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Demand for Health Care Services and Child Health Status in Nigeria- A Control Function Approach

Adeoti, A. I. - Department of Agricultural Economics, University of Ibadan, Oyo State, Nigeria
E-mail: jadeoti@yahoo.co.uk

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Awoniyi, O. A. - Department of Agricultural Economics and Extension Services, Bowen University, Iwo, Osun State Nigeria

Abstract

Nigeria has experienced significant increase in economic growth in the last decade yet the health indicators are very poor particularly in the rural sector where poverty incidence is high. The study attempts to provide insights into the determinants of health status and the demand for health care in Nigeria. Using the 2008 DHS data, the effect of the demand for health care service as a complement to other unobservable factors that affect health status of children is explored based on the complementary hypothesis. The data was analyzed using different estimation procedures and the result of the control function is explained. The demand for immunization for children is significant

in explaining child health. This expectedly induces the use of other health enhancing inputs and behaviours. In poor families, immunization was not significant. Also, older children and those residing in the rural areas suffer more from poor health but educated mothers have healthier children. Policy recommendation is that the immunization coverage area be increased. In addition, improving education among women will enhance the demand for health inputs and improve the health of their children particularly for the poor and those residing in the rural areas

Key words: complementarity, control function, immunization, Nigeria, underweight.

Introduction

Human capital has been identified as a major factor that influences poverty aside from physical capital (Strauss J and Thomas D, 1998). Health is an important component of human capital in the sense that investment in health has important direct effects on productivity and thus on economic growth. On theoretical ground they interact in important ways with health affecting economic growth and economic growth affecting health (Ajayi, 1992). Improved health status is expected to lead to enhanced welfare as well as economic growth. Access to health services consists of at least five components of service provision: availability, affordability, acceptability, appropriateness and quality. Although government in many instances both in the past and more recently continue to invest in the health sector, incidence analysis suggests that public spending in health and education benefits the non poor disproportionately. For example, NDHS, (2008) reported that only 4.8percent of children living in households in the poorest quintile are fully vaccinated, while 52.7 percent of children living in households in the richest quintile have received all recommended vaccinations. The national CWIQ survey carried out in 2006 reveals that 55.1 percent of the population sampled had access to health services and with marked difference in accessibility across rural and urban areas (NBS, 2006). Supply-side

problem, no doubt, will influence household health outcomes, but the demand-side is also of equal importance. Das Gupta (1990) pointed out that having an infant immunized requires a considerable degree of active participation on the part of the parents, in knowing and remembering when to have the child immunized, and in being convinced enough of the benefits of modern health care.

Several studies have been conducted on the supply of health care services in Nigeria (Ichoku 2005; Mbanefoh and Soyibo, 1994) and few on the demand for these services (Ichoku and Leibbrandt, 2003; Akin et al, 1986). Besides reports on preliminary surveys, specific in depth economic analysis on the determinants of health status in Nigeria is rare. Recognizing the importance of health indices and the poor state of these indices in Nigeria as compared with other developing countries like Brazil, it is imperative to improve on these indices. Consequent upon this, this study aims at producing insights into the factors that affect the health status of children.

Objectives

1. Determine the factors influencing the demand for immunization by households cross poverty groups and sector.
2. Analyze the effect of immunization and socioeconomic factors on health status of children across poverty groups and sector.

National health indicators

The low Human Poverty Index (HPI) rating reveals low human capital development with severe deprivation in health, education and access to improved water source. The health indicators in Nigeria are poor and becoming more worrisome. Table 1 presents some health indicators in Nigeria. Information on child mortality available in the Nigeria's Demographic and Health Surveys (DHS) carried out differently in between 1990, 2003 and 2008 shows an uneven trend but still high in international comparison. The nutritional status of under-five children is one of the acceptable indicators of households'

well-being (Thomas *et al*, 1990). Child health status has not shown remarkable improvement over time.

