside Ghana. This may have implications for cut flower purchases. The expression of preference should be backed by the ability to pay; therefore level of monthly income became important. As much as 43% of 280 respondents earned less than GHS 500 a month, about US$ 1,567.00 annually (based on 1US$ = 3.8GHS) (Table 5).

Table 5: Monthly Income Level

	Frequency	Valid Percent
Less than GHS 500	120	42.9
GHS 500 – GHS 1000	86	30.7
GHS 1001 – GHS 2000	50	17.9
Above GHS 2000	24	8.6
Total	280	100

Source: Field data

This is quite a low income compared to that found by Li *et al.* (2016) of about US$ 50, 000, earned annually by 53% of their sample. The low income of respondents could negatively affect cut flower purchases.

The respondents who purchased cut flowers were almost equally distributed between the sexes (Table 6). Only about 30% (124) of the respondents purchased cut flowers. This is far lower than the 79% found by Asiedu (2014). Although the 30% appears to be high, it is a better reflection of cut flower use in the city than was found by Asiedu (2014).

Table 6: Cross tabulation of Cut Flowers Purchase and Gender

		Gender		Total
		Female	Male	
Purchase of cut flowers	No	132 (69.5)[1]	144 (68.6)	276 (69.0)
	Yes	58 (30.5)	66 (31.4)	124 (31.0)
Total		190	210	400

Chi-Square Tests

	Value	Df[2]	Asymptotic Significance (2-sided)
Pearson Chi-Square	0.038	1	0.846
Likelihood Ratio	0.038	1	0.845
Contingency coefficient	0.010	-	0.846
Number of valid Cases	400		

[1] *Numbers in parenthesis are percentages within each gender category as well as the combined sample.* [2]*Df=degrees of freedom.*

Source: Field data

A cross tabulation on the association between cut flower purchase and gender is presented in Table 6. All tests (second panel of Table 6) show that there was no association between gender and cut flower purchased. However, in respect of frequency of purchase, females purchased more cut flowers than males and the difference was statistically significant (Table 7), based on univariate analysis.

Reasons were assigned by the majority (276 out of 400) of respondents who did not purchase cut flowers (Table 8). Lack of interest was indicated by 37.5% of the 266 people who responded. Inadequate knowledge of cut flowers was the reason assigned by 34.5% of the 266 respondents.

Another 15% stated high prices of cut flowers. Indeed, these were reasons assigned by more than 80% of the respondents to this question, as reasons for non-purchase of cut flowers. Addressing these concerns could spur cut flowers consumption, *ceteris paribus*. Asiedu (2014) also found less knowledge in caring for cut flowers and high prices of cut flowers as deterrents to purchasing cut flowers.

Table 7: Gender Differences between Frequencies of Purchase of Cut Flowers

Gender	N	Mean	Standard Deviation	Standard error of mean	Mean difference	*t* statistic
Female	54	10.93	17.06	2.322	7.236	2.965***
Male	58	3.69	5.72	0.751		
Total	112	7.179	13.000	-	-	-

Source: Field data

Table 8: Reasons for not Purchasing Cut Flowers

	Frequency	Percent	Valid Percent
Lack of interest in cut flowers	100	36.2	37.6
Inadequate knowledge on cut flower	92	33.3	34.6
Expensive prices of cut flowers	40	14.5	15.0
Unavailability of preferred cut flowers	16	5.8	6.0
Poor knowledge on location of floral shops	16	5.8	6.0
Perceptions of cut flowers	2	0.7	0.8
Total	266	96.4	100

Source: Field data

All respondents were asked to indicate their preference for type of cut flowers. About 66% indicated Roses followed by Lilies (16.8%) and Orchids (7.3%) (Table 9). Whilst Asiedu (2014) found these as the top three preferred types of cut flowers, roses were the main cut flower types traded by Columbia, Kenya, Ecuador and Ethiopia although Columbia is the largest exporter of Chrysanthemum (Rivers, 2015; Royal FloraHolland, 2016; Rabobank, 2016; COMTRADE, 2017).

Table 9: Most Preferred Type of Cut flowers

	Frequency	Percent	Valid Percent
Roses	254	63.5	66.5
Lilies	64	16.0	16.8
Orchids	28	7.0	7.3
Chrysanthemums	18	4.5	4.7
Carnations	6	1.5	1.6
Gladioli	4	1.0	1.0
Bear Grass	2	0.5	0.5
Other	6	1.5	1.6
Total	382	95.5	100

Source: Field data

Table 10: Most Preferred Colour of Cut Flowers

	Frequency	Percent	Valid Percent
RedBronze	122	30.5	31.9
PeachPink	76	19.0	19.9
BluePurple	64	16.0	16.8
Yellow	62	15.5	16.2
White	58	14.5	15.2
Total	382	95.5	100.0

Source: Field data

Colours give attraction to flowers. More than 30% of the respondents preferred REDBRONZE colour, about 20% preferred PEACHPINK (Table 10). BLUEPURPLE, YELLOW and WHITE were preferred almost equally. Unlike type of cut flowers, preferences for colour were distributed relatively evenly across colours. This may be due to the fact that all flowers possess colour whilst not all flowers possess similar properties such as fragrance.

