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Education demand elasticity in Ghana: Evidence from household level data

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ABSTRACT

Education remains a key factor in human capital accumulation development. Owing to its impact on economic growth and individual welfare, government and household education finance have gained prominence in developing countries. This study seeks to explain the sensitivity of household education demand based on both school type and level owing to changes in household income and price of education, incorporating selected demographic factors in the analysis. To perform this demand analysis, the author adopted the extended version of the Quadratic Almost Ideal Demand System (QUIAIDS) and the 2016/17 Ghana Living Standard Survey 7. The result shows that education at each level is a normal good; the demand of which increases owing to a one percent increase in household education budget (income). Also, households are income elastic to demand general pre-tertiary education but price inelastic at each level of education. The results further show that public education has higher income elasticities than private education. The author also find that even though both school types are price inelastic, the quantity demanded of private education is more sensitive to change in education cost that public- education at all levels.

Keywords: Education, Elasticity, Ghana, Household expenditure, Household Income, Quadratic Almost Ideal Demand System

1. INTRODUCTION

As the world increases focus on intra-national income inequalities, the relevance of social protection programmes aiming at the poor has become more pronounced on policy agenda of middle to low income countries and development partners. Key among these programmes is education (human capital development) This is due to the significant impact of quality education on inclusive growth (Oyinlola et al., 2020; Ogundari & Awokuse, 2018; Raheem et al., 2020), poverty reduction (Boateng et al., 2000 & 2019), technological and agriculture productivity (Barro & Lee, 2010), health (Center on Society and Health, 2015), equity, social stability, and stable democratic values.

According to UNESCO (2012), every US$1 spent on education leads to an average of US$12 increase in economic growth. The Human Development Index and the Sustainable Development Goals (SDGs) for instance emphasized the importance of education as a key measurement indicator. At the household level, education is perceived as a catalyst to breaking from household inter-generational poverty cycle. Education provides better employment opportunities for individuals, raises skills and productivity levels, reduces poverty, and improves the quality of life (Hanushek & Woessmann, 2020; Kotaskova et al., 2018). Against this backdrop, public (government) and private (particularly household) education financing and the quality and quantity of education have gained prominence in literature especially among developing economies. (Zubairi & Rose, 2016).

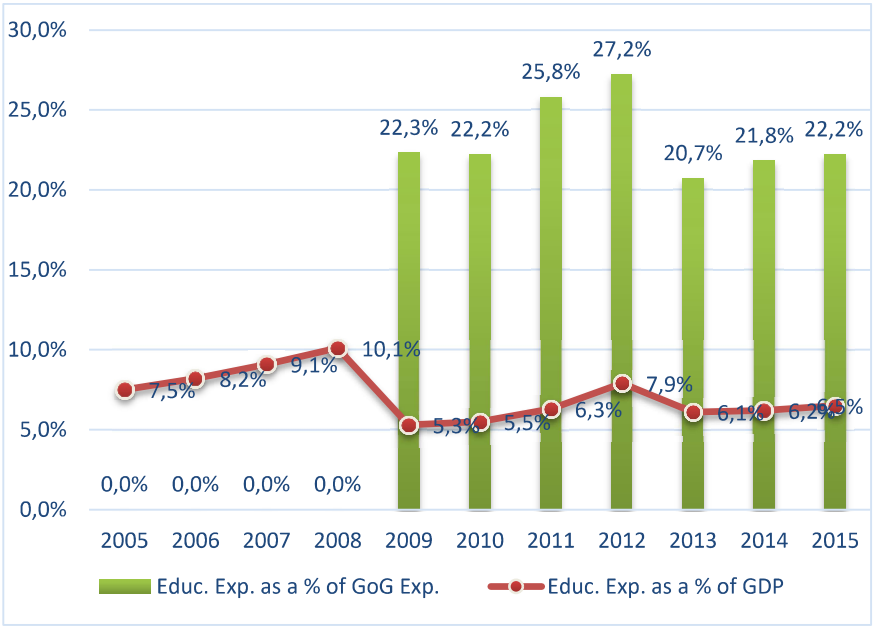
Even though the central role of governments in education through policy and funding is global, low government education spending especially in middle to low-income countries continue to hurt the poorest households in those countries who do not have sufficient resources to privately finance demand for education. (Zubairi & Rose, 2016). According to Transparency International (2013) out of 135 countries who implement tuition free public basic education, households in 110 of these countries continue to pay some sort of education

fees. Findings from the 2015 Education Monitoring Report suggests that poorer a country is the higher the share of household education expenditure. For largely low-income countries, household expenditure exceeds government expenditure. (UNESCO, 2015).

1.1. Government and household education expenditure in Ghana

Ghana is touted as among the highest government education spending countries in Africa. According to the World Bank government education spending in Ghana is 4.5 percent of Gross Domestic Product (GDP), marginally above the global average of 4.2 percent and a sub-Saharan African average of 3.6 percent in 2016. From Figure 1, the share of expenditure on education to GDP ratio of government education expenditure to GDP in 2014 was 6.5 percent, higher than 13.5 recorded in 2009. However, the share of expenditure on education to overall government expenditure drop slightly from 22.3 percent in 2009 to 22.2 percent in 2014. Significantly, total government expenditure in the education sector has been increasing from GH 4.88 billion (US$ 1.1 billion) in 2013 to GHS 7.1 billion (US$ 1.6 billion) in 2015. In 2015, Tertiary education had the largest share (25.7 percent) of government total education expenditure, followed by Senior High School (SHS) and basic education (Ministry of Education Sector Performance Report, 2016). The evidence of government education expenditure at the basic level for instance is the increasing net enrollment from 62.1 percent in 1999 to 88.9 percent in 2014 (UN MDG).

