Children's Health and Asset Endowments in Cameroon

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Abstract: *This study attempts to carry out a comprehensive analysis on "children's health and asset endowments (AE) in Cameroon". The objective is to examine the effects of child health on household asset endowments. From the Control Function Model, we compute the result using the combined 2004/2011 demographic and health survey. The result of the Control function shows that child health is positively and significantly associated with the production of HAE. In addition, the relationship between child health and asset indicator is a matter of the male gender while decomposing child health effect on AE for household residence, we realized that it is more an issue of rural household residence due to inadequate provision of public goods. In terms of policy, child health should be included in the new vision of successful asset building so that, families raising children with good health, asset accumulation should start early and last long.*

Keywords: *child health, control function, direct and indirect, household asset endowments, Cameroon*

1. Introduction

Timely, accurate and comprehensive information on children's health, development and asset endowments is essential for monitoring the progress of government economy, which is critical for the development of evidence-based policy. The notion of asset endowments across the social sciences has received considerable attention, unfortunately until now, there is no single measure of asset endowments that is generally accepted above all others. Consequently, many conceptual and methodological issues concerning asset endowments measurement need to be treated with care (UNICEF, 2019). In this study, our usage of the term household asset endowments is considered as endowments related to the household's ability to sustain life through food supplies, wealth and health. Child health in general appears to be an important component of economic growth and poverty reduction because it shapes both present and future human capital, as well as livelihood prospects. Good health at childhood as argued, does not only affect the physical growth potential, risk of morbidity and mortality in later years of life; but also releases potential household savings on medical expenditures and extra-time to adult household members to take more advantage of labour market opportunities, as well as the child's capacity to learn and prospects for better future standards of living (Tambi, 2017).

The policies that increase availability of child health services act on the supply side of the market for these services while policies that increase their consumption act on the demand side. As justified by Adeoti and Oni (2017), both sorts of policies need to be implemented to improve child health. While the availability of reproductive health services and commodities is a necessary condition for better health, it is by no means sufficient. Child health products and services must be used in order for them to improve health. Thus, an understanding of the demand side of child health care markets is key to the design and implementation of policies that enhance the health

of new born. Hence, it is imperative for policy-makers to know the parameters of child health care demand functions and the associated health production technologies to plan for provision and utilization of family health services and related goods.

In viewing studies on child health and economic prosperity in later life, evidence suggests that insults to child health affect both health and economic prosperity into adulthood (see Haddad et al., 2003). For example, in twin studies Behrman and Rosenzweig (2004) found that the higher birth weight twin was taller, completed more education and had higher wages as an adult. Adeoti and Oni (2017) noted that the finding that birth weight is predictive of health human capital outcomes in later life may indicate that low birth weight is a marker for poverty and other sources of deprivation, broadly defined while in utero. For example, the low birth weight is predictive of lower school attainment and less success in the labour market. This literature serves to highlight the need to understand influences on child health and how it can be improved and maintained to secure favourable future economic outcomes such as asset accumulation (Adeoti and Oni, 2017).

It is widely acknowledged that a healthy nation is a wealthy nation. Bloom and Canning (2000) posit that there are good reasons and strong evidence that health improvements stimulate economic development, contrary to the traditionally held belief that higher incomes stimulate consumption that promotes health. However, both views are compatible, reflecting causality between health and economic development that is bidirectional. Several mechanisms through which health improvements can lead to income growth exist (Kaba et al., 2017). Healthier populations tend to have higher labour productivity, live longer and therefore have incentives to save and invest in skills, education and physical capital and eventually benefit from the "demographic dividend". Furthermore, investments in health increase human capital that is vital for fostering economic development. To the extent that better health contributes to economic growth and makes investment in health a tool for macroeconomic policy (Alongifor, 2016).

As stated by Greotaert et al (1997) household endowments help the household to have access to income from different sources; hence, it helps to reduce intra year income variability which is common among rural households in SSA countries. These assets serve as sources of opportunities/constraints to getting out of poverty among different households. The endowments determine what they do, how they do it, and their capability to adapt to changes beyond their control. The availability of household endowments can thus suppress opportunities for some members of a community while enhancing others. As a result, a key factor in ensuring a good and sustainable quality of life may lie on a more equitable distribution of physical assets combined with the human assets of a household.

From the above analysis, in developing countries, studies on the impact of macro level economic changes due to child health have mainly focused on the effects of economic down turns (Pongou et al., 2006 on Cameroon). Little attention has been paid to the health effects on asset endowments especially using health survey. Haddad et al (2003) separately analyzed household and country level data, and others have used only country level data (Fambon and Baye, 2017) but none has tracked changes on household asset/wealth accumulation during a period of sustained child health in any of the countries included in their analysis. Mwabu (2009) attempted empirically to link child health to household economic well-being using the household consumption survey and found that literacy status of household heads and nutrition of under three year old children is positively and significantly associated with better economic well-being using household consumption survey. Despite the importance of this study, it did not examine the role of other effects on child health that we intend to investigate in this study.

