LUND UNIVERSITY
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Masters in Economic History

PRIMARY HEALTH CARE AND CHILD MORTALITY AND ITS ASSOCIATION WITH THE WEALTH STATUS IN GHANA FROM THE 20TH CENTURY.

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Cross-country data links good health status to an increase in wealth status (income levels) as evidenced by existing prevalence of rates of child morbidity and mortality in poorer settings. Essentially, Primary Health Care amongst other affordable health interventions is prioritized in most countries now. This thesis focuses on Ghana, to establish whether there exists an association between wealth and child mortality including other health determinants to help identify high-risk regions with low source of health funding. The thesis utilizes cross-sectional data from six surveys conducted by the Demographic and Health Surveys between 1988 to 2014 and employs a linear probability model to analyze the data. The results show on individual levels, health determinants like the first set of vaccines given to children who own health cards were consistently likely to be associated with child mortality reduction. Whilst richer households in the highest quintiles are also likely to be associated with child mortality reduction but not consistently significant. Evidence from regional levels also show vaccination is not very effective in some regions and at least secondary education level of women is likely to lower child mortality rate.

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1. Introduction

1.1 Background

It is an undisputed fact that some populations are healthier than others. For instance, in considering under-5 mortality rate[1] (U5MR), it is unacceptably higher in developing countries than developed countries (Houweling et al., 2005). Thus, it is argued that health is treated as intrinsically linked with income as an increase in income growth levels is seen as probably resulting in health improvement (Soares, 2007). This positive relationship, first documented by Preston (1975) concentrated on cross-country data of life expectancy and income per capita. The Preston curve estimates that richer settings, on average, can expect to live longer than those born in poor countries (Preston, 1975).

However, Preston further indicated that, although there is a list of possible reasons for such a relationship between health and income levels, the mechanism sometimes becomes speculative and groundless (Preston, 1975). Instead, a cross-sectional relationship between the two variables can be stimulated to change by new influences and cannot be analyzed based on a particular time-sequence of tastes of health-related services (Preston, 2007). Nevertheless, Preston (1975) explained that there is a persuasive reason for expecting an association between income levels and mortality change (health status) although, there is the need to note, this relationship is not so clear over time.

To further elaborate on this argument, Preston (2007) admit it is difficult to devise a plausible model in which the change in mortality is a direct influence on the level of income. Unless conceivably, such positive fraction of additions to current income is invested in various health enterprises (like government hospitals

[1] (World Health Organization, 2016) considers Under-5 mortality rate (U5MR) as the risk of a child dying before completing 5 years of age. World Health Organization (2016) records, the highest under 5 mortality rates is in the African Region estimated at about 76.5 per 1000 live births.

and training programme for health personnel) which exert a consequential effect on mortality levels (Preston, 2007).

In analyzing this relationship also, some social scientists have debunked this positive correlation (Soares, 2007). Demeny (1965, p 203 - 232) for instance stated "...There is a high degree of uniformity between mortality trends through time and in different countries – a uniformity not existent as far as trends in per capita income are concerned." Thus, some criticisms leveled against the Preston curve is that it lacks some evidence on country-specific determinants of the health indicators as it considers cross-country data within a particular year. (Soares, 2007). Spence and Lewis (2009, p. 9) also contend that "although the Preston curve shows a close relationship between income and health in the cross-sectional data, longitudinal data suggest that this relationship may not hold within individual countries over time."

In developing economies, fewer studies have been extensively conducted to understand the various determinants probably causing the disparity within the specific country. Some findings show that the association between the health of a child (under-5 mortality rate) and socio-economic determinants varies in strength between richer and poorer children. Thus, to analyze the relationship between these determinants (income levels, education, and human welfare) using cross-country data, the country-specific determinants and long-run effects are sometimes obscured. In order for modern economies of developing countries to be effective in tackling and understanding child mortality, it is imperative to employ current evidence of determinants which are somewhat country-specific and also considers long-run trend by using a data from different years. This will help understand the health trends over time and the determinants stimulating the change.

A positive step adopted by modern economies of most developing countries is the intensification of Primary Health Care (PHC) and other affordable health interventions to improve the health of the poor and bridge the health inequality gap. Health interventions like the anti-malaria campaigns, vaccination and immunization programs from the World Health Organization (WHO) since 1950 have improved the health of not only the rich but the poor as well (Acemoglu & Johnson, 2007). These interventions have also helped to reduce the child morbidity (death by disease) and mortality rates although they have not entirely eradicated the problem.