In policy terms, the two past decades have seen successive Ghana governments embark on structural reforms to improve education delivery in Ghana. For instance, under the Ghana Economic Recovery Program (ERP) introduced in 1987, education was seen as a critical component to restoring inclusive growth through enhanced access and equitable distribution of education systems. Other policies include the Free and Universal Primary education (FCUBE) initiative seeking to achieve the Free Compulsory Universal Basic Education. Tied to this was the Capitation Grant Scheme which is targeted at absorbing extra education costs incurred by households. There is also the free school uniform distribution initiative, free textbook distribution initiative, local scholarship program, teacher trainees, and nursing students' allowances. These are all conscious efforts targeted at making education cheap, lucrative, and easily accessible to households in Ghana. Aside from government contributions to education, households also privately fund education. These household contributions are more pronounced in developing countries like Ghana where there are limited resources for government to fully fund education, whereas households consider investment in education as one that has long-term multiplying benefits, the immediate cost of education could be dire and discourage household demand for education.



Source: Ministry of Education Sector Performance Report, 2016

Figure 1: Ratio of government educational expenditure to gdp and ratio of government education expenditure to total government expenditure

Household education financing in Ghana continues to rise amid the government's continual effort in absorbing some household education costs. According to the two recent rounds of the GLSS, the share of education expenditure for a household in 2016 increased to 13.1 percent from 10.6 percent in 2013. (GSS, 2013; GSS, 2016). This is translated into an average annual cash expenditure of GH 1,271 (US$ 287.98) and GH 2,472 (US$ 560.11) in 2012/13 and 2015/16 respectively. The share of household spending on education in Ghana exceeds the sub-Saharan African average of 6.5 percent in 2014 (Bashir et al., 2018). This is because households are confronted with high direct and indirect education costs. These costs come in the form of tuition fees, extra classes fees, home tuition fees, "teachers motivation fees", building funds, computer levies, Parent-Teacher Association dues (PTA), school bus fees, compulsory uniform fees, and other indirect education expenditures which are often not absorbed by the government. These costs could rise to become a household extra financial drain, especially for households from rural areas even if the actual tuition fee is zero in the presence of fully subsidized tuition fees. Average household education expenditure is about GH 573.87 (US$ 130.02) for public primary education, but the figure increased more than two times for senior high education before climaxing at 12 times the cost for tertiary education (GLSS, 2016). Table 1 gives a breakdown of household education expenditure. From the table, the education cost aside from tuition and registration cost accounts for 66 percent, 44 percent, and 30 percent of basic, secondary, and tertiary education in Ghana, respectively.

Table 1: Average household amount spent on a person attending school/college

Education Level	School and Registration Fees (GHC)	Contribution to PTA (GHC)	Expenses on school uniforms and sports clothes (GHC)	Expenses on Books and school supplies (GHC)	Expenses on Transport to and from school (GHC)	Expenses on Lodging, Food and boarding (GHC)	Expenses on extra classes (GHC)	In Kind Expenses (GHC)	Other (cannot breakdown) (GHC)
Basic	617.16	33.64	102.27	209.22	98.53	833.91	114.46	23.82	124.26
Secondary	1897.09	52.02	65.2	272.45	455.7	964.61	75.8	34.51	512.34
Tertiary	18693.48	18.95	45.41	1997.63	1978.14	4471.61	22.28	46.94	1727.05

Source: Ghana Living Standard Survey Report (2016/2017)

As an economy develops, there are changes to household education preferences and expenditure. Against this framework, it is important to estimate the country-specific evidence on household sensitivity to education demand as a result of changes in income of household and education costs. For a country like Ghana, demand estimations on the exact responsiveness of demand of education as a result of variation in the income of household and cost of education have received little restricted attention. More so, there are limited studies that estimate heterogeneity demand analysis based on school type and academic levels in Ghana using a comprehensive demand model. Past studies which describe household education demand behavior in Ghana largely adopted models such as Nested Multinomial logit, probit, and logit models that estimated probabilistic elasticities and determinants of household education. Examples of these studies include (Donkoh & Amikuzuno, 2011; Lavy, 1996; Gaddah et al., 2015; Iddrisu et al., 2017, 2018). These estimates do not reflect exact demand elasticities.

To fill this gap, the study leveraged the demand model– Quadratic Almost Ideal Demand System (QUAIDS) by Banks et al. (1997) and a more recent GLSS 7 data to broaden the research study in estimating exact demand elasticities for each school level and type, in which demand for these education levels and type is dependent on household income and cost of education. The study also took into cognizance in its estimation, demographic factors such as household location (urban/rural), household head's sex, and the employment status of the head of the household. The results of this study will provide additional evidence in the context of Ghana to guide policy decisions to build a robust educational system. This study will also, enhance future studies into human capital development and financing in Ghana and other countries.

The remaining segment is organized as follows; Section 2 reviews related existing literature on similar topics. Section 3 explains the methodology adopted while section 4 summarized the data used. The empirical results and analysis is presented in the 5th section. The last section summaries the paper and suggests recommendations for policymakers in the country.

6. LITERATURE REVIEW

The Human Capital Theory by Becker (1964) underscores the literature foundation of this study. The theory argues a positive relationship between formal training or education and productivity and income by increasing the intellectual stock of economically productive human capability (Gyimah-Brempong et al. 2006; Nowak & Dahal, 2016). Just as in demand analysis, the demand for education is influenced by demand and supply factors. While the supply price of education is the price at which education is offered which includes government and non-government investments, the demand price is the price at which households are willing to pay to obtain an education. As such, an equilibrium is achieved when the demand and supply price of education converges. Households make education investments for various reasons. These reasons are either economic, social, or cultural. Social and cultural reasons include demographic factors while economic reasons

include education cost and the decision to sacrifice consumption to increase education investment for positive future returns. Households invest in education when the expected returns at least equal the expected education expenditure.

Recent studies have focused on the significance of each level of education on economic growth. This could be largely attributed to the depth of knowledge and skills taught at each level of education. The level of expertise and skills taught in schools increases at higher levels of education. In a study conducted by Nowak and Dahal (2016), they found that tertiary education's contribution to economic growth is higher than basic education. Notwithstanding, basic and secondary education are equally important, serving as relevant prerequisites for tertiary education. Barro and Robert (2013) also found that the length of stay in school positively builds the needed expertise, skills, and labor productivity required to influence economic growth.