Further, asset studies using demographic and health survey data are spatial in Africa and Cameroon in particular. This gap in the literature could be understood in the context of paucity of household level data during the period of growth that characterized many countries in Africa

after independence. Most data have been collected only in the late 1970s and 1980s when most economies (DHS collected only in 1991, 1998, 2004 and 2011 while household consumption surveys were collected in 1996, 2001, 2007 respectively in the case of Cameroon) were experiencing severe declines. In addition, Alongifor (2016) noted that, Cameroon is ranked <u>18th among the 20 countries</u> in the world with second largest contributor to the under-five and maternal mortality rate in the world in 2016. She equally revealed that many poor women and girls in Cameroon experience difficulties accessing quality health care service also maternal health is a <u>human right</u> and no woman should be deprived of this right. In this study, we shall use the Cameroon DHS collected in the year 2004 and 2011 to examine the determinants of child health and the extent to which its changes can influence household asset endowments. To do this, we consider the following objectives: to examine the effects of child health on household asset endowments, compare the degree of child health influence on household asset endowments in rural and urban areas, to verify gender disparities in the child health effect on household asset endowments and to propose relevant policy to improve on the child health and asset endowments relationship.

2. Literature Review

Weil (2006) in examining the link between health and economic outcomes at either the individual or the national level has generally examined two types of health measures: inputs into health and health outcomes. Inputs into health are the physical factors of an individual's health. This includes nutrition at various points in life (in utero, in childhood and in adulthood), exposure to pathogens and the availability of medical care. Health outcomes are the characteristic that are determined both by an individual's health inputs and by his genetic endowments. Examples include life expectancy, height, and ability to work hard and cognitive functioning. For the purpose of explaining income differences among countries or individuals, the key health outcome of interest is how health affects the ability to produce outcomes. In contrast to human capital in the form of, health, there are a number of health outcomes that can be observed at either the individual level or both. These health outcomes are referred to as health indicators. However, this study is concerned with the input measurement of health, particularly the reproductive healthcare through which we want to examine the direct and indirect effects of child health on household wealth.

In a similar study using household consumption survey and children of 0 to 36 months, Baye and Fambon (2010) underscored that child health is associated with high levels of production. Their result revealed that female headed households would exploit the resulting extra-time, budgetary savings and peace of mind at work, because of better child health, to enhance economic well-being more effectively than those of their male counterparts. Not-with-standing, our study is different from that of Baye and Fambon (2010) in that: (i) the data set is different, while they used the 2001 Cameroon household consumption survey, we will used the 2004 and 2011 demographic health survey, (ii) we shall use as a measure of child health, height-for-age, meanwhile they used weight-for-age standard scores. Lastly, (iii) they were interested in evaluating spill-over effects of literacy on child nutritional status, however, we are interested in linking child health on asset endowment.

Likewise, efforts to promote economic development in communities and regions need to assess and improve the health of the community as well as other core systems such as transportation. Asset endowment is dependent upon many factors, including effective policies and institutions (such as governance, economic policy and public systems) as well as human resources and technology. Health has a critical role in asset endowments by impacting parts of life – directly on human resources and indirectly on public systems and public policies. As Tambi

and Atemnkeng (2018) has demonstrated, improvements in health have contributed as much to the overall improvement in life style as have all other advances combined.

In an early empirical review of the impact of health on economic development, Sorkin (1977) concluded that health, seen through reductions in mortality, had an important impact on economic growth during the early twentieth century. Thus, Sorkin pointed out several ways through which health programs could have an impact on economic development of developing nations (Aguayo-Rico et al., 2005), the first way is through productivity gains and increasing man-hours of work. Adeoti and Oni (2017) explains that productivity of labour depends on factors like physical and mental capabilities, investments in human capital and efficiency of labour organization and management and emphasizes that changes in health could affect labour productivity through the previous channels. Also, labour productivity could be reduced by the need to care for sick relatives or by reducing years of schooling if parents are chronically ill. On the other hand improvements in health could positively affect the experience level of the work force by increasing life expectancy and good health status condition.

The second way is making feasible the development of previously unsettled regions, a major health program could initiate the development of areas where economic activity was deterred by unfavourable health matters. Tambi (2017) indicated that health and health services can improve or retard economic development and social and economic changes within a region. The third way is improving innovation and entrepreneurship by changing the attitudes of people. Aguayo-Rico et al (2005) used a step wise regression equation with macro economic data of 22 poor countries, using agricultural output as the dependent variable, with several social, economic and health data as independent variables to show how the influence of health factors on output seems to be larger compared with other economic and social variables. Hence health program could change the happenings of the lives of the poor by taking their own decisions to influence the events of their everyday activities.

3. Methodology

As noted above, we envisage a framework in which household utility function encompasses child health, which is captured in this study by height-for-age of children up to 59 months old. According to Fambon and Baye (2017) and Mwabu (2009), anthropometric indicators of child health tend to be positively associated in many studies with a child's chances of survival, later health status, subsequent performance in school and eventually productivity as an adult worker (Becker, 1981).

The household provides the environment in which individuals produce and consume health and other goods and services. In addition to providing its members with an environment for production and consumption of private and public goods, the household also provides the mechanism for intra household allocation of essential commodities such as health care, food, clothing and reproductive health services. This allocation mechanism is important because it determines the well-being of all household members (Tambi and Atemnkeng, 2018). Thus, estimation of the parameters of the asset endowments production function requires knowledge of inputs into the process and since inputs and outputs are jointly determined, causality might also occur in the other direction. Moreover, many studies have shown that economic development is a key determinant of health outcomes (Tambi, 2017). Therefore, we use a conventional method to reduce the problem of endogeneity that is by using the instrumental variable (IV) method.