In Ghana, Primary Health Care is mostly provided by the government and largely administered by the Ministry of Health and Ghana Health Services. A research by the Institute for Resource and Development in 1988 on the demography and health of the populace in Ghana showed the commitment of the Government of Ghana in attaining health for all by the year 2000. It is also estimated that in 2005, the government of Ghana spent about 34% of its expenditure on health care (the highest in the Sub-Saharan African region) making PHC accessible to all Ghanaians (World Health Organization, 2005). Furthermore, to ensure the PHC programme is efficient and effective, the health service is decentralized to the districts, with re-orientation and re-training of personnel (DHS Journal, 1988). In addition, in order for the programme to meet the "Triple Aim"[2] of the PHC, it prioritizes on areas of Maternal and Child care, Family Planning and Nutrition (just to mention a few) at affordable cost. Consequently, this scheme has paid-off by improving the health status of the populace. A typical

[2] Triple Aim of PHC is to simultaneously achieve improvements in three components namely health, patient experience and cost (Berwick, Nolan & Whittington, 2008).

example is the National Health Insurance Scheme (NHIS) that overtook the "Cash and Carry System"[3] which was previously practiced in the country.

Despite the contribution of the PHC, it has also been argued as having its own disadvantages. Walsh and Warren (1980) indicate the programme is selective in its operation and exhibits some level of biases inter and intra countries. Analysis from the Demographic and Health Surveys supports this notion by indicating that, in Nigeria, children from the wealthiest households are likely to be vaccinated than those from the poorest households (Rutstein & Kiersten, 2004). Similarly, over 90 percent of wealthy Philippines women are assisted by a health professional at delivery in comparison to only 25 percent of poorer households (Rutstein & Kiersten, 2004). The question that arises is why this selective approach of the PHC programme? It is plausible, with the Triple Aim of PHC in perspective, a selective PHC program will be the most cost-effective form of medical intervention in the least developed countries as funds may not be readily available.

1.2 Research Aim and Question

From the on-going discussion, although, it can be established that, PHC in the host country and most developing countries face some challenges, it is somewhat bridging the health inequality gap. This counter historical context of the direct positive correlation between health and wealth in cross-country analysis. As the stimulating factor may not necessarily be the income levels. To this end, as it is uncertain where the influence of health lies specifically in Low Income Countries (hereafter, LIC), the question the study posit is that; is wealth status intrinsically associated with health status with no other proximate determinants having an effect on health? Thus, to give an in-depth explanation on this phenomenon, the

[3] "The Cash and Carry system of paying for health care at the point of service put an enormous financial pressure on the poor and served as a major barrier to health care access." For further elaboration, see Owusu-Sekyere and Bagah (2014, p. 188).

thesis endeavors to explain whether, in developing countries (specifically, Ghana), the curvature relationship of health (child health) and wealth status exist as explained in the Preston Curve. Ultimately the linkage will help understand whether the rate of child death is determined by the wealth status of the households in regional levels or has little or no relationship when other health determinants of PHC and socio-economic determinants are considered.

The study aims to address the argument that in Low Income Countries (LIC), using country-specific data across different years, there is the likelihood of other determinants (not necessarily income-levels) that could help in reducing U5MR. Ghana Demographic and Health Surveys Journal (hereafter, Ghana-DHS) in 1988 also asserts that, Ghana has over the years address issues of child health by establishing and adopting programme targeted to combat the major childhood diseases like diphtheria, tetanus, whooping cough, poliomyelitis, measles, and tuberculosis. Since the early 1960's, the country has also adopted the World Health Organization (WHO) expanded programme on immunization to reduce the massive loss of children to these diseases (Demographic and Health Surveys Journal, 1988). It is imperative to know that although these programme are structured to favor the host country, it will help to also provide policymakers necessary information on health indicators within the Sub-region. Additionally, modern research will help bridge the gap of health inequality as it will help locate the high-risk regions (vulnerable groups of society) with less source of health funding.