The preference for type of cut flower and colour may be exercised through purchase in time space. Birthdays and love influence more than 80% of the cut flower purchasers (Second panel of Table 11). Thus, calendar and non-calendar periods and occasions offered a great opportunity to promote and sell cut flowers. Majority (68.3%) of those who purchased cut flowers on calendar days, did so on Valentine's Day (Table 12).

Table 11: Usual Purchase Times of Cut Flowers

	Calendar day(s)		
	Frequency	Percent	Valid Percent
Valentine's Day	56	14.0	68.3
Mother's Day	10	2.5	12.2
Christmas	10	2.5	12.2
Father's Day	6	1.5	7.3
Total	82	20.5	100.0
	Non-calendar day(s)		
Birthdays	54	13.5	51.9
Love	24	6.0	23.1
Home decoration	12	3.0	11.5
Anniversaries	6	1.5	5.8
Get well occasions	4	1.0	3.8
Cemetery or memorial occasions	4	1.0	3.8
Total	104	26.0	100

Source: Field data

Table 12: Relationship between Calendar Day Purchase and Colour of Cut Flower Purchased

		Valentine's Day		
		No	Yes	Total
RedBronze	No	20	32	52
	Yes	6	24	30
	Total	26	56	82
Chi-Square tests		Value	Df	Probability
Pearson Chi-Square		2.994	1	0.08
Likelihood Ratio		3.124	1	0.08
Linear-by-Linear Association		2.958	1	0.09

Source: Data analyses

The colour associated with Valentine's Day is red. Thus, we assessed if colour of cut flower purchased would be related to calendar day. Based on Table 12, majority of those who purchased cut flowers on Valentine's Day, preferred RedBronze to other colours. Three tests; Pearson chi-square, Likelihood ratio and linear-by-linear association tests showed that the null hypothesis that there was no association between calendar day purchases of cut flowers and colour, was rejected at the 10% level of probability. Although these probabilities were weak, the consistency of the test results and the proportions in the cells in Table 12 lent credence to the result. Therefore, on Valentine's Day, purchasers of cut flowers preferred RedBronze coloured cut flowers, a colour that matched the colour of the season, to other colours.

Model selection

The model specification test results are presented in Table 13. The RESET test statistics were all statistically insignificant. That is, the null hypotheses that were, are no power terms in the test equation could not be rejected. In other words, there were no omitted variables. This implied, the equation estimated by the functional forms; logit, probit, loglog, cloglog and cauchit were well specified. A closer examination of the loglog, cloglog and cauchit functional forms showed that the test statistics were lower than those of the traditional logit and probit functional forms. This points to seeming better specification of the model by the former link functions than the latter.

Turning to the functional form specification, the GGOFF test statistics (second panel of Table 13) were all statistically insignificant. The null hypothesis that the link functions were a 'good' representation of the data could not be rejected. This implied the link functions employed were a 'good' representation of the data. As in the case of the RESET test, the GGOFF test statistics also showed that, those of loglog and cloglog were 'better' representation of the data than those of the traditional logit and probit. Djokoto and Afari-Sefa (2017) provided similar findings for other binary choice problems. Thus, the loglog, cloglog and cauchit functional forms should be considered in binary choice model estimations.

Table 13: Specification Tests

	Logit	Probit	Loglog	Cloglog	Cauchit
RESET	0.343	0.307	0.151	0.033	0.190
Goodness-of-functional form test					
GGOFF	1.354	1.349	0.095	0.045	1.551
P test					
$H_{A\text{logit}}$	-	0.676	0.054	1.799	0.559
$H_{A\text{probit}}$	0.153	-	0.000	1.305	1.034
$H_{A\text{loglog}}$	0.721	0.817	-	2.315	2.329
$H_{A\text{cloglog}}$	0.061	0.060	0.419	-	2.605
$H_{A\text{cauchit}}$	3.800*	4.108**	2.651	4.941**	-