Hypothetical mechanism Linking Children's Health to Asset Endowments (AE)[1]

Child health *(CH)* can affect household asset endowments *(WI)* either positively or negatively through several ways not-with-standing, child health is generally associated with increase household asset endowments and they can be jointly estimated though each has its own interpretation. As stated in most child health literature, family health, especially child and mother health and socio-economic characteristics, are important components of household asset endowments and poverty reduction because they shape both present and future human capital and livelihood opportunities (Adeoti and Oni, 2017). Thus, good health at childhood does not only affect the biological growth potential, risk of morbidity and mortality in later years of life; but also engenders potential household savings on medical expenditures and releases extra-time to adult household members to take more advantage of labour market opportunities, as well as the child's capacity to learn and secure better future standards of living. In this regard, children's health can be considered an important input in the well-being production function of the household-registering mainly indirect effects on household income via the extra-time, peace of mind and potential savings. The causal link of child health and household asset endowments can be depicted by the following structural equation:

$$WI = w_1 \pi_a + \eta CH + \varepsilon_1 \tag{1}$$

where, *WI* is household asset endowments and capture in this study by wealth index; *CH* is child health (haz); w_1 is a vector of exogenous covariates (place of resident, sex of child, sex of household head, father's age, mother's age...); η is the parameter of the potentially endogenous explanatory variable in the asset endowments function, π_a is the vector of parameters to be estimated and ε_1 is the error term that captures both random effects and unobservable variables.

The estimation of the parameter η would show the effect of child health on household asset. Following Wooldridge (2002) the reduced form of child health generating asset endowments estimation strategy can take the following form:

$$CH = w_1 \pi_{ch} + w_2 \Omega_{ch} + \varepsilon_2 \tag{2}$$

Where, w_2 is a vector of exogenous instrumental variables affecting *CH* but have no direct influence on asset, π_{ch} and Ω_{ch} are vectors of parameters of exogenous explanatory variables in the reduced form child health function to be estimated and ε_2 is the error term that captures both the random effects and other relevant but unobservable characteristics or complementary inputs.

In the recent literature, the endogenous explanatory variables are commonly referred to as "treatment variables". This terminology stresses the fact that the most credible way to measure the effect of an endogenous variable on the outcome variable of interest (i.e. to identify treatment effect) is to vary the endogenous variable experimentally. In an experimental setting, this variation is achieved through a random assignment of units of study into treatment and control groups.

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[1] For a complete review of this literature: see Wooldrige (2002)

The word "treatment" is used to indicate that a section of the study sample is "treated". Since this variation occurs when other causal factors are held constant, it is possible to identify the effect of the characteristic on outcome variable of interest. In the absence of an experiment, such a variation is achieved through an econometric procedure, with the aid of a structural model (see, Strauss and Thomas, 1998).

From above, Equation 1 is the structural equation of interest that is the asset endowments production technology whose parameters are to be estimated. Equation 2 is the linear projection of the potentially endogenous variable on all the exogenous variables. The instrumental variable model based on equations 1 and 2 will be estimated for the determinants of asset endowments using the econometric software STATA 14. However, the heterogeneity of household asset due to non-linear interaction of child health with unobservable and omitted variables could bias the estimated structural coefficients. The control function approach (Card, 2001) is used to address this issue. As noted by Card (2001) to take care of potential endogeneity bias and non-linear interactions of unobservable variables with the observed regressors specified in the asset endowments function regressors simultaneously; equation 1 can be upgraded to equation 3 and the control function specification will take the form:

$$WI = w_1 \pi + \eta CH + \gamma_1 \hat{\varepsilon}_2 + \gamma_2 (\hat{\varepsilon}_2 * CH) + u \tag{3}$$

where, $\hat{\varepsilon}_2$ is fitted residual of CH, derived from the reduced form linear probability model of child health (equation 2); $(\hat{\varepsilon}_2 * CH)$ is interaction of the fitted child health residual with the actual value of health status, u is a composite error term comprising ε_1 and the unpredicted part of ε_2, under the assumption that $E(u) = 0$ and $\pi, \eta, \lambda, \gamma$ are parameters to be estimated.

Exclusion restrictions are imposed on equation 3 because the set of instruments for child health status is absent from the equation. The terms $\hat{\varepsilon}_2$ and $(\hat{\varepsilon}_2 * CH)$ in equation 3 are the control function variables because they control for the effects of unobserved factors that would otherwise contaminate the estimates of the structural parameters. The reduced form child health residual, $\hat{\varepsilon}_2$ serves as the control for unobservable variables that correlate with CH. In particular, if an unobserved variable is linear in $\hat{\varepsilon}_2$, it is only the constant term that is affected by the unobservable and the instrumental variable (IV) estimates of equation 3 are consistent even without the inclusion of the interaction term.

As noted earlier, the outcome variable is capture by wealth index to represent our household asset endowments. This is due partly to the merits of an already constructed index as to otherwise (see Filmer and Pritchett, 1998) this is clearly demonstrated in the data section. Further, to use an already constructed index is suitable in our context in the fact that the wealth index was specifically constructed using Cameroon specific variables as have been demonstrated by the World Bank researchers since 1998. To avoid negative values[2] on our index, we normalize the values so that the index are scale to a [0, 1] range. To do this, we use the normalization indicator through the application of the formula: normal_indicator = (indicator-r(max))/(r(min)-

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[2]Negative values pose severe interpretation difficulties. Given the negative values, it becomes necessary to transform the values in to positive values to ensure that the values of the indices range between 0 and 1. Interpretation then becomes easy. Households with index close to 0 are asset poor, while those with values close to 1 are asset non-poor.

r(max)). The application of the command in STATA 14 normalizes the wealth index directly.