In the literature, the Engel curve framework is one of the common methods used to estimate income elasticity of demand relationship. Acar et al. (2016) model the income elasticity of education in Turkey using the Engel methodology controlling for household demographics by income groups. The study used the Turkish Household Budget Survey for 2003, 2007 and 2012. They found that in 2012, household heads among the top quartile with high school and tertiary education spent 140 percent and 191.1 percent respectively on education more than household heads with lower basic education. The study also found that the income elasticity of education increases with time in Turkey. Notwithstanding, the income elasticity of education decrease as one moves from a lower-income group to a higher-income group. Kenayathulla (2016) used the same Engel method to estimate the expenditure elasticity of education for households in Malaysia by focusing on gender gaps in household education expenditure. The study did not find any significant difference in household demand for education among male and female students. Notwithstanding, demand for education was found to be inelastic with expenditure elasticity of 0.76. Dybczak et al. (2014) estimated who adopted the QUIADS model to estimate education demand for the Czech Republic found the income elasticity of total education demand to be 1.233 suggesting a luxury good and uncompensated price elasticity to be -0.338 without incorporating demographic factors. The study, however, found that employed households are more likely to make education expenditures than unemployed household heads whiles households with more than three members are more likely to make higher expenditures on education than households with fewer members.

Regarding the objective of the study, there are very limited studies on education demand elasticities in Ghana. One of the earliest pieces of literature is the study by Lavy (1996) using the GLSS 2 and the logit model. The study estimated the price elasticity of education in Ghana to be -0.1 by substituting the price of education with distance to school. He also concluded that the cost of basic education is influenced by the cost of a higher level of education. Lavy estimated further that the likelihood to demand primary education as a proportion of demand for middle education by a household member in terms of probabilistic elasticity using distance to school as a proxy for price is 4.2. The study by Kirsten and Alain (2012) supports this conclusion by Lavy. They found that schools that are less distanced from home have a higher probability of school enrollment than schools more distanced from home. The limitation of Lavy's study is the proxy for the price of education and the logit model used which estimates probabilistic elasticities. Probabilities are not exact elasticities and may mislead any critical demand analysis.

Gaddah et al. (2015) focused on the willingness of households to pay for education to estimate education demand for education in Ghana adopting the nested multinomial logit model. Basically, their study found that at higher levels, education became more price elastic. According to Gaddah et al (2015), the poorest quintile has higher price elasticity for secondary education demand than primary education in Ghana but has higher income elasticities for primary education than for secondary education. Specifically, they estimated price elasticity of -0.147 and -0.850 for primary and secondary education respectively, and corresponding income elasticity of 0.521 and 0.005.

Other studies also focused on the influence of the sex of the household head on household education demand and expenditure. According to Donkoh and Amikuzuno (2011) even though male-headed households make the highest education expenditure in Ghana, female household heads are more likely to make education expenditure in Ghana. Their study also supports the assertion that households with younger heads who acquired some level of education are more likely to make an investment in education than those that have no formal education. Their study adopted the Probit model using the GLSS 5.

Iddrisu et al. (2017) also postulated a positive impact of female-headed households and higher incomes on household education expenditure. Considering gender bias analysis in household education expenditure in Ghana, Iddrisu et al. (2018) and Sackey (2007) found that household expenditure on female members is highly dependent on the availability of resources than in the case of male members, and this worsens at the secondary and tertiary levels. At the basic level, however, Iddrisu et al. (2018) found no gender bias in household education expenditure.

These studies remain largely estimating probabilistic elasticities and determinants of education expenditure in Ghana. Hence, one needs to be careful in interpreting the price and income elasticities estimated in the context that, these studies have limitations on the restricted -variables used and the methodology used. The study adopts the QUAIDS model and examines the character of households in demand for each level of education based on school types, in which this demand depends on education expenditure budget (income) and price, and other household demographic factors.

2. METHODOLOGY

2.1. Quadratic Almost Ideal Demand System (QUAIDS)

This analysis adopts the Quadratic Almost Ideal Demand System (QUAIDS) by Banks et al. (1997). The QUAIDS model is an extension of the commonly used Almost Ideal Demand System (AIDS) model by Deaton and Muellbauer (1980), which is originally an indirect functional utility function derived from a general class of Price-Independent Generalized Logarithmic (PIGLOG) models. The AIDS models the expenditure share of a good as a function of household total expenditure on a basket of goods, own price, and the price of other goods of a household.

Banks et al. (1997) found that the AIDS linear restriction imposed on preferences concerning the logarithm of income was too strong hence the QUAIDS which incorporates quadratic logarithmic income term to relax the restriction. Even though AIDS is a complete demand system, AIDS tends to be non-linear because it shows bias (Banks et al., 1997). This was true when Banks et al. (1997) tested the AIDS model by incorporating a quadratic term of income (example, making the Engel curves quadratic) and found that no higher degree of dependence on income is needed in the model. The QUAIDS is also a generalized and more flexible model which allows for the incorporation of demographic variables unlike in the case of AIDS (Ray, 1983; Blacklow et al. 2010). According to Poi (2012), the QUAIDS model is derived from the following indirect utility function:

$$\ln V(\mathbf{p}, m) = \left[\left\{ \frac{\ln m - \ln a(\mathbf{p})}{b(\mathbf{p})} \right\}^{-1} + \lambda(\mathbf{p}) \right]^{-1} \quad (1)$$

Where vector **p** represents commodity prices and **m** is total expenditure made by a household
The transcendental logarithm function , ln a(p) is defined as;

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{i=1}^{k} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{k} \sum_{j=1}^{k} \gamma_{ij} \ln p_i \ln p_k \quad (2)$$

b(p) is the Cobb–Douglas price aggregator given as;

$$b(\mathbf{p}) = \prod_{i=1}^{k} p_i^{\beta_i} \quad (3)$$

$$\lambda(p) = \sum_{i=1}^{k} \lambda_i \ln p_i \,, \quad (4)$$

For the model to be consistent with economic theory, the following restrictions are imposed;

- The adding up property requires that:

$$\sum_{i=1}^{n}\alpha_i = 1 \quad \sum_{i=1}^{n}\beta_i = 0 \quad \sum_{i=1}^{n}\gamma_{ij} = 0 \quad \sum_{i=1}^{n}\lambda_i = 0 \tag{5}$$

- The homogenous property requires the function is homogeneous of degree zero in expenditure and prices:

$$\sum_{j=1}^{n}\gamma_{ij} = 0 \quad \forall i \tag{6}$$

- Symmetry property requires that:

$$\gamma_{ij} = \gamma_{ji} \tag{7}$$

The **quaids** command imposes these conditions automatically, that means, the restricted (static) version of the model was estimated.