1.3 Outline of the Thesis

Following the introduction, a theoretical framework will be built to know the variables considered. Subsequently, the study discusses previous research and findings. The research hypothesis is clearly stated thereafter. The succeeding sections discusses the methodology, the main results and analysis of the results. The last section summarizes the discussion of the study and gives a

recommendation for future research. The study will encompass households in the 10 major regions in Ghana. These regions include Greater-Accra, Central, Ashanti, Brong-Ahafo, Eastern, Northern, Upper East, Upper West, Volta and Western Regions.

2 Theoretical Framework

Traditionally, the two main frameworks adopted to research child survival is based on social science approaches and medical science approaches. The social scientist focused on the correlation between mortality and socioeconomic characteristics by creating casual inferences about the mortality determinants (Mosley & Chen, 1984). Whilst, the medical research focused purposely on the biological process of diseases (infections or malnutrition) and less focus on mortality rate, instead, morbidity as the main dependent variable (Mosley & Chen, 1984). Ideally, for economic historians, the scope of the study is on the approaches and concept from the social science. However, incorporating the two major approaches helps to entirely understand child mortality, especially in developing countries (Mosley and Chen, 1984). Additionally, the views from other research disciplines will ensure a comprehensive understanding of this study and why some variables are considered in this study.

In theory, to identify the key variables that drive mortality and morbidity, we first need to identify the proximate determinants. According to Mosley and Chen (1984) these proximate determinants can be grouped into five (5) categories:

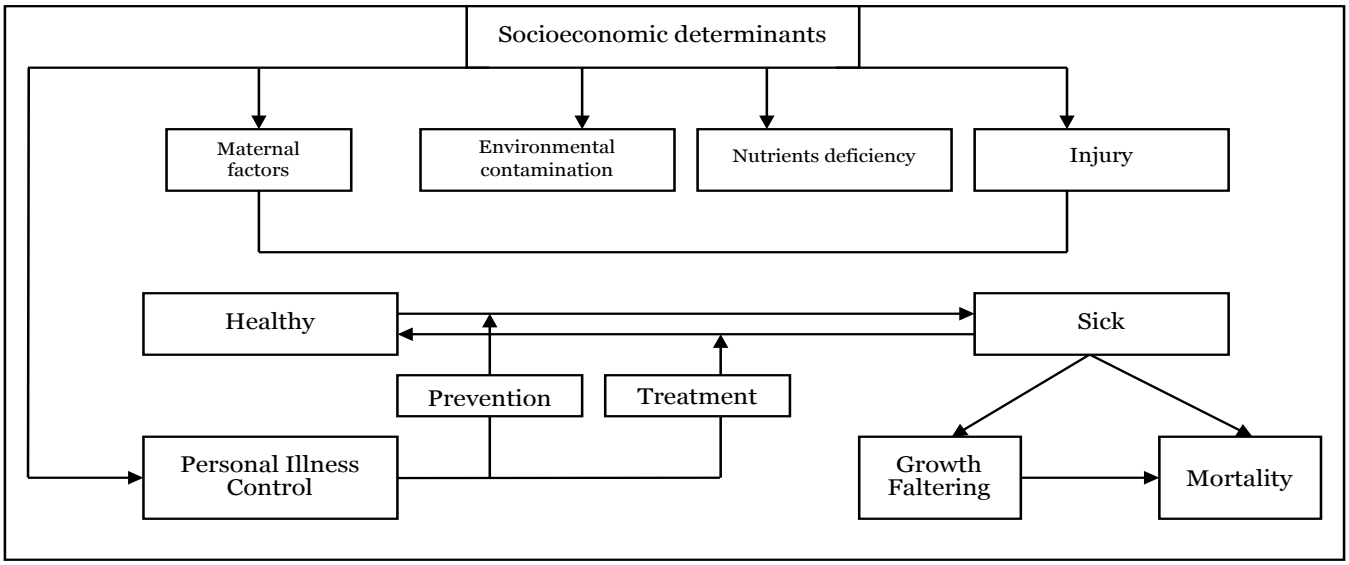
- Maternal factors: Example age
- Environmental contamination: Example air
- Injury: Example accidents /intentional
- Nutrient deficiency: Example calories in-take
- Personal illness control: Example preventive measures

The first three (3) categories are based on the social scientist perspective on socio-economic determinants of a child's survival, whilst the last two (2) categories are

based on the medical perspective of socioeconomic determinants of a child's survival (Mosley and Chen, 1984).