Literature review and estimation concerns

Currie and Stabile (2003), in their review found a vast literature documenting the relationship between socioeconomic status and health and emphasized that it has been difficult to determine whether the relationship exists primarily because health affects socioeconomic status, whether socioeconomic status has a direct impact on health, or whether both are affected by some third factor such as rate of time preferences. They substantiated their argument citing works done by Deaton and Paxson (1999) that emphasized the difficulty of inferring a causal relationship from aggregate cross-country or cross-state data, as has been done in many previous studies. Thus they used a panel Canadian children data. Case *et al* (2002) used data from many sources to examine at the relationship between family income and overall health status, where health status is a categorical variable with values 1 = Excellent, 2 = Very Good, 3 = Good, 4 = Fair, and 5 = Poor. The study found out that children's health is positively related to household income, and that the relationship between household income and children's health status becomes more pronounced as children grow older. The health of children from families with lower incomes erodes faster with age. In explaining income-health relationship, it may be that higher income parents are better able to manage chronic health problems.

Controlling for age, parental education and household demographics, Deolalikar (1996) found income elasticities of 0.7 and 1.9 on weight-for age and weight-for-height respectively in Kenya in 1994. Income is statistically highly significant in determining mortality and height-for-age in multivariate analysis of data from Uganda in 1992, but not in determining weight-for-height (Mackinnon, 1995b).

Christiansen and Alderman (2001) measured child malnutrition in Ethiopia using height-for-age z-score. It was found that gender of the child, household resources, food prices, maternal education and

strengthening of nutritional knowledge of the community through child growth monitoring or nutritional education are the key determinants of chronic growth disturbances. Also, Silva (2005) analyzed the determinants of child malnutrition in Ethiopia. The result showed that child's age, mother's height, household wealth; educational levels of the mothers and access to good water explain to a large extent the nutritional status of children. Kabubo-Mariara et al (2006) analyze the determinants of children nutritional status from the 1998 and 2003 Demographic and Health Surveys (DHS) for Kenya. Results suggest that child characteristics are significant determinants of children's nutritional status. In addition, share of women in a household and mother's education are found to be important household characteristics. Household assets are also important determinants of children's nutrition status but nutrition improves at a decreasing rate with assets.

There have been several studies on the factors that determine the use of health care services

Most people find it intuitively plausible that the effects of income on health, if it exists at all should be greater among the poor people than among the rich. Although, there is a great deal of evidence that the effect is not confined only to the poor, the intuition is supported by the evidence (Deaton, A, 2003). The responsiveness of the poor and non-poor individuals to changes in prices of health care may be different. While some studies have found that the poor are not affected differently from the non-poor, when prices of health services are increased(Akin et al,1995; Lindelow,2005) ,some other studies gives evidence that the magnitude of the price effect varies with changes in an individual's welfare status. In particular, demand is more elastic for the lowest or poorest quintile and inelastic for the top quintile (Gertler et al, 1987). This suggests that households' poverty status will impact on their demand for health care services.

These studies have revealed that socioeconomic factors such as income, mother's education, other community factors such as food

prices, availability of skilled personnel in the community all affect health status. However, Sahn (1994) reports that the effect of income on weight-for-height is small.

Regressing outcomes such as health, on inputs, such as use of health care, will render biased estimates of the causal impact of the latter because both the inputs and the outcomes reflect the values of the health endowments. (O'Donnell *et al*, 2008b). The most popular empirical strategy is to estimate reduced form demand relations. If estimates of the health production technology are desired, then the problems of omitted variable bias and unobservable heterogeneity must be confronted. For example, regressing health on health care use, while omitting education, will give a biased estimate of the impact of health care in the likely instance that it is correlated with education. Resolution of the problem demands a sufficiently rich data set. The problem of heterogeneity bias arises from the unobservable health endowment, which induces correlation between the observable and unobservable components of a model of health determination. With cross-section data, correction of the resulting bias requires the availability of instruments. Appropriate instruments vary with the specific inputs being considered. At a general level, instruments used in the estimation of health production functions commonly come from geographic variation in market prices, from family endowments, for example, land rights, from characteristics of public health programs at the regional level. Also, local commodity prices and measures of community level infrastructure have been shown to be valid instruments for health inputs (Rosenzweig and Schultz, 1983; Strauss, 1986; Strauss and Thomas, 1998; Wooldridge, 2002, Ajakaiye and Mwabu, 2007).