Next, is to compute the Marshallian demand equation of the QUAIDS model in terms of expenditure shares by applying Roy's identity to equation (1), after substituting equations (2), (3) and (4)

$$w_i = \alpha_i + \sum_{j=1}^{J}\gamma_{ij}\ln p_j + \beta_i \ln\left[\frac{m}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{m}{a(p)}\right]\right\}^2 + \varepsilon_i \tag{8}$$

By setting $\lambda_i = 0$ reduces equation (8) to the original AIDS model.

QUAIDS allows for the incorporation of household demographics in the model. The effects of household demographics on household demand in the model are introduced by way of specific price scaling technique proposed by Ray (1983), according to which income is deflated by the equivalence scale:

$$\overline{m}_0(\mathbf{z}) = 1 + \boldsymbol{\rho}'\mathbf{z} \tag{9}$$

Where ***ρ'*** is the scale parameter and **z** is the captured demographic characteristics. The corresponding QUAIDS model incorporating demographic characteristics is given as:

$$w_i = \alpha_i + \sum_{j=1}^{k}\gamma_{ij}\ln p_j + (\beta_i + \boldsymbol{\eta}_i'\mathbf{z})\ln\left\{\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})}\right\} + \frac{\lambda_i}{b(\mathbf{p})\,c(\mathbf{p},\mathbf{z})}\left[\ln\left\{\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})}\right\}\right]^2 \tag{10}$$

where

$$c(\mathbf{p},\mathbf{z}) = \prod_{j=1}^{k} p_j^{\boldsymbol{\eta}_j'\mathbf{z}}$$

According to Banks et al. (1997), the income elasticities and the uncompensated price, having controlled for demographic factors is given as;

i. Uncompensated Price;

$$\epsilon_{ij} = -\delta_{ij} + \frac{1}{w_i}\left(\gamma_{ij} - \left[\beta_i + \boldsymbol{\eta}_i'\mathbf{z} + \frac{2\lambda_i}{b(\mathbf{p})\,c(\mathbf{p},\mathbf{z})}\ln\left\{\frac{m}{\overline{m}_0(\mathbf{z})\,a(\mathbf{p})}\right\}\right]\times \left(\alpha_j + \sum_l \gamma_{jl}\ln p_l\right) - \frac{(\beta_j + \boldsymbol{\eta}_j'\mathbf{z})\,\lambda_i}{b(\mathbf{p})\,c(\mathbf{p},\mathbf{z})}\left[\ln\left\{\frac{m}{\overline{m}_0(\mathbf{z})\,a(\mathbf{p})}\right\}\right]^2\right) \tag{11}$$

ii. The income elasticity;

$$\mu_i = 1 + \frac{1}{w_i}\left[\beta_i + \boldsymbol{\eta}_i'\mathbf{z} + \frac{2\lambda_i}{b(\mathbf{p})\,c(\mathbf{p},\mathbf{z})}\ln\left\{\frac{m}{\overline{m}_0(\mathbf{z})\,a(\mathbf{p})}\right\}\right] \tag{12}$$

From equation 12, the QUAIDS model suggests that nature of a good; whether necessity or luxury, could vary for same good at different income levels. This is unlike the AIDS model, where the nature of a good; whether necessity or luxury does not vary at different income levels.

2.2. Estimating the QUAIDS Model

To calculate the price of education (P_i) the study divided education total expenditure for a household for the i^{th} level of education by the corresponding student enrollment. Whereas w_i measures the share in education total expenditure for a household (i.e., w = p*q / x) of the i^{th} level of education. Similarly, the study obtained the quantity demanded an i^{th} level of education by dividing school enrollment of the i^{th} level of education by the corresponding appropriate population for that education level. The education total expenditure for a household is denoted by *m*, while, Z denotes demographic variables for a household (i.e sex of the family head, rural/urban location of the household, and employment status of household head).

To obtain the parameters in QUAIDS, the expenditure share equations are estimated together and the Iterated Feasible Generalized Nonlinear Least-Squares based on the Seemingly Unrelated Regression (SUR) method is used. The study used STATA 13 by applying STATA's nlsur command with the ifgnls option. Following the adding up restriction imposed on the QUAIDS model, and to avoid singular covariance matrix, the expenditure shares of one of the equations is dropped and the nonlinear maximum likelihood method is applied to the rest equations. This use of the maximum likelihood method is invariant to the deleted equation. According to Poi (2012), the iterated feasible generalized nonlinear least-squares estimator is comparable to the multivariate normal maximum-likelihood estimator for this nature of analysis. The minimum expenditure needed to achieve the lowest standard of living given unity price is denoted is defined by the parameter α_0; which is the lowest log expenditure value in the data (Banks et al., 1997).

Considering these facts, the study first estimated the elasticities for general education, basic, secondary, and tertiary schools before estimating six (6) education expenditure share equations with respect to total household education (budget) given as, public basic education (w1), private basic education (w2), public secondary education (w3), private secondary education (w4), public secondary education (w5), private secondary education (w6).

2.3. Demographic Variables

In demand analysis, household characteristics are key in interpreting consumer demand results. Household demographics give a better understanding of household behavior (Luhrmann,2005). However, one must be careful not to use too many demographics when adopting the QUAIDS model. This is because for every additional demographic variable added, the number of coefficients to be estimated increases significantly.
Thus, the study incorporates the following limited household demographics;

- Rural/Urban location of Household (Okuwa, 2004; Bashir et al., 2018). A binary variable is created; 0 for urban households and 1 for rural households.
- labor market status of the head of the household (Dybczak et al.,2014). A binary variable is created; 0 for unemployed household heads and 1 for employed household heads.
- Sex of Household Head. Abbam (2018); and Okuwa et al (2015). A binary variable is created; (0) Female-headed household and (1) Male headed household.