To further elaborate on this framework, Figure 1 below exhibits a flowchart of the operation of the framework on the health of the population. Figure 1 depicts that, the first four groups (example: age, air, accident, and calories in-take) influence the rate of shift of healthy individuals to become sick. For instance, if some individuals live in an unclean environment, and continually inhales bad air, the likelihood of them getting sick is high due to the unclean air in the community. Thus, the proximate cause is the bad air in the community. However, this can be controlled by the last category, personal illness control, which influence the rate of illness (through prevention) and recovery rate (through treatment). Yet, if the population is unable to control for the illness (through prevention or treatment) due to lack of facilities to prevent the unclean air or the treat the illness, they ultimately become sick as can be seen in Figure 1 below. The consequence is either growth faltering (disability among survivors) or death. Below is a flow chart with a detailed description from (Mosley & Chen, 1984).

Figure 1 Proximate determinants on the health dynamics of a population



Source: Mosley and Chen (1984)

2.1 Selected Determinants of Mortality Considered

As aforementioned, there is the possibility of new influences and other proximate determinants stimulating changes in health status (mortality reduction). Thus, this section will elaborate on the variables considered in this study to know how relevant these new influences (determinants) affect the health status specifically in developing economies like Ghana. Using the framework of Mosley and Chen (1984) as the yardstick of selection of the determinants for this thesis and to ensure a clear analysis is made, this thesis endeavors to structure these determinants into direct and indirect characteristics. The direct characteristics affect the health of the child without any influence from other sources. This may include; biological attributes at birth (like sex of the child), and health inputs before, during and after delivery (like parental behavior and breastfeeding) (Nketiah-Amponsah, 2010). Whilst the indirect characteristics are the proxies needed for the child's survivor. Such characteristics include; household characteristics (like household income (wealth), access to safe drinking water and sanitation) as well as supply side factors that indicate the availability of health infrastructure (Nketiah-Amponsah, 2010).

In the selection of the dependent variable, Mosley and Chen (1984, p. 142) proposed that "typically most social sciences examine mortality as the dependent variable." Mosley and Chen (1984) further assert that this dependent variable has strength due to the fact that, the definitive events may not be difficult to measure and aggregate. On the other hand, medical scientist focuses on disease or nutritional status of survivors (Mosley & Chen, 1984). Although in the selection of the dependent variable Mosley & Chen (1984) applied a combined level model taking into account the growth faltering among survivors and mortality, in this study, the latter (mortality) will be considered as the dependent variable as the former is beyond (although not farfetched) this thesis.

The other variables (determinants) considered for this study is based on previous studies and Mosley and Chen (1984) framework. Amongst the variables considered is the residential location of the household. This essential variable helps explain the indirect influences that the mother and the child receive by virtue of their geographical settings whether the urban center or rural area. Wang (2002) support this notion and explains that knowledge of the rural and urban separation also helps policy perspective. In addition, the regional settings will help understand whether the PHC programme is bias towards the urban centers rather than the more vulnerable rural settings.

To add to that, the main source of water and sanitary conditions (like toilet facility) will also be considered in this study. The reason for the inclusion of these two variables is to provide an understanding of how the household considers sanitation important as it may have a spillover effect if not checked. For instance, should the main source of water of the community be a direct source (water bodies) and the same locality lacks toilet facilities, then it is plausible people within this community are likely to be affected by poor sanitary conditions like defecation into the water bodies. Eventually, the wellbeing of the breastfeeding mother may be complicated if there is an outbreak of disease and this will have an effect on the baby. To support this claim, some findings show that in China, children living in a locality with poor access to the flush toilet have a high mortality rate (Wang, 2002). Other studies by Pandey et. al. (1998): Hughes, Lvovsky and Dunleavy, (2001): Jalan and Ravallion (2003) and Mishra and Retherford (1997) all expressed the importance of safe water and sanitation facilities on the health of the children.