It is also widely recognized that the estimation of health production functions is subject to problems of interdependence and endogeneity. Many of the likely determinants, such as family income and education of parents are interrelated, such that having both as determinants could give biased estimators. In addition, there tend to exist mutual relations between health inputs (supply variables) and health outputs (illness

incidence) causing endogeneity in the estimation of health production functions. The traditional econometric solution to the endogeneity problem is the use of instruments for endogenous variables. Some studies have employed this approach and will serve as guide in this study (Ajakaiye and Mwabu, 2007; Fambon S et al, 2009). This study adopts the control function approach with the use of instrumental variables to estimate the required parameters. The approach controls for both endogeneity and heterogeneity in the sampled households.

Theoretical framework

Utility function

The determinants of an individual's health usually are decisions made by the individual or the household in which he or she lives. Therefore a natural starting point is the determination of individual health at the household level. Following Strauss and Thomas (1998), the household is assumed to be the major decision making unit and the economic problem is one of maximizing a utility function subject to constraints. The household production model therefore provides a framework for investigating the relationship between health outcomes and other variables. Following the utility function by Ajakaiye and Mwabu, 2007; the utility function is expressed in the form:

$U = U(C, T, H)$ 1

Where

C = Consumption of non-health goods that yields utility but has no direct effect on health status in the household

T = Consumption of health–related goods that yields utility and also have direct effect on health status in the household

H = Health status in the household measured by anthropometric measures in the household

$H = F(N, E, B, S, A\ \mu)$ 2

Where

H is the health status

N is the use of health care services

E is the demographic and socio-economic characteristics of the individual,

B is the time of the ith individual devoted to health-related procedures,

S is the household endowment

A is the endowment of the community

N is the purchased market inputs such as use of health care services providers (HS) that affect household health status. μ is the component of household health status due either to genetic or environmental conditions.

The household maximizes (1) given (2) subject to the budget constraint given by equation (3)

$$I = CP_c + TP_T + NP_N \quad \text{.....3}$$

Where,

I = exogenous income;

$P_cP_TP_N$ = prices of the health-neutral good C (such as clothing), health-related consumer good T (such as quitting smoking) and health investment good N (such as use of health services) respectively; Note that from equations (1) and (2) that the health investment good is purchased only for the purpose of improving health status so that it enters the household's utility function through H.

Following Strauss J and Duncan Thomas(1998) and Son M and Menchavez R (2008), the health production function relates health outcomes to health inputs, time devoted to health related procedures, demographic and socio economic characteristics, household assets

,community health characteristics and prices and to factors unobserved to the analyst that affect health.

The health status as outputs include examples such as a person's height, body mass (weight measured in kilograms/height, measured in metres), disease incidence or severity, or ability to function easily at specific physical activities such as walking for 1 kilometre or mortality. Examples of health inputs include use of health facilities, medications, immunizations ,nutrient intakes such as calories, proteins, iron, vitamins and minerals; type of feeding in the case of infants (e.g., sole breastfeeding, supplemented breastfeeding and so forth). Others are water and sanitation quality as a measure of exposure to pathogens; exposure to underlying disease conditions, for which one crude proxy may be rainfall.

Methodology

Scope of the study

Nigeria is the most populous country in Africa and the ninth most populous Country in the world providing habitation for 1.9% of the world's population as at 2005. There is a forecast that this will rise to 2.2% in 2015, and attain the sixth most populous country rank by 2050. The National Population Commission (NPC) put the population of Nigeria at about 88.5 million in 1991 and 140 million in 2006 (FRN, 2007). The 2006 census estimates further claims that 42.3% of the population is between 0 and 14 years of age, while 54.6% of the population is 15 to 65 years of age. The birth rate is significantly higher than the death rate, at 40.4 and 16.9 per 1000 people respectively.

Sources of data

The study uses secondary data comprising mainly of the DHS data collected Macro International. The DHS survey data is a national representative data and provides data on the age, weight and height of children and adult in households. In addition, it contains rich

demographic data and few relevant socio-economic data. Also, it provides information on household assets and households' choice of HS provider. The data on HS providers and food prices are obtained from the National Bureau of Statistics and Federal Ministries of Health, Abuja.