As argued in Wooldridge (2002), the IV estimates of equation 3 are unbiased and consistent only when the following conditions hold: (1) the expected value of the interaction between child health and its residual $(\hat{\varepsilon}_2 * CH)$ is zero, or the expectation of the interaction between child health and its fitted residual is linear, and (2) there is no sample selection problem. However, if the correlation is non-linear, then the control function approach is required and the inclusion of the interaction term $(\hat{\varepsilon}_2 * CH)$, equation 3 purges the estimated coefficients o the effects of unobservable variables (Bategeka et al., 2009).

To sum up, because of the above biases, the OLS estimation method is no longer appropriate; we use the control function to estimate the HAE function. When the control function variables are generated via the reduced form model of the demand for child health services; this corresponds to the first stage estimate of the IV. The control function variables will purge the structural estimates of potential simultaneity bias and unobserved heterogeneity. By so doing, control function helps to avoid any form of simultaneous and heterogeneous bias problems.

Cluster Mean of Average Distance to Health Center and average Size of Child at Birth as Potentially Strong and Valid Instruments

Theoretically, one key to the success of the instrumental variables strategy is identifying an instrument with sufficient predictive power. The manner in which a treatment variable is use or capture will determine whether it will have a sufficient predictive power or not. The predictive power of the variable 'average distant to health facility' strongly depends on the way its capture or handle. Different authors have use the variable differently in the literature (Awiti, 2014) and observed that it's a valid and strong instrument. Focusing on our study, the average distant to health facility has been a subject of discussion so far as child health is concerned. The distance which must be travelled in order to use health services – is one aspect of access which is very important because it presents barriers of cost, time and inconvenience.

It has been argued that increasing distance from health services inhibits the use of primary and secondary care and that it is associated with a range of poor health outcomes, from higher than expected numbers of deaths from asthma to lower than expected five year survival from cancer and other diseases. It can be argued that the average distant to health facility is an endogenous variable given that the household has to make a decision of either to live closer to the health facility or far from the health facility. In Cameroon, this is a reality in the sense that the choice of household residence is determine by five principal factors: medical centre, school, church, place of work and house ownership. These five factors are very important in terms of decision making related to residence. In such a case, we can say average distant to health facility is a decision variable and therefore cannot be used to instrument for household asset endowments.

However, in our study average distant to health facility will be captured at the cluster level and measured in the years in which the mother was pregnant with the child. The Cameroon demographic and health survey was collected and the results were presented for Cameroon (the national territory), other towns, urban and rural zones and each of the 12 areas of study constituting the 10 regions plus Douala and Yaounde. This means that the average distant to health facility is presented at the regional level to determine whether the distant to health facility was a major problem or not at the time the mother was pregnant with the child. This means that individual decision of mothers to live beside the health facility for one reason or the other is minimized since all the mothers within a given region will not make the same decision at the same

time, rendering the variable exogenous. In this case, average distant to health facility is assumed to be a strong and valid instrument. Further in a preliminary test we observed that this instrument can be a valid and strong predictive power in our study, however, whether or not we are flexible to switch to any other.

As concerning child size at birth, a child's size at birth has been found to predict household asset related issues in several studies to date (Ong et al., 2002). This instrument has to overcome the potential endogeneity problem between child health and household asset, especially as it's exogenous to household asset endowments. The exogenous instrument is motivated by the observation that the opportunity cost of parents' time is substantially lowered when the size of the child at birth is relatively small (<2500g). As stipulated in child health studies this is a variable that perfectly correlates with child health. Size at birth is one of the strongest determinants of perinatal survival (Ong et al., 2002), yet in most populations, the mean birth weight is slightly lower than optimal for offspring survival.

Thus, size of child at birth is a good determinant of child health that does not correlate with household asset endowments except through the child health. Therefore, its use as an instrument is a strong and significant predictor of child health. Further, size at birth is strongly related to a number of maternal factors including parity, length of gestation, mother's adult size and mother's own birth weight. It should also be noted that the importance of genetic factors has come from studies of monozygous and dizygous twins, where estimates of heritability of birth weight range from 30 to 70 percent (Ong et al., 2002). Ong et al (2002), however, reported that there may be a stronger relationship between the birth weights of the mother and that of the offspring particularly in infants born with a low birth weight and that these relationships may vary with parity. The child size at birth as an instrument may not only be strong, relevant but also valid and this instrument will help us control even the genetic link as well as other endogeneity problems. This instrument has been used by Ong et al (2002) in the case of early childhood growth in relation to maternal smoking, parity and infant breast-feeding.

4. Data Setting

Knowing and improving child health measurement as well as measuring accurately its complex dimensions is the next challenge as it can serve the purpose of improving the quality of decision making and the quality of economic evaluation of health (Murray and Frenk, 2008). Health statistics are necessary inputs in this purpose and that question was already asked in 1992 by Starfield when he underlined the lack of information on chronic illness in routinely collected data. The Cameroon 2004 and 2011 demographic and health survey was designed to assist in the study of the demand for healthcare inputs, production of reproductive health outcomes such as nutritional status of children and links existing between the different sections of the questionnaire, files containing information on individuals and households characteristics were used for our purpose. At the level of individuals, information compiled includes: demographic characteristics, mother socioeconomic characteristics and anthropometric characteristics of children aged 0-59 months. At the household level, among other things, the survey gathered information on access to basic social services (health facility, education and employment), land ownership, place of residence and wealth index. The dependent variable in this study is the HAE and capture by wealth index.