The Wald Test is used to confirm the significance of the selected demographic variables. The null hypothesis is that household education expenditure in Ghana is not influenced by the selected household factors in the estimation.

2.4. QUAIDS Model Assumption

In QUAIDS estimations, market demand and supply interaction cannot be used to predict price in this model, hence the model adopts fixed prices for each consumer. The household demand model analysis also assumes more than one member in the household and education expenditure is not at the discretion of individual consumers but the household.

3. DATA AND SUMMARY STATISTICS

To perform an education demand elasticity analysis for a household in Ghana the author relied on 2016/17, 7th round of the Ghana Living Standard Survey (GLSS). The GLSS 7 captures data on all forms of household expenditure on education. That is, total education expenditure for a household on basic, secondary, and tertiary education. The data also captures household demographics such as gender of household head, rural/urban location of household, and the employment status of the household head. One limitation of the GLSS 7 data for this study is that the reported household income data could be underestimated because the informal sector forms a large section of Ghana's population and whose source of income is predominantly from their subsistence farm harvest (Deaton, 1997). The study thus relied on household expenditure instead of the actual income estimate for its analysis.

This study, however, focuses on just 8585 observations, which captures all forms of data on household education expenditure for currently enrolled students at the time of the survey. The cost of education as captured by the GLSS7 includes boarding fees, registration and tuition fees, extra classes fees, transportation fees to school, Parent Teacher Association levy, and any other forms of education expenditure information gathered in the survey data. The study defines each level of education as follows:

i. **Basic Education:** This includes preschool, primary and junior secondary school,
ii. **Secondary Education:** This includes senior secondary school and vocational/technical school, and
iii. **Tertiary Education:** This captures polytechnics, teacher training, agric, nursing training (cert), university (bachelor), university (postgraduate), and Professional studies.

The overall objective of this study is to estimate household education demand price and income elasticity for private and public education of each level of education in Ghana using the extended version of the QUAIDS model incorporating demographic variables (example, labor market status of household head, rural/urban location of household, and sex of household head) using GLSS 7. To make our results consistent, the study computes data for only households that have members who are currently enrolled in school for which education expenditure is made. Secondly, the study also examined the heterogeneity in household responsiveness to the changes in price and income by disaggregating the results into private and public education.

The descriptive statistics from Table 2 show that 39.74 percent of the sample data reside in urban areas, while 67.17 percent and 38.42 percent of members who attend public and private schools respectively are from rural households. Also, 80.82 percent of household heads engage in some level of employment whiles 69.59 percent of employed male household heads send their members to school. Respectively, 67.87 percent and 67.94 percent of male-headed households send their members to public and private schools than female-headed households. Basic education takes about 81 percent of household education expenditure, followed by secondary education. In monetary terms, households make an average of GH 1071.75 (US $ 242.8) public basic, GH 2984.54 (U$676.3) public secondary, and GH 5524.256 (U$ 1251.8) public tertiary education expenditure. Urban households spend an average of GH 2978.01 (US $ 674.8) on general education expenditure, whereas rural households spend on average GH 1133.37 (US$ 256.8) on general education. Private education at each level constitutes the highest household education expenditure because private education has the highest average education cost

Table 2: Summary statistics

	General Education		Public Education		Private Education	
Variables	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Share of education expenditure (Basic)	0.813	(0.004)	0.548	(0.005)	0.266	(0.004)
Share of education expenditure (Secondary)	0.119	(0.003)	0.109	(0.003)	0.01	(0.001)
Share of education expenditure (Tertiary)	0.068	(0.003)	0.058	(0.002)	0.01	(0.001)
Average cost of basic education	574.17	(14.05)	320.17	(5.77)	1108.78	(34.91)
Average cost of secondary education	1781.18	(77.35)	1702.16	(71.76)	2534.52	(434.84)
Average cost of tertiary education	4357.78	(212.82)	4044.39	(161.33)	6206.82	(1004.96)
Rural education expenditure (GH)	1133.37	(27.00)	848.24	(23.22)	285.13	(12.94)
Urban education expenditure (GH)	2978.01	(97.08)	1474.98	(56.84)	1503.03	(80.86)
Basic education expenditure (GH)	1687.26	(35.95)	1071.75	(26.74)	1901.78	(67.36)
Secondary education expenditure (GH)	3769.28	(123.62)	2984.54	(103.88)	3906.38	(527.97)
Tertiary education expenditure (GH)	6665.78	(319.37)	5524.256	(221.93)	8061.1	(1496.71)
	General	**Public**	**Private**			
Rural (%)	60.26%	67.17%	38.42%			
Urban (%)	39.74%	32.83%	61.58%			
Male headed household (%)	67.77%	67.87%	67.94%			
Female headed household (%)	32.23%	32.13%	32.06%			
Employed household head (%)	80.82%	79.63%	67.94%			
Employed household head (male %)	69.59%	69.12%	70.31%			
Employed household head (female %)	30.59%	30.88%	29.69%			

NB: SE depicts Standard Error

4. FINDINGS AND DISCUSSION

4.1. Wald Test Result

As explained earlier the Wald test is used to test for the relevance of the household demographics incorporated in the model. The Wald test results from Table 3, suggest that all the demographic variables are statistically significant. Hence the study rejects the null hypothesis and invariably confirms the significance of our results by incorporating the demographic factors used in this analysis. The estimated parameter of the QUAIDS model is presented in the Appendix. Notwithstanding, the study is more interested in the elasticity estimates not the parameters per se.