Types of data

The literature reviewed reveals that individual health status and the demand for health care services (HS) depend on a variety of factors. Accordingly, the data used for the study include the following:

i) Individual and household demographic and socio-economic characteristics – These include the age and gender of the child. Household characteristics include household structures which are household size, employment status and formal education of mother.

ii) Community characteristics - The type of HS providers in the community which are public, private, religious and traditional care providers in the community. The time taken to fetch water, local prices of food items namely beans and rice. The data for the food prices were obtained from the National Bureau of Statistics Agricultural Survey Report for 2005/2006. The average prices of the selected commodities for the year were used. The Naira value of the food prices were collected at the farm gate and also from the retailers across the 36 states and the Federal Capital Territory for the year. The farm gate prices were used as the food prices of the commodities in the rural areas of the country while the retail prices were used as the prices of the commodities in the urban sector of the 36 states and the Federal Capital Territory. Also the geographical location, that is, whether rural or urban were obtained.

iii) Household income status– The wealth index was used as proxy for household income. The asset index represents an internally coherent, robust and comparable measure of poverty (Booysen, 2002). The households were classified into poor and non-poor based on their wealth index according to DHS classification. The wealth index was

categorized into 5 groups which are: Richest, Richer, Middle, Poor and Poorest. Households whose wealth index belongs to poor and poorest according to the wealth index were classified as poor. While households whose wealth index falls within the richest, rich and middle class were classified as non-poor

iv) *Use of HS* The demand for immunization for children is used as health input in the children's health model .Children who are partially immunized or fully immunized were categorized as immunized while those who were not immunized at all are categorized as not immunized.

v) Other household characteristics- agricultural land owned, anthropometric measures of children (underweight).

vi) Environmental factor is the mean rainfall in dry and wet seasons. The rainfall data was sourced from the Nigerian Metrological Station for the 36 states in the country plus the Federal Capital Territory. The average rainfall in mm's during the dry season and during the wet season for each of the State capitals was used as a proxy for the precipitation across the States and the Federal Capital Territory.

Empirical model

The empirical model in this study is an health production function as expressed in the following structural equation:

$$H = \delta_H X_i + \beta N + \varepsilon_1 \quad \text{..... 4}$$

δ,β, ε are vectors of parameters to be estimated, and the disturbance term respectively.

H = health status of the individual

N = health input demand

X_i = exogenous variables affecting health status

For Children

H = Z scores for Weight-for-age.

N = Received vaccination (1 if yes, 0 otherwise)

The weight for age is selected since it is a composite index of height-for-age and weight-for-height and takes into account both acute and chronic malnutrition. The N variable captures the demand for health input in the empirical model. It is considered to be complementary to other inputs that improve the health of child and mother. It is hypothesized that the demand for these health input will serve as an incentive to undertake other health-augmenting behaviours (see Ajakaiye and Mwabu, (2007), Mwabu, 2008, Dow et al. (1999)). It is used as a proxy for unobservable behavioural factors affecting health status. N is an endogenous variable and as discussed earlier, estimating the structural equation without controlling for endogeneity will lead to biased estimates of the causal impact of the health outcome. This requires the estimation of reduced form demand equation.

The reduced form equation is expressed as:

$$N = \delta_N X + \varepsilon_2 \quad \text{.....5}$$

X = exogenous variables consisting of X_i and vector of instrumental variables

To control for endogeneity, and heterogeneity, equation (4) is expressed explicitly as in equation (6)

$$H = \alpha_0 + \delta X_i + \beta N + \alpha_1 V_1 + \gamma_1 (V_1 \times N) + \lambda Q + \theta (N \times Q) + \mu \quad \text{.....6}$$

Where:

V_1 = Fitted residual of N (observed value of N minus its fitted value), derived from a linear probability model;

V_1xN = Interaction of the fitted child immunization residual with the

actual value of the vaccination status;

Q = exogenously supplied health input such as quality of health care provided;

N x Q = Interaction of the fitted child immunization residual with the exogenously supplied health input;

Q is the input set whose utilisation is induced by immunisation or is complemented by it. The θQ is the complementarity effect which shows the effect of a unit increase in the interaction of Q with immunisation. Data on Q is not available so that its effect and its interaction with immunisation is not included in the estimated model, the indirect effect is absorbed in the parameter estimate for immunization, β (Mwabu, 2008).