The endogenous variable is z-score for anthropometric measures of child health (height-for-age), we shall equally compare our results to weight-for-age and weight-for-height z-score to ensure robustness. The z-scores are measured as standard deviation units from the reference median and are often used by nutritionists as indicators of long-run and short-run nutritional status. The z-scores can be constructed using the World Health Organization/National Center

for Health Statistics/Center for Disease Control International Growth Reference as the standard for well-nourished children. For example, the height-for-age z-score for a child i in age and gender group c can be constructed as $Z_{ic} = (H_{ic} - MedianH_c)/\sigma_c$, where H_{ic} is the measured height of the child, and $MedianH_c$ and σ_c are the age- and gender-specific median heights and standard deviation of heights respectively of well-nourished children. Height-for-age reflects the accumulation of past outcomes and thus is a long-run measure of child health status, while weight-for-height is thought to be a good shorter-run measure of nutritional and health status (Fambon and Baye, 2017).

Wealth index is a composite index composed of key asset ownership variables; it is used as a proxy indicator of household level of wealth. As a measure of economic status, wealth has several advantages; it represents a more permanent status than does either income or consumption. Wealth is more easily measured (with only a single respondent needed in most cases) and requires far fewer questions than either consumption expenditures or income. It can also be considered as an underlying unobserved variable that is one that needs to have indicator variables that are associated with a household's relative position in the distribution of the underlying wealth factor (Morris et al., 2000). DHS surveys have already collected a number of such indicator variables, usually for purposes other than ascertaining economic status but which are thought to be correlated with a household's economic status such as productive/non productive assets (e.g. radio, refrigerator, television, bicycle, car, telephone, motorcycle,…), household amenities (e.g. source of drinking water, type of toilet facility, floor, wall and roof material, electricity,…) and others (such as unbuilt piece of land, owner of a house, land,…).

The advantage of using wealth index as a proxy for consumption expenditure is that (i) the wealth index overcomes the limitations of utilizing consumption expenditure and income in measuring wealth levels of households; (ii) the asset-based wealth index is more readily available and is a more stable measurement; (iii) wealth indices are considered effective indicators of long-term socio-economic position, living standard or welfare of households; (iv) They often perform better than expenditure data in explaining variation in education, child mortality, nutrition, fertility and health care use (Filmer and Pritchett, 2001). However wealth indices are not comparable among countries and time points, so this constitutes its major disadvantage.

5. Empirical Results

5.1. Weighted Sample Descriptive Statistics

Table 1 presents the weighted sample statistics for short listed variables to be used in our regression results. From table 1 we observe that about 40 percent of household live in urban centers and 60 percent in rural area with a household size average of about 10.47. As concerns sex of household, there are 85.9 percent male headed households with an average child health of -1.179 percent of children ranging from 0 to 59 months. There is equal distribution of sex 49 percent male and 51 percent female children and a mean year of schooling in complete years being 4.98 years. Still in this statistical table about 7.34 percent of women are working in the agricultural sector with 4.47 mean years of completed years of schooling.

Table 1. Weighted Sample Statistics for short listed variables to be used in regression

Variable	OBS	Mean	SD	Min	Max
Dependent Variable					
Household asset endowment index	19857	0.718	0.197	0	1
Potentially endogenous Variable					
Child health	8213	-1.179	1.615	-5.99	5.71
Exogenous Explanatory Variables					
Mother's education in years of schooling	19857	4.474	3.941	0	17

Mother's occupation (1= mother works in the agricultural sector, 0= otherwise)	19857	0.073	0.261	0	1
Mother in 15 - 19 years Age Group	19857	0.082	0.274	0	1
Mother in 20 - 24 years Age Group	19857	0.237	0.425	0	1
Mother in 25 - 29 years Age Group	19857	0.268	0.443	0	1
Mother in 30 - 34 years Age Group	19857	0.199	0.399	0	1
Mother in 35 - 39 years Age Group	19857	0.127	0.333	0	1
Mother in 40 - 44 years Age Group	19857	0.065	0.246	0	1
Household size	19857	10.479	6.200	1	44
Household size squared	19857	148.276	213.977	1	1936
Father's education in years of schooling	19857	4.985	4.848	0	17
Sex of child (1 = male, 0 otherwise)	19857	0.493	0.499	0	1
Male sons in the house	19857	1.566	1.358	0	9
Area of Residence (1= urban, 0= otherwise)	19857	0.401	0.490	0	1
Urban *d2011	19857	0.232	0.422	0	1
2011 dummy	19857	0.588	0.492	0	1
Potential instruments for endogenous inputs and Control function variables					
Child size at Birth (1= large size, 0 otherwise)	19857	0.796	0.402	0	1
Distant to health facility is a big problem	19857	0.524	0.499	0	1
Child health Residual	8213	0.014	1.564	-5.341	7.477
Child health × its Residual	8213	2.421	4.270	-1.193	42.025
Inverse of the Mills Ratio (IMR)	19857	0.526	0.182	0.003	0.609
Variables identifying Gender					
Male household heads = 1, 0 otherwise	19857	0.859	0.347	0	1
Female household head = 1, 0 otherwise	19857	0.140	0.347	0	1

Source: Computed by the author from the 2004/2011 pooled Cameroon DHS
N/B: Figures are sample Means and Standard Deviation

The data shows that 71.8 percent of households among the many respondents of the 2004/2011 DHS were asset non-poor. In 2011, many men and women went to school with an average year of schooling of about 2.7 in both sexes as compared to their counterparts in 2004. Most women in the households in the 2004/2011 year of data collection were classified in to 5 years interval of age group with the majority of age-group being the 25-29 age-groups with a mean percentage of 26.8 percent. About 79.69 percent of these mothers gave birth to babies with a large child size while 52.4 of them had big problems in terms of distant to health facility.