Vaccination and immunization of children is another variable considered in this study to purposely show the regional distribution of the PHC intervention targeted to the children. It is undoubtedly true that the importance of vaccines cannot be underestimated when analyzing child mortality, as it is the first set of

drugs the child receives to improve the immune system. Wang (2002) in estimating the importance of vaccination indicated, vaccination coverage in the first year of life of the child significantly reduces the mortality rates of children. However, in Ghana, there is a challenge. Research on Ghana Poverty Past, Present, and Future in 1995 shows that poorer households are less inclined to seek this health care compared to their richer counterparts. The research also shows that the number of visits to publicly-funded health centers by the richest quintile exceeded the poorest quintile (Nyarko, 1995). This has important implications for the incidence of Primary Health Care programme as bias towards the rich in earlier years (Nyarko, 1995). However, recent reports show a tremendous improvement in the vaccination coverage although not evenly distributed in the region Ghana-DHS Journal, (2014). Furthermore, the argument posits that this improvement in the coverage of immunization and vaccination by the Primary Health Care programme by the government has reduced the child mortality rate (DHS Journal, 2014).

The next set of variables considered are the assets of the household to ascertain how rich or poor the household is. Despite the prolific nature of the DHS data over other data sources, a major limitation is the absence of the data on income or expenditure variables (Wang, 2002). Thus, Filmer and Pritchett (2001) propose the use of a wealth index as a measure of welfare. Interestingly Wagstaff and Watanabe (2003) emphasized that the ranking of households by their economic positions based on the asset index is as close to that based on expenditure and consumption. Hence, in the subsequent section, an overview will be given on all the variables considered in constructing the wealth index, why the wealth index was considered and analyze how important it is to the study.

2.2 Wealth Index

Many rudimental methods have been adopted in analyzing the wealth index (Filmer & Pritchett, 2001: Rutein & Johnson, 2004). Most often, these methods employ traditional indexes like consumer expenditures of the household to estimate the wealth index. That notwithstanding, other developments have also been made. Wagstaff and Watanabe (2003) for instance extended the wealth to consider the choice of Socio-Economic Status (SES) in the measurement of health inequality. Eventually, Wagstaff and Watanabe (2003) indicated that a wealth index based on assets is not far-fetched from a consumption-based Wealth Index.

Thus, in constructing the wealth index for the Ghana, the DHS Wealth index method is adopted. The motivation for adapting to this method is due to its relevance to the study as it seeks to explore areas of health, and other socio-economic indicators. Interestingly, Gwatkin et al. (2007) explain the World Bank used the DHS method for policy and program recommendation. Other reports in UNICEF's Multiple Indicator Cluster Survey (MICS) and AIDS Indicator Surveys (AIS) have also employed the DHS Wealth Index method. To add to the aforementioned reasons for employing the DHS Wealth Index method is the significance of the index in countries that lack reliable data on income and expenditures, which are the traditional indicators used to measure household economic status. Filmer and Pritchett, (2001) and Rutstein and Johnson (2004) also argue that the DHS Wealth Index represents long-term (permanent) economic status much better, and also is much easier to implement.

The wealth index analysis was introduced to DHS around the end of the 1990's. Thus, using exactly the wealth index in the DHS dataset will omit analysis on 1988 in our study. To bridge this gap, this study uses easy-to-collect data on a household's ownership of selected assets, such as televisions, radio, car, refrigerator, motorcycle, and bicycles; types of water access, sanitation facilities

(the type of toilet facility) and floor materials of households. This is generated by a statistical procedure known as Principal Components Analysis (PCA) which is utilized by the DHS dataset. Using the PCA procedure, the study, establish five wealth quintiles to compare the influence of wealth on the health of the child in a household.

The wealth index of DHS puts individual households on a continuous scale of relative wealth. Each household asset for which information is collected is assigned a weight or factor score generated through the principal components analysis aforementioned. The resulting asset scores are standardized in relation to a standard normal distribution with a mean of zero and a standard deviation of one. These standardized scores are then used to create the breakpoints that define wealth quintiles as Lowest, Second, Middle, Fourth, and Highest. The sample is then divided into population quintiles of 5 groups with the same number of individuals in each. The construction is done in STATA using the PCA procedure of DHS explained.

In other not to be biased, a separate index is not prepared for rural and urban population groups. However, the assets are selectively considered. For instance, in Ghana, ownership of a motorcycle in the Northern part of the country is deemed as a higher status than in the Southern part of the country which considers ownership of a car as a higher status. Thus, the total value for indicators produced by this weighting scheme is representative of the total households, as they take into account the fact that the numbers of individuals that own the assets, may vary across wealth quintiles. To add to that, in Ghana, electricity is also estimated as a requisite of households. Wang (2002) establishes that access to electricity has a significant effect on the reduction of child mortality. Thus, this is also weighted to know the wealth status of the household.