μ = Composite error term comprising ε_1 and a predicted part of ε_2 under the assumption that $E(\varepsilon_1) = 0$;

Exogenous variables (X_i) hypothesized in this study to influence child health status are;

Household characteristics

Employment status of mother (1 if employed, 0 otherwise)

Mothers has no formal education (yes=1, 0 otherwise)

Household size

Individual characteristics

Age of the child in months

Gender of the child (1 if male, 0 otherwise)

Child received immunization (yes=1, 0 otherwise)

Instrumental variables are:

The instruments used in the estimation of health production functions commonly come from geographic variation in market prices, from

family endowments, for example, land rights, and from characteristics of public health programs at the regional level. The constraint on data has limited the choice of the instruments to household's ownership of agricultural land, food prices and precipitation. Also, in the absence of data on distance and time taken to health infrastructure, time taken to water source is to be used as proxy. The instruments are:

- agricultural land owned (own land =1,0 otherwise)
- time taken to get to water source in minutes(proxy for time taken to get to health infrastructure);
- prices per kg of rice and beans,
- mean rainfall in mm in dry season and wet season in each cluster.

The empirical model is estimated using the Two Stage Least Squares and the Control function estimation procedures. This is compared with the Ordinary Least Squares estimated parameters. The model will be estimated for all households and also disaggregated based on sector and poverty status of the household.

Results

Socio-economic characteristics of children

The mean age of the children is 28 months and that of their mothers is 29 years. This indicates that the average child is about 2years of age while mothers are about middle aged and can be considered young. The mean household size is 7 and can be considered large which would reduce the mean per capita household expenditure and invariably reduce the amount that can be expended on purchasing nutritious food. About half of the children are male showing almost equal gender representation in the sampled children. Also, 50 percent have been either partially or fully immunized .Children who were not immunized stand the risk of contacting diseases since some of the diseases are communicable diseases with the likelihood of impairing their health. The level of immunization coverage need to be expanded

and all households needs to be sensitized further on its importance. The results in table 2 also reveals that about two-third of mothers are engaged in income generating activity while 47percent have no education. Education is key to access and appreciation of government programmes and high income labor activities, it is therefore of importance that efforts to improve the level of education of girls and women be enhanced.

Determinants for the demand for child immunization

The result for the full sample is presented in Table 3. The excluded instruments in the model must be correlated with the endogenous variable which shows a measure of its relevance or strength but uncorrelated with the error term known as exogeneity. The Partial R^2 shows the relevance of the instrument and its significance is tested for by the F ratio. The F test statistic is significant at 1 percent which implies that the instruments are relevant. The size of the F statistic reveals the strength of the instruments and their predictive powers. The rule of thumb is that F statistic that is equal or more than ten; reveals that the excluded instruments are not weak (Mwabu, 2008). The F statistic for the instruments in the estimated model reveals that the instruments are not weak. The result indicates that the excluded instruments are correlated with the endogenous variable and the association is not weak. To test for over identifying restrictions, the result in Table 4 reveals the Sargan test for over identification of instruments. The null hypothesis of the presence of over identification is rejected and implies that the instruments are not correlated with the error term. The estimated model therefore fits the data well.

The result reveals that eight of the variables were significant at levels not more than 10 percent. Four of these variables have negative influence on the probability to demand for immunization for children .These are the prices of food commodities like rice and beans, having mothers that do not have formal education and precipitation in the dry season. These two food items are staples in the Nigerian diet and are

not cultivated in all agro ecological zones. Households therefore have to spend their income on the purchase of these items. This result shows that inflation can reduce the probability to demand for immunization. Low literacy level of mothers also reduces the probability of being immunized as such mothers may not appreciate the importance of it or may prefer traditional methods of child care. The result of the study conforms with the study of Thomas (2010) in which he identified children whose mothers have high literacy level were fully immunized when compared with children whose mothers has no formal education. Factors that increase the probability of demanding for immunization are the age of the child, mothers' occupation and household size. Residing in the urban sector also increases the probability to demand for immunization. Mothers that are employed are likely to be more informed due to their interaction with others and will be willing to immunize their children. It should be noted that the size of the coefficients are small which means their influence is still minimal. Contrary to a priori expectation, the increase in the age of the child increases the probability to get immunized. The expectation is that mother's will be eager to immunize the younger ones to ensure their survival than the older ones. This might be due to the fact that the children can get immunized in schools, religious centres etc; as a result of the Government programme on Expanded Immunization Programme without the effort of their mothers. The same also explains the positive influence of household size. Survey carried out by Wood *et al*, 1998 also shows that children between 7-12 months missed their immunization when compared with older children.