Table 3: Wald Test for Household Demographics

Wald Test	Overall Education Prob > Chi Sq	Based on School Type Prob > Chi Sq
Rural/Urban location of household	0.0000	0.0000
Gender of Household Head	0.0000	0.0000
Employment Status of Household Head	0.0000	0.0000

4.2. QUAIDS demand elasticity for education results and discussion

The QUAIDS elasticities are discussed below for each education level. The income (expenditure) elasticity estimates the proportional change in demand for a good owing to a proportional change in consumer income. On the other hand, the price elasticity measures the proportional change in demand for a good owing to a proportional change in the price of the good (ceteris paribus).

4.2.1. Expenditure elasticity for education demand

The expenditure elasticities are presented in Table 4. All expenditure elasticities are positive indicating normal goods; the demand for which rises as household income rises. From Table 4, households in Ghana are progressively income elastic to demand general pre-tertiary education with estimated elasticities slightly above 1; the demand of which increases as household education expenditure rises. The estimated elasticities perhaps show that households in Ghana are much interested in acquiring at least quality pre-tertiary education for their members as a prerequisite for an increased opportunity for future education returns. As such, as their education expenditure rise, they become motivated to invest and increase their pre-tertiary education expenditure for their members by a higher percentage. From Table 4, households increase their general pre-tertiary education expenditure by an average of 1.0 percent owing to a 1 percent rise in household income. However, the study finds that tertiary education is income inelastic with an estimated elasticity of 0.948. This is not surprising because tertiary enrollments are generally low in Ghana unlike pre-tertiary levels (MOE, 2016). Consequently, the percentage change in the share of tertiary education expenditure is low but remains a relevant level in household education demand.

Table 4: Price and Income Elasticity of Household Education Demand In Ghana

	Expenditure Elasticity	Uncompensated Price Elasticities		
	Income	**Basic Price**	**Secondary Price**	**Tertiary Price**
Basic	1.013***	**-0.741*** **	-0.153***	-0.118***
	(0.007)	**(0.018)**	(0.008)	(0.006)
Secondary	1.021***	-0.135***	**-0.812*** **	-0.074***
	(0.004)	(0.008)	**(0.011)**	(0.004)
Tertiary	0.941***	-0.041***	-0.045***	**-0.856*** **
	(0.002)	(0.001)	(0.001)	**(0.003)**

Note: Significance of coefficients at 0.1%, 1% and 5% depicted by ***, ** and * respectively
Standard errors in parentheses

4.2.2. Price elasticity for education demand

Consistent with demand theory, the uncompensated own-price estimated in Table 4 are all negative confirming a normal good, where price and quantity demanded are inversely related. These results are also consistent with the study by Gaddah et al. (2015) and Lavy (1996) who found a negative relationship between price and demand for education in Ghana. The cross-price elasticities are also negative suggesting all levels of education are complementary goods. This is expected because each lower level of education serves as a prerequisite to progressing to a higher level and the benefits of each level of education are unique and thus cannot be substituted. This also explains why the cross-price elasticities are lower than the own-price elasticities. Notwithstanding, the results further show that households are price inelastic to demand each level of general education with estimated price elasticities less than 1. In addition, the own-price elasticity for each level of education rises at higher levels of education. This is likely because the average cost of education rises at higher levels. Secondly, education has fewer household expenditure alternatives because of its future financial benefit to the household. Hence, education at each level becomes a necessity and does not respond largely to cost changes. However, the choice of spending on education other than other household expenditures decreases as one moves from a lower level of education to a higher level because of the increasing cost of acquiring them. As such, any further increase in the cost of the corresponding level of education decreases household equivalent education expenditure by a higher percentage, even though it is a necessity good. This explains why the own-price elasticities increase at higher levels of education.

4.2.3. Expenditure elasticity for education demand based on school type

Table 5 presents the heterogeneous demand elasticity of education based on school type. From the table, both public and private education are normal goods the demand for which increases as a result of a rise in the household education budget. The study finds that households are income elastic to demand public pre-tertiary education and private basic education but income inelastic to the rest. Additionally, the major difference between public and private education is that demand for the former is more sensitive to changes in household income than the latter. Based on the results, the inference drawn suggests that households are guided by investing in quality public education for their members. According to Rolleston and Adefeso-Olateju (2014); Schendel, McCowan and Oketch (2014), households are compelled to make extra education expenditures aside from tuition fees when they seek higher quality education. For instance, even though public basic education is compulsorily free, households are still income elastic to their demand to influence the quality of service rendered to students. At the private school level, available data per UIS data show that private basic education in Ghana is only 21 percent higher than in public schools. This has led to the increased emergence of private schools (both profit and not-to-profit basic schools) in the country. Available data from UIS data show a corresponding increase in enrollment from 13 percent in 1999 to 25.75 percent in 2016 at the basic schools, which offer quality education and are also well. At the secondary school level, the income elasticity of demand

for public secondary education is greater (1.023) than private secondary education (0.932). This suggests that households are more interested in demanding public secondary education than private secondary education because the former is considered to render more efficient education and is more common, and cheaper but also lacks some major infrastructure than the latter. Hence household enrollments are high in public secondary schools, which makes them increase their education expenditure share to public secondary education than private secondary schools.

Table 5: Expenditure and price elasticity of education demand by school type

	P1	P2	P3	P4	P5	P6
Q1	**-0.624*****	-0.188***	-0.209***	-0.052***	-0.156***	-0.056***
Q2	-0.102***	**-0.805*****	-0.067***	-0.024***	-0.056***	-0.026***
Q3	-0.064***	-0.059***	**-0.808*****	-0.019***	-0.049***	-0.023***
Q4	-0.033***	-0.011	-0.012	**-0.816*****	-0.018**	-0.064***
Q5	-0.031	-0.026***	-0.022***	-0.021***	**-0.849*****	-0.022***
Q6	-0.029	-0.009	-0.000	-0.043***	-0.012	**-0.876*****

	Expenditure Elasticity	
	Public	**Private**
Basic	1.285***	1.08***
Secondary	1.023***	0.932***
Tertiary	0.972***	0.970***

Note: ∗∗∗, ∗∗ and ∗ indicates significance at 0.1%, 1% and 5% respectively
Note: Q1-Q6 and P1-P6 are the respective quantities and prices of public basic, private basic, public secondary, private secondary, public tertiary and private tertiary education.