3 Previous Research and Findings

As this thesis endeavors to explore the association between wealth and health (specifically child mortality), a look into previous research will give a broad perspective on the field of study whilst simultaneously creating a linkage with the other determinants which may be stimulating the improvement in health (reduction in child mortality). Thus, the initial section (2.1) will review the wealth status and mortality to understand what literature says. Whilst the subsequent section (2.2) will review the literature on some Primary Health Care and socioeconomic determinants of child mortality to know the arguments on the other possible determinants of child mortality.

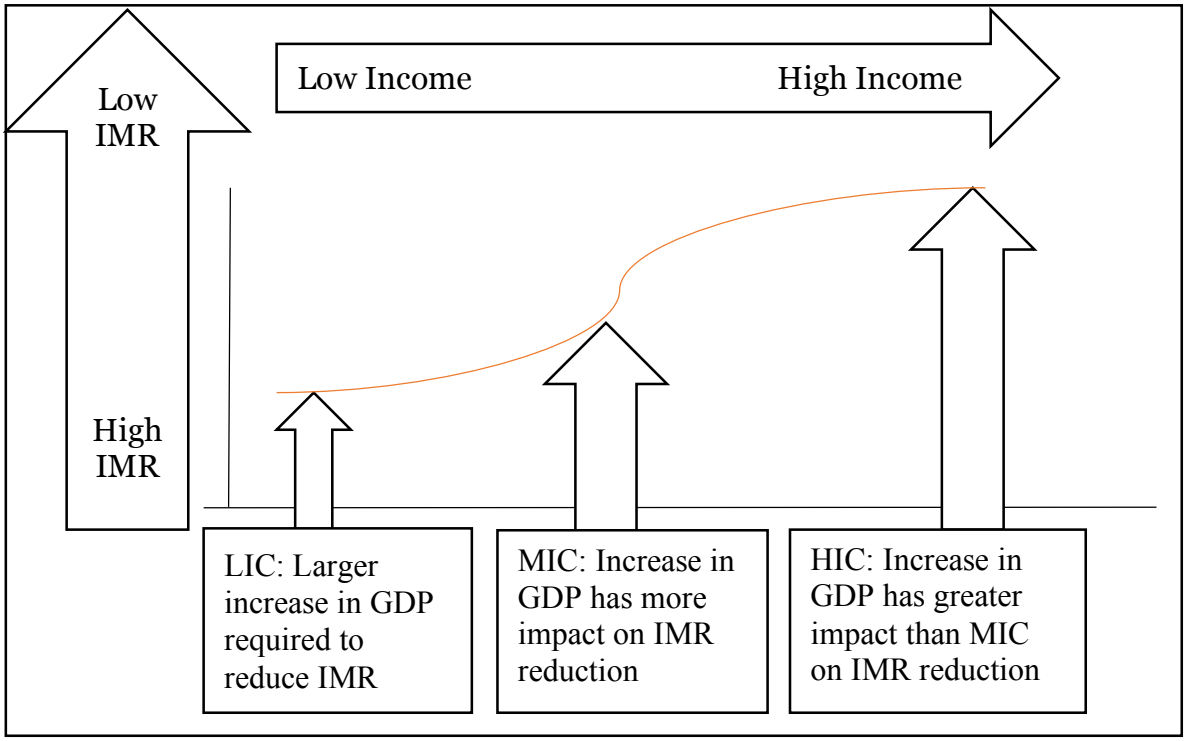
3.1 Wealth Status and Mortality

Cross-sectional analysis has consistently exhibited a straightforward analogy that health is positively correlated with wealth during the 20th century (Preston, 2007). However, Preston (2007, p 485) also admits that "it is difficult to devise a plausible model in which the rate of change of mortality is a direct function of the level of income." This statement indicates, the positive correlation between the two variables is not wholly affirmed. In analyzing the findings using logistic models, Preston (2007) explained from 1930 through 1960, the correlation between the variables changed specifically in LIC with mortality disassociating from income. Interpretations given for such results were associated with two major reasons according to Preston (2007). One is the evolution of various health measures which were widely exploited by the LIC (example vaccination and antibiotics). As well as the vigorous international health interventions and programme (from WHO) after the post-war period (Preston,2007: Acemoglu & Johnson, 2007). Nonetheless, Preston claims that although income is a trivial factor in recent mortality trends, there is no justification for its omission from

models that aspire to explain this relationship. As such cross-sectional data suggest strong responsiveness of income on mortality.