5.2. Household Asset Endowments Production Function

Table 2 presents estimates of the asset endowments function under different assumptions using child health (haz) as the main independent variable, while controlling for other correlates. As seen in table 2, column 1 reports the linear regression (OLS) estimates of the structural parameters; column 2 gives survey-based 2SLS estimates, column 3 accounts for endogeniety and sample selection bias, while column 4 checks for unobserved heterogeneity and sample selection bias. Table 2 presents the result of HAE production function.

Table 2. Household Asset Endowment Production function under different assumptions - Dependent variable: Asset endowment (Robust linearized t-statistics in parentheses, except otherwise specified)

Variables	Method of Estimation: Survey-based Regression Models			
	Linear Regression	IV 2SLS	Control Function	
Child health	-0.008*** (-9.89)	0.028** (2.17)	0.026** (2.46)	0.026** (2.48)
Mother's education	-0.019*** (-42.60)	-0.021*** (-23.25)	-0.021*** (-27.40)	-0.021*** (-27.35)

Mother works in the agricultural sector,	0.043*** (8.14)	0.048*** (7.81)	0.049*** (8.87)	0.049*** (8.86)
Mother in 15 - 19 years Age Group	0. 041*** (3.79)	0.044*** (3.71)	0.047*** (4.38)	0.042*** (4.34)
Mother in 20 - 24 years Age Group	0.039*** (3.93)	0. 049*** (4.20)	0.050*** (4.76)	0.049*** (4.72)
Mother in 25 - 29 years Age Group	0.036*** (3.67)	0.046*** (4.02)	0.047*** (4.55)	0.046*** (4.49)
Mother in 30 - 34 years Age Group	0. 041*** (4.15)	0.046*** (4.15)	0. 050*** (4.91)	0.049*** (4.82)
Mother in 35 - 39 years Age Group	0.026*** (2.61)	0.034*** (2.99)	0.36*** (3.43)	0.035*** (3.36)
Mother in 40 - 44 years Age Group	0. 022** (2.10)	0.030** (2.47)	0.030*** (2.81)	0.029*** (2.74)
Household size	-0.005*** (-6.96)	-0.005*** (-6.57)	-0.003*** (-4.09)	-0. 003*** (-4.10)
Household size squared	0.000*** (3.50)	0. 000*** (3.15)	-4.19e-06 (-0.16)	-3.81e-06 (-0.15)
Male household head	-0.021*** (-5.66)	-0.022*** (-5.19)	-0.022*** (-5.89)	-0.022*** (-5.87)
Father's education in years of schooling	-0.004*** (-11.49)	0. 004*** (-10.24)	-0.004*** (-10.98)	-0.004*** (-10.96)
Male child	-0.009*** (-3.19)	-0.005* (-1.67)	-0.006** (-2.04)	-0.005** (-2.02)
Presence of sons in the house	0.006*** (5.28)	0. 006*** (5.01)	0.005*** (4.79)	0.006*** (4.82)
Urban Residence	-0.177*** (-40.02)	-0.189*** (-28.54)	-0.188*** (-34.55)	-0.188*** (-34.51)
Urban *d2011	-0.035*** (-6.44)	-0.032*** (-5.15)	-0.033*** (-6.15)	-0.033*** (-6.12)
2011 dummy	0.011*** (3.23)	-0. 005 (1.17)	0.012*** (3.17)	0.012*** (3.16)
Control Function Variables (Account for household Asset endowment effects of unobservable in the error term)				
Child health Residual	n/a.	n/a	-0.034*** (-3.23)	-0.034** (-2.42)
Child Health × its Residual	n/a	n/a	n/a	0.001*** (2.65)
Inverse of the Mills Ratio	n/a	n/a	-0.297*** (-4.71)	-0.296*** (-4.70)
Constant	0.902*** (75.72)	0.960*** (39.31)	1.121*** (27.37)	1.119*** (27.32)
R-squared	0.6453	0.5616	0.6467	0.6470
F-Stat [df: p-val]	828.31 [18, 8194; 0.0000]	666.04 [18, 8194; 0.000]	749.82 [20, 8192; 0.0000]	714.97 [21; 8191; 0.0000]
Weak identification test: Cragg-Donald F-Stat [10% maximal IV relative bias]	n/a	24.666[16.38]	n/a	n/a
Durbin-Wu - Hausman Chi2 test for exogeneity of the potential endogenous variables [df: p-value]	n/a	6.440[0.0002]	n/a	n/a
Number of Observations	8213			

Source: Computed by author using pooled data of 2004/2011 survey data and STATA 10.1.
Notes: (·) implies *t*-ratios. ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively.