Source: Data Analyses

The third panel of Table 13 presented the results of the Davidson and McKinnon (1981) *P* test. As noted in the methodology section, the rejection of the null hypothesis, the usual approach to interpretation of hypothesis test, was applicable, unlike in the RESET and GGOFF tests. Since, all link functions were appropriate based on the RESET and GGOFF tests, any of them could be used as the null hypothesis. However, there was the need to select one out of the five. The results of the *P* test in the third panel of Table 12 were useful for this purpose. The approach in application of the *P* test was to pitch selected model(s) against others on a one-on-one basis, as noted earlier. The selected model was usually one for which the null hypothesis was rejected[2]. The null hypothesis that the logit link function was preferred to all others could not be rejected, except in the case of the cauchit link function. Similarly, the null hypotheses that probit and cloglog were preferred to cauchit, was also rejected. Thus far, cauchit functional form was clearly preferred to logit, probit and cloglog link functions. It was only in the case of loglog as the null hypothesis that the null hypothesis could not be rejected. The failure to clearly reject the null hypothesis for loglog, as well as the failure to reject the null hypothesis in the case where cauchit link function was the null hypothesis with loglog as the alternative hypothesis, suggested both link functions may be desirable. Nevertheless, either loglog or cauchit must be chosen. To avoid arbitrariness, we looked closely at the *P* test values. The magnitude of the test statistic for cauchit link function as the null and loglog link function as the alternative hypothesis was 2.329, whilst that of the reverse specification of the hypothesis was 2.651. The magnitude of the former in relation to the latter, suggested that the extent of failure to reject the cauchit link function as the null hypothesis was stronger than the extent of failure to reject the loglog link function as the null hypothesis. As a result, and the failure to reject the null hypothesis notwithstanding,

[2] See for example Ramalho et al. (2010, 2011), Djokoto (2015) and Djokoto and Afari-Sefa (2017) for application of the *P* test within the context of index numbers.

cauchit link function was preferred to loglog link function. Together with the earlier clear rejection of logit, probit and cloglog, the cauchit link function was thus selected.

Not only does the selection of cauchit link function have implications for binary choice modelling in particular, there are also implications for index models in general. First, the cauchit link function was selected using a battery of tests, thus the choice is statistically sound. Second, the choice of cauchit link function departs from the commonly used logit and probit link functions. Third, whilst Djokoto & Afari-Sefa (2017) selected cloglog link function by similar battery of tests for fair-trade and organic cocoa adoption, this article selected cauchit link function. Regarding index models, Papke & Wooldridge (1996) and Ogundari (2014) specified probit link function *a priori*. However, others selected logit (Ramalho *et al.*, 2010; Djokoto, 2015), loglog (Qu, 2014; Djokoto & Gidiglo, 2016; Djokoto *et al.*, 2017) and cloglog (Djokoto & Afari-Sefa, 2017), using battery of tests outlined earlier. The selection of cauchit link function is a departure from the link functions selected within the index modelling environment. This also reinforces the need to select the appropriate link function among the set of known link functions rather than specify logit or probit *a priori*.

Drivers of cut flower consumption

The estimation results of the selected cauchit link function are presented in Table 14. The non-response to some of the items accounted for the decline of the number of observations from 400 to 207. Nevertheless, this number of observations yielding degree of freedom of 193 was adequate to produce efficient hypothesis test results. The R squared-type measure of 0.1778 seemed small compared to the R squared measures for usual regression estimations and may raise issues of omitted variable bias and functional form misspecification. However, the RESET and GGOFF tests showed there were no omitted variable bias and no functional form misspecification issues.

Indeed, the constant term in the estimated model was statistically insignificant, suggesting inclusion of additional explanatory variables would not have resulted in additional statistically significant parameter estimates. On these three counts, the R squared-type measure is adequate, thus the model statistics are appropriate and useful for discussion.

Table 14: Estimation Results of Cut Flowers Purchase Behaviour

	Coefficients (Robust Standard Error)	Marginal effects (Delta-method Standard Error)
EDUCATION	-0.1694 (0.7308)	-0.0286 (0.1222)
EMPLOYMENT STATUS	-0.2289 (0.9832)	0.0386 (0.1613)
OVERSEAS VISIT	0.6407 (0.6976)	0.1082 (0.1041)
AGE	-0.2061 (0.9331)	-0.0348 (0.1598)
INCOME	0.7454** (0.3693)	0.1258*** (0.0458)
GENDER	0.4553 (0.8547)	0.0769 (0.1468)
ROSES	-1.4183 (0.9407)	-0.2394* (0.1344)
LILIES	-1.2197 (1.1650)	-0.2059 (0.2054)
ORCHID	-0.6105 (0.8389)	-0.1031 (0.1332)
REDBRONZE	1.6987 (1.1238)	0.2868* (0.1586)
PEACHPINK	0.8657 (0.8856)	0.1461 (0.1461)
BLUEPURPLE	1.9751 (2.9140)	0.3334 (0.4530)
YELLOW	1.6439** (0.7931)	0.2775** (0.1254)