Figure 2 below depicts the framework for the Preston Curve establishing the relationship between Infant Mortality Rate (IMR) and Income Levels in the Low-Income Countries (LIC), High-Income Countries (HIC) and Middle-Income Countries (MIC). Figure 2 shows that in LIC, larger increases in Gross Domestic Product (GDP) is required to reduce IMR. However, in the HIC increase in GDP has reduced IMR.

Figure 2 **Framework of the Preston Curve**



Source: Author's own elaboration based on Preston (1975)
IMR: *Infant Mortality Rate,* ***LIC:*** *Low Income Countries,* ***MIC:*** *Middle Income Countries,* ***HIC:*** *High Income Countries*

Soares (2007), in a closer look at life expectancy changes in the developing world (Low-income countries) explained; although the relationship is present, in reality, it seems incomplete. As there are "several dimensions of human welfare" (Soares, 2007 p. 247). Furthermore, from 1960 the relationship shifted with the

developing countries experiencing rising life expectancy coupled with not so convincing income levels (Soares, 2007). The challenge is, in cross-country analysis, country-specific trends are sometimes not recognized entirely. Soares (2007) support this notion by analyzing that, the effect of the AIDS epidemic on cross-country trend in life expectancy on some of the countries (like Botswana, Lesotho, Namibia, Swaziland and South Africa, just to mention a few) in the data, after 1990 experienced declines in life-expectancy. This, therefore, underscores any change observed during that period of the epidemic as it is evident AIDS played a pivotal role in the life-expectancy reduction and mortality rate increase. In other developing countries like Bolivia, Honduras, and Nicaragua, Soares (2007) indicated that a negative growth in income is associated with gains in life expectancy. Yet, Soares (2007) also indicate that the shift in the relationship does not indicate that income levels do not play an essential role in health status (life-expectancy) but to a greater extent, many factors like differentials in nutrition and health services across variant income levels should be considered.

Riley and Alter (1989) also admits hygienic knowledge may also be an influence that improves health. To expound on the hygienic knowledge, Easterlin (1999) indicates that the most important decision-making units have been households and governments. As a wide array of decisions relating to the household operation are crucial to preventing disease. Similarly, governments action is also necessary to implement new methods of disease control and prevention. Thus, inasmuch as the new influences, as well as wealth status, may improve the health status, the onus lies on the household and government on making the decision (Easterlin, 1999). Nobel Laureate, Robert W. Fogel in 2004 also explains that beginning from the 20th century almost every change in mortality comes from sources related to improved income material living standards (income levels). Fogel (2004) focused on nutrition and its significance in determining the body-mass index of the children which help to explain whether the child is malnourished or not.

3.2 Other Determinants of Mortality

Previous studies on determinants of child mortality are mostly segregated into two-folds and consistently uses data from the Census, Living Standards and Demographic and Health Surveys (DHS) (Nketiah-Amponsah, 2010). Whilst some employ a cross-sectional or a panel household data, others focus on a time series household data (see Imam, 2004; Hanmer, Lensink & White, 2003; Fayissa, 2001; Ranis & Stewart, 2000; Waldmann, 1992). Klaauw and Wang (2004) for instance, used a cross-sectional data from DHS on Ethiopia to examine the environmental determinants of child mortality by constructing hazard models (Weibull, the Piecewise, and the Cox models) to interpret their result. The study examines the age-specific determinants of neonatal, infant and under-five mortality. Interestingly, the results indicated that electricity, improved levels of women education, sanitation facilities as well as in-door air pollution negatively correlated with child deaths. With strong statistical correlation between child mortality rates and poor environmental conditions. Thus, the study by Klaauw and Wang (2004) shows the essential role some indirect determinants play in child death reduction.