4.2.4. Price elasticity for education demand based on school type

The uncompensated own-price and cross-price elasticities of demand for all levels of education are presented in Table 5. From the table, all price elasticities are negative. The negative cross-price elasticities show that all the education goods demanded are complementary goods. Similarly, the price elasticities estimated increases at higher levels of education. One major difference between public and private schools is that the latter has higher absolute own-price elasticity values than the former. This is much expected because public schools are large beneficiaries of government subsidies and interventions in Ghana's educational system which makes them cheaper and more preferred largely. Despite the inelastic own-price elasticity estimated especially for public schools, one must be careful in interpreting the results as the basis for increased school fees. This is because the estimated prices are quite high to warrant increased fees. Given that indirect education expenses are about 51.5 percent of household total education expenditure and also the share of education total expenditure to household total expenditure in 2016 rose to 13.1 percent compared to 10.6 percent recorded in 2013 (GLSS 6 & 7 report), one can infer from the results that, households are gradually burdened with high education cost. According to Akyeampong (2019), if these costs are not curtailed, they could disincentive household education demand by a greater percentage by increasing the opportunity cost of education. In summary, the results show that household education demand for all levels of education is more sensitive to income changes than changes in the cost of education. Households quantity demanded for private education is more responsive to changes in cost than for public education in Ghana.

4.3. Demographic heterogeneity demand elasticity analysis

The sub-group heterogeneity analysis of this study establishes the difference in responsiveness between urban and rural household education demand elasticities for each level and type based on the QUAIDS model

estimates. It is important to note that the demographic factors used were incorporated to make our results significant and reflective of demographic considerations. However, one can further estimate the elasticities based on individual household demographics. This study examines the rural/urban locality elasticity comparison. Future studies may estimate other demographic factors based on their study objectives using the QUAIDS model. Tables 6 show the price and expenditure elasticities for each level and type of education based on the rural/urban location of the household in Ghana. From the tables, almost all the elasticities are significant at 0.1 percent. Similarly, all expenditure elasticities are positive indicating normal goods; the demand for which increases as household income rises. As expected, the price elasticities are all negative confirming a normal good where price and quantity demand for each level of education are inversely related

4.3.1. Expenditure elasticity for education demand based on school type and location of household

The results show rural households are income elastic to demand both public and private basic education while urban households are income elastic to public pre-tertiary and private basic education. Based on the results, one can infer that rural households are interested in acquiring at least quality basic education for their members amidst a limited budget if they seek to break from the intergenerational poverty cycle (Sackey, 2007). This is reflected in the high share of education expenditure and increased school enrollment at these levels of education. Notwithstanding, the income elasticities estimated for secondary and tertiary education among rural households is less than one indicating how relevant they are to them even though their share of education expenditure is lower. Urban households on the other hand are likely to have richer households and consider quality basic and secondary education as the minimum education prerequisite for increased employment and income opportunities for their members. They thus have increased education expenditure share and enrollment in these levels of education. A percentage increase in household expenditure increases pre-tertiary education expenditure by a higher percentage. The study finds that both rural and urban households are more income elastic to demand public education than private education except for rural public tertiary education.

Table 6: Demand elasticity of education demand by school type and location of household

Variable	**Expenditure Elasticity**			**Price Elasticity**		
	National	*Rural*	*Urban*	*National*	*Rural*	*Urban*
Public						
Basic	1.285***	1.32***	1.195***	-0.624***	-0.615***	-0.646***
Secondary	1.023***	0.998***	1.052***	-0.808***	-0.818***	-0.796***
Tertiary	0.972***	0.961***	0.979***	-0.849***	-0.843***	-0.853***
Private						
Basic	1.08***	1.069***	1.086***	-0.805***	-0.749***	-0.839***
Secondary	0.932***	0.977***	0.906***	-0.816***	-0.843***	-0.8***
Tertiary	0.97***	0.975***	0.967***	-0.876***	-0.877***	-0.876***

Note: ***, ** and * indicates significance at 0.1%, 1% and 5% respectively

4.3.2. Price elasticity for education demand based on school type and location of household

The results from Table 6 show that own-price elasticities for both rural and urban households at each level of education are progressively high and negative. This suggests both households see each level of education as very important and are less price-sensitive to its quantity demand. The price elasticities estimated suggest that rural households consider the opportunity cost of education to be reasonably low considering the greater future monetary benefits education brings to the household. Thus, even though expensive amidst their limited budget, the change in education cost does not influence the change in their corresponding quantity demand by a greater percentage. Among urban households, the combination of increased income and future benefits of education to the household position them to cater for the education needs of their members. Thus, the change in the cost of education has little impact on their purchasing power. This explains why the price elasticities are less than one. Comparatively, the study finds that, even though rural households are the least price-sensitive to both public and private basic education expenditure compared to urban households, rural households have higher own-price elasticities of demand for both public and private secondary education than urban households. This reflects the increasing cost of secondary education and its impact on demand for secondary education, especially among rural households.

Detectably, even though there is a significant variation in the price sensitivity of demand for each level of education, the difference is not too large in magnitude between rural and urban households. According to Tilak (2002) "if households perceive that the quality of human and physical infrastructure in the school is inadequate they feel compelled to invest in education." Indeed, poor school infrastructure and inadequate supply of resources are more pronounced in rural areas. This largely compels rural households to make high inevitable indirect education cost amidst a limited budget at the post-basic education level, especially. It is important these costs are efficiently curtailed, if not, any further increase could worsen the education expenditure among rural households. Studies in Ghana show that the high school enrollment in rural public basic schools despite setting tuition fees to zero is a reflection of the high opportunity cost of education in Ghana (Gadda et al., 2015). As expected, both rural and urban households are less price inelastic to private education than public education.

5. CONTRIBUTION OF THE STUDY

The study provides a strong insight about the education demand in Ghana based on school type and household level. It shows very important educational demand like its proportionality to household education budget. This manuscript could be used as possible reference for some individuals and/or groups who are concerned with education demand elasticity not only in Ghana but in other localities (or countries).