Constant	-2.1799 (1.4869)	- -
Model statistics		
Number of observations	207	
Log pseudolikelihood	-114.5505	
Degree of freedom	193	
R2-type measure:	0.1778	

Note: ***, **, * represent 1%, 5% and 10% level of statistical significance respectively.
Source: Data analyses

Personal characteristics such as *EDUCATION, EMPLOYMENT STATUS,* and *OVERSEAS VISIT* had no discernible effect on cut flower purchase. These results suggest that these personal characteristics, individually, would not be useful for strategies that influence cut flower purchase in Accra. The same implication relates to *AGE* and *GENDER*. Our results depart from the findings of Li *et al.* (2016).

Respondents with high *INCOME* were more likely to purchase cut flowers. This result is based on the understanding that cut flowers are not necessities but possess aesthetic attributes. Moreover, these attributes influenced the use of cut flowers for personal and gift purposes, based on reasons ranging from expressions of love or sympathy to apology or appreciation (Yue & Hall, 2010; Zhao *et al.*, 2016). Since several studies have also acknowledged the role of price in the demand for cut flowers (Girapuntong & Ward, 2002; Tilekar, 2004; Yue & Hall, 2010; Palma *et al.*, 2011; Delgado *et al.*, 2012; Lim *et al.*, 2014; Usman, 2015; Hovhannisyan & Khachatryan, 2017), high income earners are thus, more likely to afford cut flowers at market prices.

The marginal effect of *ROSES* was negative and statistically significant implying that reference cut flower types were preferred to *ROSES*. This is rather surprising as the univariate statistics suggested otherwise. In as much as this result is based on multivariate analysis, coupled with the findings of COMTRADE (2017), Royal FloraHolland (2016) and Rabobank (2016), further research would be required to elucidate the types of cut flowers purchased. The statistical insignificance of the other cut flower types suggests these preferences are indistinguishable from the reference group. Regarding colour attributes, *REDBRONZE* and *YELLOW* were important variables that determined cut flower purchase decisions. The preference for *REDBRONZE* and *YELLOW* may have been influenced by their brightness, and the calendar-day effect, in the case of the former, as noted earlier. Preference for *REDBRONZE* over other colour attributes is not unknown (COMTRADE, 2017; Royal FloraHolland, 2016; Rabobank, 2016) however, the preference of *YELLOW* to the reference colour; *WHITE* and by extension *PEACHPINK* and *BLUEPURPLE,* not only depart from the univariate results above, but also the findings of the existing literature (Blumthal *et al.*, 2003; Hong *et al.*, 2005; Yue & Behe, 2010; Home, 2012; Stumpf *et al.*,2012; Shreiner *et al.*, 2013; Zhao *et al.*, 2016), *albeit* for countries other than Ghana. These findings require that local cut flower producers, marketers and importers must prioritise *REDBRONZE* and *YELLOW* cut flowers over *PEACHPINK* and *BLUEPURPLE* in their production, stocking and import decisions.

Conclusions and Recommendations

Following the low consumption of cut flowers in Ghana and the dearth in the literature on the drivers of cut flower purchase decisions, we identified the reasons for non-purchase of cut flowers and the drivers of cut flower purchase decisions, using data on inhabitants of Accra, the capital city of Ghana.

The reasons for not patronising cut flowers were lack of interest, inadequate knowledge and high prices of cut flowers. Monthly income, rose cut flowers, redbronze and yellow coloured cut flowers drove cut flower purchase decisions. Although promotion of other less preferred types of flowers will not be out of place, cut flower importers and vendors should prioritise roses, lilies and orchids. The low consumption of cut flowers requires that the horticulturists association in Ghana promotes cut flowers through awareness creation and other activities that will whip up interest in the use of cut flowers. Sellers of cut flowers should stock more red coloured flowers, around the 14th of February, to take advantage of the season. The yawning gap between imports and exports provides market opportunities for local cut flower producers. Also, it is recommended that further research is conducted to identify the varieties of cut flowers most imported and how these can be grown locally. Producers and or sellers should work towards reducing cost of cut flowers which should translate into more competitive prices, thereby engendering greater consumption. Since income drove cut flower purchase decisions, marketing communication strategies of sellers should be primarily targeted at persons in the middle and high income classes. The selection of the cuachit link function is yet another evidence of the need to explore link functions other than probit and logit, in binary choice problems.

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