The results in column 1 reveal that child health is negatively and significantly associated to household asset endowments while the estimates of columns 2, 3 and 4 shows that child health is positively and significantly associated with the production of household asset endowments,

captured by the height-for- age z - score. Critically, the coefficient in column 1 (-0.8 percent) on child health is clearly not representative of the underlying population where as the other columns give survey-based regression models that are representative of the underlying population. Column 2 estimates (2.8 percent) of the structural parameters accounts for endogeneity of child health, but no sample selection or unobserved heterogeneity, according to this 2SLS estimates, child health increases the acquisition of household assets such as houses, cars, telephones, television, radio and telephone.

The control function estimates of 3 and 4 reveals that column 3 estimates (2.6 percent) accounts for endogeniety with sample selection, while column 4 estimates (2.6 percent) checks whether unobserved heterogeneity is a problem. Thus, they yield identical effects of child health on household asset endowments in an average of 2.6 percent. Given that the 2SLS estimates accounts for endogeneity but not sample selection and it's significant only at 10 percent, implies the results of 2SLS can be biased. Column 4 is significant at 5 percent with an interaction term equal to 0.001, is also correlating with the asset indicator at 1 percent significant level. This detection of statistical significance of the coefficient on interaction term is evidence that the unobservable variables that are associated with selection of children into estimation sample are not separable from unobservables that are correlated with household asset endowments. These inseparable unobservables are captured by the interaction of haz with its residual (haz × predicted haz residual). Therefore, since the estimated coefficients are marginally stable between specifications 3 and 4, the results from the parsimonious specification 4 are preferred.

Following the result of 4 therefore, the estimate of 2.6 means the health of the child strongly influences the potential power of household in acquiring assets. This result implies that if a child is in good health, the household may benefit from potential savings on medical expenditures, extra-time that could be redeployed to additional income earning activities that improve household income and enhance the acquisition of household asset. This result also implies that using the correct estimation procedure is critical for policy implications (Baye, 2010).

Checking the relevance and robustness of this result, we observed that in table 5b, the weak identification test: Cragg-Donald F-Stat [10% maximal IV relative bias] is 24.666[16.38], implies we reject the possibility that our instrument (large child size) is weak. The diagnostic tests of Durbin-Wu-Hausman Chi2 test for exogeneity of the potential endogenous variables [df: p-value] of 6.440[0.0002] shows that we rejects exogeneity of child health in the household asset endowments production function. Further, the coefficient of the predicted residual of child health (coefficient = -0.034; t = -2.42) in column 4 is statistically significant (though negative), confirming that this input into household asset endowments is indeed endogenous, so that inclusion of this residual term in the health generating equation, as in above, is required for consistent estimation of structural parameters.

Variables in our sample positively correlating with the asset indicator include; father's education, mothers working in the agricultural sector, mother's age groups and presence of male siblings in the household whereas variables such as mother's education, male household head, urban resident and household size are negatively associated with household assets. The estimate of time dummy (1.2 percent) in column 4 reveals also that household asset was better acquired in 2011 than in 2004. Making allusion to the reduced form estimates of child health, we realized that apart from mother's education, male child head of household, urban residence, household size and large child size at birth that are registering increasing returns to child health, other variables are each individually significant and inversely affecting the demand for better childcare. In addition to the strength of the study, the parameter estimates of the one identifying child health variables are jointly significant (p<0.000), according to the Anderson-Rubin F-statistics of 44.654. These results are clearly summarized in table 2. More generally, better child health (birth weight)

increases household income through potential savings that could be realized on health expenditures and indirectly through extra-time that could be redeployed to additional labour market participation opportunities. The key argument here is not that child health directly increases household income, but that better child health elicits extra-time, which is strongly correlated with enhanced training and labour market participation possibilities that increase household income.

5.3. Estimate of HAE Function by Household Head and Household Residence

Table 3 present the results of the decomposition of child health effect on HAE for type of household head (male - female) and household residence (urban - rural) in Cameroon. The result of column 4 of the control function which is our preferred result of the full sample is presented for the male - female correlate and the urban – rural correlate.

Correlates of Male - Female household head

From table 3, we observed that child health is positively and significantly associated with the production of household assets. Considering the male household head (2.5 percent, significant at 5 percent level) and female household head (4.6 percent, significant at 10 percent) results, we noticed that the magnitude of the influence of child health on HAE production of the female headed households, is in excess of that of their male counterparts. This result implies that in a given good state of child health, the females will acquire more household asset as compared to their male counterparts. However, the female coefficient is significant only for 10 percent, implying that the relationship between child health and asset indicator is more a matter of the male and then the female headed households. The covariates in the male household head and female headed households positively impacting HAE include: mother's age-groups, mother agriculturalist and male siblings whereas education, household size father's education and urban residence are negatively significantly affecting the asset endowments. Another important aspect of this result is that in 2011, the situation of child health effects on HAE was stronger in 2004 for the male headed households as compare to 2011 at a rate of -1.3 percent.