Determinants of underweight of full sample

Table 4 presents the results of the factors that determine underweight in children under different estimation procedures and four assumptions. Firstly, the OLS result reveals an insignificant relationship between immunization and the health of the child as measured by underweight. Secondly, using the 2SLS estimation

procedure shows a significant relationship between the two variables. In addition, the size of the coefficient increased from 0.0066 to 0.9027. The Durbin –Wu- Hausmann chi- square test reveals that the null hypothesis that the immunization variable is not exogenous should be accepted and therefore endogeneity is implied. The OLS estimation procedure is therefore incorrect and gives a spurious result of the model. Thirdly, the model was estimated by controlling for the linear interaction of vaccination with its residual. The predicted immunization residual was significant at 1percent. This implies that the market health input is endogenous and therefore controlling for the endogeneity of immunization purges the structural equation of the correlation of immunization with the error term. In the fourth and final estimation, the model did not improve controlling for the non linear interaction between the predicted residuals and immunization and therefore heterogeneity cannot be explained in the sample.

The control function estimate under the linear interaction of vaccination with its residual and the result of the IV estimation procedure gave similar result .The result of the control function is used to explain the result. It shows that only the endogeneity of the immunization variable is controlled for in the fitted model.

The result shows that immunization reduces underweight in children and therefore the government must continue its drive to increase the coverage areas for child immunization. However, complementarity hypothesis explains that the reduction in underweight cannot be due to immunization only but that mothers would have also engaged in other health enhancing behaviours and use other inputs to reduce underweight As stated in the section on the empirical model, the reduction in underweight is also captured in the quality of the health care. The indirect effect of the quality of health care is captured in the estimated coefficient of the immunization variable. Therefore, following the complementarity hypothesis, the reduction in underweight comes from the use of health and non-health inputs, health enhancing behaviours, quality of health inputs; all induced by immunization of the child. This implies that a causal relationship

cannot be implied for the immunization variable alone and therefore the exact magnitude of the direct effect of immunization on child health cannot be stated.

Other variables that significantly affect underweight are age of the child, mother's educational status, household size and sector of residence. Various studies have also identified these variables as factors that influence child nutritional health status (Mwabu, 2006; Oyekale, 2007; Kabubo et al 2009, Omilola 2010, Ajieroh 2010). Older children are more likely to be underweight than younger ones. This is in consonance with the outcome of similar studies (Mwabu, 2006, Oyekale,2007; Kabubo et al 2009). Having a mother without formal education will increase underweight. This agrees with Ajieroh (2010) who stated that having mothers with formal education will impact positively on child health. Increase in household size will increase underweight and underweight occurs more in rural areas than in urban areas.

Determinants of underweight using the control function for full sample and sub-samples by sector and poverty status

The results of the sub sectors and poverty status are presented in Table 5. The result of the rural sub-sample indicates that only the gender of child and mothers having no formal education impacts significantly on the child health status. A child being male and mothers having no formal education increases underweight among children. For households in the urban sector, only one variable has a significant effect on child health status. This significant variable is the age of child, which implies that as a child grows older there is the tendency for the child to be underweight

Disaggregating by the poverty status of the households reveals that immunization is not significant in reducing underweight among children born in poor households. It is possible that the preoccupation on ensuring survival does not allow them create time to go for immunization. In line with the complementarity's hypothesis, these

mothers may not be providing other complements necessary for their child's health. Also in poor households, mothers having no formal education increases underweight while residing in the urban sector reduces it. It shows that the children in poor households born by educated parents and residing in the urban sector fare better than those in the rural sector. The problem of children being underweight remains a challenge for the poor especially those in rural areas and the result of the whole sample reveals that immunization can reduce underweight along with other factors. Although immunization coverage has increased from 13% in 2003 to 23% in 2008 (NDHS, 2008) in the country, more efforts should be made to sensitize and reach poor households. The result for non-poor households reveals that immunization significantly reduces underweight. The size of the coefficient is also large.

It is only in the rural sector that gender is still a significant variable. It reveals that cultural institutions are strong and slow to change in traditional settings in particular. Having no education also increases underweight among the poor and in rural sector while older children are more underweight in urban and non-poor households. In general, underweight is less in the urban sector.