6. LIMITATION OF THE STUDY

One limitation of the study and the GLSS7 data used is the inability to capture and control for the quality of education households attend.

7. CONCLUSION

Our study examines the demand for education in Ghana, based on school type and level on the household using the GLSS 7 data. The study adopts the demographic extended version QUAIDS model incorporating sex of household head, rural-urban location of the household, and the labor status of the household head. One fundamental finding of the paper is that demand for each education level increases as the household education budget increases. Specifically, households are income elastic to pre-tertiary education expenditure but price inelastic to education expenditure at all levels. Notwithstanding, the own-price elasticities of demand rise at higher levels of education. The household heterogeneous analysis based on school type shows that households are income elastic to public pre-tertiary and private basic education demand with estimated income elasticities greater than 1. The study also finds that public education at all levels has higher income elasticities than private education at all levels.

Concerning cost, the study finds that households are price inelastic to both public and private education. Notwithstanding the own-price elasticity of demand for each level of private education is higher in absolute value than public education. The cross-price elasticity also shows that all education goods are complementary with negative price elasticities. Considering demographic factors, the study finds that rural and urban

households have higher income elasticities of demand for public education at all levels than private education except for rural public tertiary education. However, both rural and urban households are price inelastic to demand all levels of education.

One critical finding shows that rural households have higher own-price elasticity of demand for both private and public secondary education than urban households and this draws critical policy attention. Considering the fact that secondary education is set as a minimum prerequisite for increased education future benefits and job opportunities, the high cost of secondary education especially among the poor could discourage their demand for it by a higher percentage and worsen economic fundamental challenges. In policy recommendation, the study is aligned with the Free Senior High School policy introduced recently in the education system in Ghana. This policy will make secondary education affordable to the poor. The study further recommends the continuous and efficient implementation of the school feeding programme, capitation grants, scholarships to rural students, construction of classroom blocks, free distribution of school uniforms, buses, textbooks, sanitary pads, and footwear, especially in the rural areas. Government should consider adopting some private secondary schools under the free SHS program, especially for rural households. Offering government resource assistance to these private secondary schools to complement public secondary education is a right call.

Additionally, the government through the sector Ministry should remove unapproved education fees charged especially by the management of public schools, which often increases the cost of education in Ghana. Leveraging digitalization, a standardized school billing system should be developed with its accompanying mechanisms for all levels of education, especially public education. This system affords parents/students to know the specifics of a school bill and serves as a check for school managers. School managers who violate the standard bill and charge unapproved fees should be punished to serve as a deterrent to others. The effective implementation of this will result in a significant reduction in the actual fees charged to public school students, especially because a greater percentage of school fees are already paid for by the government. An independent education regulatory body should be formed to also regulate the fees charged by private institutions since they also benefit from government supports in diverse forms.

8. DECLARATION OF COMPETING INTEREST

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Appendix

Table 7: QUAIDS estimated results (General Education)

Variable	Basic	Secondary	Tertiary
Constants	0.262***	0.344***	0.398***
	(0.007)	(0.005)	(0.005)
Linear expenditure (beta)	0.08***	-0.028***	-0.052***
	(0.004)	(0.003)	(0.002)
Quadratic expenditure (lambda)	-0.003***	0.003***	-0.000***
	(0.000)	(0.000)	(0.000)
Household location (rural) (eta^1)	-0.025***	-0.016***	0.041***
	(0.003)	(0.002)	(0.000)
Sex of household head (male) (eta^2)	0.002	-0.003***	0.001*
	(0.000)***	0.000)	(0.000)
Employment status of household head (employed) (eta^3)	-0.005***	0.006***	-0.002***
	(0.000)	(0.001)	(0.000)
Basic education price	0.082***	-0.045***	-0.037***
	(0.001)	(0.001)	(0.001)
Secondary education price		0.079***	-0.034***
		(0.001)	(0.000)
Tertiary education price			0.071***
			(0.000)
Rho (demographic expenditure			
Location (rural)	-0.999***		
	(0.000)		
Sex of household head (male)	-0.000		
	(0.00)		
Labour status of household head (employed)	-0.000		
	(0.000)		

NB: ***, ** and * indicates significance at 0.1%, 1% and 5% respectively; standard errors in parenthesis.

Table 8: QUAIDS estimated results (Public and Private education)

Variable	Q1	Q2	Q3	Q4	Q5	Q6
Constants	0.13***	0.156***	0.175***	0.159***	0.209***	0.172***
	(0.004)	(0.004)	0.003)	(0.002)	(0.002)	(0.002)
Linear expenditure (beta)	0.036***	0.062***	0.04***	-0.064***	0.004*	-0.07***
	(0.004)	(0.003)	(0.003)	(0.001)	(0.002)	(0.001)
Quadratic expenditure (lambda)	0.007***	-0.014***	-0.014***	0.013***	-0.006***	0.014***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Household location (rural) (eta^1)	0.014***	-0.004***	-0.002	-0.001***	-0.005***	0.002***
	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Sex of household head(male) (eta^2)	0.004**	-0.0004	-0.003***	-0.0002	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Employment status of household head (employed) (eta^3)	-0.002	0.006***	-0.003***	-0.000	-0.002	0.000
	(0.002)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
P1	0.112***	-0.042**	-0.031***	-0.009***	-0.024***	-0.01***
	(0.001)	(0.00)	(0.000)	(0.000)	(0.000)	(0.001)
P2		0.096***	-0.024***	-0.006***	-0.018***	-0.006***
		(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
P3			0.086***	-0.007***	-0.016***	-0.008***
			(0.000)	(0.000)	(0.000)	(0.000)
P4				0.061***	-0.014***	-0.025***
				(0.000)	(0.000)	(0.000)
P5					0.087***	-0.014***
					(0.000)	(0.000)
P6						0.063***
						(0.000)
Rho (demographic expenditure						
Location (rural)	-					

NB: ***, ** and * indicates significance at 0.1%, 1% and 5% respectively; standard errors in parenthesis.
NB: Q1-Q6 and P1-P6 are the respective quantities and prices of public basic, private basic, public secondary, private secondary, public tertiary and private tertiary education.