Table 3. HAE Production function by gender of Household Head - Dependent variable: Asset endowments Indicator (Robust linearized t-statistics in parentheses, except otherwise specified)

Variable	Method of Estimation Approach: Survey-based Control Function			
	Household Head		**Household Residence**	
	Male	**Female**	**Urban**	**Rural**
Child health	0.025** (2.23)	0.046* (1.66)	0.020 (0.97)	0.018* (1.77)
Mother's education	-0.021*** (-24.89)	-0.019*** (-10.49)	-0.023*** (-16.72)	-0.017*** (-21.48)
Mother works in the agricultural sector,	0.052*** (8.45)	0.037*** (2.79)	0.108*** (9.02)	0.020*** (3.89)
Mother in 15 - 19 years Age Group	0.052*** (4.49)	0.019 (0.65)	0.060** (2.55)	0.026*** (2.61)
Mother in 20 - 24 years Age Group	0.053*** (4.68)	0.013 (1.13)	0.68*** (2.94)	0.018* (1.87)
Mother in 25 - 29 years Age Group	0.049*** (4.45)	0.029 (1.00)	0.047** (2.06)	0.028*** (2.90)
Mother in 30 - 34 years Age Group	0.052*** (4.77)	0.032 (1.10)	0.055** (2.45)	0.033*** (3.49)
Mother in 35 - 39 years Age Group	0.035*** (3.09)	0.037 (1.25)	0.051** (2.17)	0.011 (1.20)
Mother in 40 - 44 years Age Group	0.031*** (2.62)	0.018 (0.61)	0.016** (0.67)	0.029*** (2.90)

Household size	-0. 002** (-2.41)	-0.008*** (-2.60)	-0.012*** (-7.48)	0.001 (0.64)
Household size squared	-0.000 (-1.30)	0.000 (0.96)	0.000*** (5.72)	-0.000*** (-5.94)
Male household head	n/a	n/a	-0.033*** (-4.88	-0.017*** (-4.24)
Father's education in years of schooling	-0.005*** (-10.88)	-0.003*** (-3.08)	0.002** (2.13)	-0.003*** (-6.80)
Sex of child (1= male, 0 otherwise)	-0.006* (-1.94)	-0.006 (-0.80)	-0.022*** (-3.49)	-0.000 (-0.01)
Male sons in the house	0.005*** (4.07)	0.008*** (2.59)	0.009*** (3.85)	0.004*** (3.41)
Urban Residence	-0.181*** (-30.46)	-0.232*** (-17.04)	n/a	n/a
Urban *d2011	-0.037*** (-6.20)	0.003 (0.29)	0.010* (-1.80)	n/a
2011 dummy (1= 2011, 0 otherwise)	0.015*** (3.64)	-0.008 (-0.79)	n/a	0.003 (1.28)
Control Function Variables (Account for household Asset endowment effects of unobservable in the error term)				
Child health Residual	-0.033*** (-2.92)	-0.053* (-1.91)	-0.034 (-1.64)	-0.022** (-2.16)
Child Health × its Residual	0.001** (2.23)	0.001* (1.67)	0.001* (1.81)	0.000*** (2.68)
IMR	-0.353*** (-4.95)	-0.107 (-0.77)	-0.264* (-1.91)	0.42 (-0.68)
Constant	1.19*** (24.63)	1.075*** (10.93)	0.952*** (11.34)	0.943*** (23.42)
R-squared	0.6524	0.6175	0.4086	0.3695
F-Stat [df: p-val]	634.70[20, 6762; 0.0000]	113.72 [20, 1409; 0.0000]	120.27[19; 3307; 0.0000]	150.12[19; 4866; 0.0000]
Number of Observations	6783	1430	3327	4886

Source: Computed by author using pooled data of 2004/2011 survey data and STATA 10.1. Notes: (·) implies *t*-ratios. ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively. Also n/a means not applicable.

Correlates of Urban – Rural residence

Decomposing child health effect on HAE for household residence, we observed that child health effect on household asset endowments is a matter of rural household residence. In Cameroon, child health in the rural community constitutes a major problem due to inadequate supply of public goods such as hospitals and portable drinking water as compare to the urban centers. Therefore, any given state of child health will strongly affect the rural households with respect to the acquisition of household asset endowments. Other variables associated to increase HAE by virtue of a given child health status includes: mother works in the agricultural sector, mother's age group and presence of male siblings in the household. The covariates associated with increase HAE in urban centers are: father's education, mother's work in the agricultural sector, mother's age group, and the presence of male siblings in the household.

6.   Conclusion

This study is entitled: "the direct and indirect effects of child health on household asset endowments". Consequently, little attention has been paid to the health effects on asset endowment especially using DHS. The main objective has been examine the effects of child health on HAE using control function modeling in demographic and health survey.

The result of the Control function shows that child health is positively and significantly

associated with the production of HAE. This implies that if a child is in good health, the household may benefit from potential savings on medical expenditures, extra-time that could be redeployed to additional income earning activities that improve household income and enhance the acquisition of household asset. We also observed that, the relationship between child health and asset indicator is a matter of the male headed households while child health effect on household asset endowments is more an issue of rural household residence due to inadequate provision of public goods such as hospitals and portable drinking water.

To better inform children health-based policy practices with asset endowments, from life course perspective, this study hypothesizes that child health have cumulative effects on household assets. In terms of policy, child health should be included in the new vision of successful asset building so that, families raising children with good health, asset accumulation should start early and last long. Policy suggestions point to the need for enhancing government's effort in consolidating human capital investment effort and instigating employment efforts; as it enable income growth, ameliorates future living standards an reduced poverty. Decision makers in Cameroon could establish obligatory laws to oblige household heads to start the process of asset accumulation early as soon as they begin to earn an income. This can be made possible by the declaration of ones asset on yearly basis, by so doing the problem of corruption is check and living conditions ameliorated due from accumulated assets later in life.

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