Conclusion and policy recommendation

The paper attempted to isolate the factors that affect the health status of children in Nigeria and particularly among the poor using different estimation procedures to control for bias in the estimates. The factors that influence the demand for health inputs were also determined. The control function approach gave robust estimates compared to the Ordinary Least Squares and Two Stage Least Squares estimation procedures. The endogeneity of the health input were controlled for in the estimations while heterogeneity in the sampled population could not be confirmed.

The factors that are key in determining the health of a child are immunization, age of the child, mother's educational status,

household size and sector. Immunization reduces underweight, but immunization alone cannot be responsible for the reduction. Due to complementarity, mothers would have also engaged in other health enhancing behaviours and use other inputs to reduce underweight including the indirect effect of the quality of health care induced by immunization. This implies that though a causal relationship cannot be implied for immunization alone as it induces the use of other health inputs which enhance child health. For the poor, immunization is not significant but mother's education is important. In addition, increased household size and living in the rural areas increases underweight in children. The important factors in determining the demand for immunization are age of child, household size, mother's education and her employment status. Education, particularly among the poor and those in the rural sector is important. The prices of food will also impact on demand for health input as households will have to spend more time to work.

In order to improve children health, it is important to improve on the coverage areas for immunization in the country. Also, the education status of mothers particularly among the poor and those in rural areas must be improved. The effect of food prices on the demand for improved health care can also be ameliorated with better work opportunities.

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Table 1: Health Indicators in Nigeria

		1999	2003	2008
1	Under-five mortality rate	168/1000	201/1000	194/1000
2	Infant mortality rate	90/1000	100/1000	75/1000
3	Accessible to safe water (%)	54.2	42.0	56
4	Contraceptive prevalence (%)	8.6	13.0	15.0
5	Maternal mortality rate	704/100,000	-	545/100,000
6	Total fertility rate	5.2	5.7	5.7
7	Children nutritional status (%) Stunting Wasting Underweight	 - - -	 42 11 24	 41 14 23
8	Mothers' nutritional status (%) Thin (BMI<18.5) Normal (BMI 18.5-24.9) Overweight BMI>25	 - - -	 15.2 64.3 20.5	 12.2 65.7 22.1
9	Life expectancy in years		56.4*	48.0
10	Immunization (%) Fully immunized Not immunized			 22.7 28.7

Source: Combination of NDHS, MICS, 1999, NDHS 2003, 2008

*Figure for 2006 (NBS)

Table 2: Socioeconomic Characteristics of Children and Mothers

Number of observation 18991

Variable	Mean	Standard Deviation
Age of Child in months	28.36	17.13
Age of mother in years	29.43	6.98
Household size	7.11	3.59
Variable	**Frequency**	**Percentage**
Gender of Child	9420	49.60
Child received immunization	9475	48.89
Underweight	4368	23.00
Employment status of mother	12,629	66.50
Mother has no formal education	8983	47.30

Source: DHS 2008

Table 3: Linear Probability Model of Demand for Immunization. Dependent Variable Equals One if Child is immunized and Zero otherwise (T statistics in Parenthesis).

Variables	Pooled
Exogenous covariates	
Age of Child (years)	0.0082 *** (17.03)
Gender of child(male =1)	-0.0200 (-1.21)
Mothers had no formal education (1= no education)	-0.0414 ** (2.15)
Mother's occupation (1=employed)	0.0169* (1.59)
Household size	0.0088 *** (3.74)
Sector (1= Urban)	0.6089*** (5.73)
Excluded instruments	
Access to Agric land (1= have access)	0.0037 (0.32)
Time spent to fetch water in minutes	0.0001 (0.58)
Log of price of rice per kg in Naira	-0.8025*** (4.04)
Log of price of beans per kg in Naira	-0.2602*** (4.01)
Cluster mean rainfall in dry season (x 10^{-2})	-0.001*** (2.60)
Cluster mean rainfall in wet season (x 10^{-2})	
Constant	0.0002 (1.18)
R^2 / (Pseudo R^2)	
Partial R^2 on excluded instruments	3.054*** (6.43)
F ratio(Test of excluded instruments)	0.0204
No of observations	0.0036
	32.98*** (0.000)
	18,991

Source: DHS 2008

Table 4: Determinants of Underweight in Children Dependent variable is the Z scores for weight for age. T statistics in Parenthesis

Variables	Estimation Under Different Assumptions			
	OLS	2SLS	Control function	
			Linear interaction of vaccination with unobservables	Non-linear interaction of vaccination with unobservables
Endogenous health input				
Immunization	-0.0066 (0.27)	0.9027*** (2.13)	0.9027*** (2.20)	0.8662*** (2.11)
Exogenous covariates				
Age of Child (years)	-0.002 (1.49)	-0.0099** (2.56)	-0.0099*** (2.65)	-0.0097*** (2.59)
Gender of child(male =1)	0.0288 (0.51)	-0.0494 (0.84)	-0.0494 (0.86)	-0.0498 (0.87)
Mothers had no formal education (1= no education)	-0.2964*** (5.00)	-0.2953*** (4.81)	-0.2953*** (4.98)	-0.2977*** (5.02)
Mother's occupation (1=employed)	-0.0130 (0.36)	-0.0257 (0.68)	-0.0257 (0.70)	-0.0256 (0.70)
Household size	-0.0061 (0.77)	-0.0164* (1.72)	0.0164* (1.78)	0.0164* (1.78)
Sector (1=Urban)	0.4133*** (6.44)	0.4088*** (6.15)	0.4088*** (6.36)	0.4070*** (6.33)
Predicted Residuals and Interaction Terms (Control Function Variables)				
Immunization residual			-0.9126*** (2.22)	-0.9421*** (2.29)
Immunization X Immunization residual				0.0091 (1.18)
Constant	0.8855*** (6.51)	0.5813*** (2.91)	0.5813*** (3.01)	0.5847*** (3.03)
R^2 F statistics	0.0409 13.34 (0.0000)	0.0658 13.10 (0.0000)	0.0052 12.30 (0.0000)	0.0052 11.09 (0.0000)
Durbin–Wu-Hausmann chi-sq(1) exogeneity test for the immunization variable (p-value)		4.93597 (0.0263)		
Sargan test for overidentification of instruments(p-value)		2.862 (0.1509)		
Number of observations	18991			

Table 5: Determinants of Underweight in Children Dependent variable is the Z scores for weight for age. (T statistics in Parentheses)

Variables	Pooled	Sector		Poverty Status	
		Rural	Urban	Poor	Non-poor
Endogenous health input					
Immunization	0.9027*** (2.20)	-0.1339 (0.41)	0.4372 (0.58)	-0.3050 (0.55)	1.1378*** (2.10)
Exogenous covariates					
Age of Child (years)	-0.0099*** (2.65)	0.0019 (0.71)	-0.0151* (1.69)	0.0034 (0.77)	-0.0218*** (3.35)
Gender of child(male =1)	0.0494 (0.86)	-0.0659*** (1.76)	0.2700 (1.55)	0.0030 (0.05)	0.0905 (0.79)
Mothers had no formal education (1= no education)	-0.2953*** (4.98)	-0.4590*** (12.21)	0.2119 (1.05)	-0.4587*** (6.73)	0.2177 (1.29)
Mother's occupation (1=employed)	-0.0257 (0.70)	0.0197 (0.82)	-0.1086 (0.97)	0.0207 (0.48)	-0.0537 (0.73)
Household size	-0.0164* (1.78)	0.0058 (0.95)	0.0207 (0.79)	-0.0092 (0.91)	-0.0261 (1.47)
Sector (1=Urban)	0.4088*** (6.36)			0.7177*** (7.53)	0.0882 (0.74)
Predicted Residuals and Interaction Terms (Control Function Variables)					
Immunization residual	-0.9126*** (2.22)	0.1503 (0.46)	-0.4963 (0.65)	0.3017 (0.54)	-1.1633*** (2.14)
Constant	0.5813*** (3.01)	0.1258 (0.93)	0.4628* (1.52)	1.6028*** (5.24)	0.3274 (1.17)
R^2	0.0052111	0.0122	0.0018	0.0088	0.0032
F statistics	12.30 (0.0000)	23.78 (0.0000)	1.44 (0.1859)	14.23 (0.0000)	2.51 (0.0101)
Number of observations	18,991	13,534	5,452	12,785	6,197