The results were not far-fetched from Wang's earlier research in 2003, which focused on a cross-sectional demographic and health survey on cross-country level. Similar to the subsequent study by Klaauw and Wang in 2004, Wang's study shows indirect determinants like access to electricity, vaccination in the first year of life and public health expenditures significantly reduce child mortality. However, in the urban areas, only access to electricity has a significant health impact while in rural areas, increasing vaccination coverage is important for reducing mortality. The results on the geographical location validate the argument that just as cross-country analysis shows a significant difference between richer settings than poorer settings, it is less likely for richer children in the urban centers to die compared to the rural areas. In addition, the effectiveness of vaccination in the rural area in the study also shows the importance of Primary Health Care to

the high-risk regions (the vulnerable group of people in the community). Although, Wang utilized a Pooled OLS which is subject to normality problems, Wang control for outliers and corrected the problem with robust t-statistics.

Derose and Kulkarni (2005); Aly and Grabowski (1990) and Woldemicael (1988) analyze child mortality rates in Zambia, Egypt, and Eritrea respectively. Findings from their regression shows that in Zambia, women's education and immunization have a significant influence on the reduction of child deaths. Whilst in Egypt, the source of drinking water in all households and sanitary condition influence child mortality rates negatively at -0.0275 and -1.41 respectively significant at 10% significant level. In Eritrea, the new findings were the type of floor material, household economic status and place of residence significantly affecting the childhood mortality through diarrhea. These determinants indirectly affect the health of the child in reducing the child mortality rates. All the three studies employed logistic models to estimate the log likelihood of the child dying or not. This estimation method limits the problems of the Pooled OLS (although a robust check can control the errors as utilized by Wang (2003)).

To add to that, Gangadharan and Maitra (2000) study were based on child mortality rate in Pakistan. Significantly, direct determinants of the age group of the child, show that, between 0 to 1 year old children there is a higher probability of children dying compared to children between ages of 1 to 5 years old. Interestingly, the estimates were also very significant for the girls than the boys which was significant at all levels Gangadharan and Maitra (2000). The study uses a probit model which also estimates the log likelihood of a child dying or surviving just as the logistic models.

On the host country, Ghana, studies conducted by Blunch (2004) focus on maternal literacy and women education as well as the importance of vaccination and postnatal care in the reduction of child mortality. Blunch (2004)

recommended that there is the need to improve the knowledge of the adult education on child health by including them in adult literacy programme. As result from the study shows a negative correlation between the aforementioned variables with child mortality. The study employed a bivariate probit model and estimated for the marginal effects of the variables. To add to that, further studies conducted by Benefo and Schultz (1996); Amankwah (1996) Tawaih (1989) and Adansi-Pipim (1985) all focus on socioeconomic determinants but not on supply side health determinants which the Primary Health Care offers (like availability of government hospitals).

Similarly, using pooled data, Gyimah (2002) established that, religion and ethnicity (at bivariate-level) contribute to the reduction of child mortality. However, when controlled with other socio-economic determinants, the religious influence becomes insignificant (Nketiah-Amponsah, 2010). These findings wholly contribute to literature, although one drawback is the lack of indirect influences like availability of government hospitals.

Amongst all the studies conducted in Ghana, Asante's study in 2003 found some contradicting result regarding Under-5 mortality determinants on co-variants level. With safe water and higher education positively influencing Under-5 mortality. Interestingly, this could be due to the simple OLS estimator models utilized in analyzing the relationship which may not have utilized the robustness test as employed by Wang (2003).

To this end, the several estimators employed shows that, the correlation between the variables considered in all the studies are not far-fetch, with few exceptions like Asante's study in 2003 which argues a positive correlation between the variables (safe water and higher education) and child mortality. Additionally, it can be seen that literature confirms the need for health determinants but solemnly considers supply-side determinants which may be offered by the Primary Health Care

program. Although, Nketiah-Amponsah (2010) study focus on some supply-side factors, it considers fewer locations in Ghana (Lawra, Ejisu-Juabeng and Dangme districts) and considers data for only one year which this thesis seeks to bridge. Table 1 is the summary of some of the previous research aforementioned.

Table 1 Summary of Studies on Determinants of Mortality

Study	Data	Method	Key Determinant(s)	Selected Key Results
CROSS-COUNTRY STUDIES				
Benefo and Schultz [1996]	1980 - 1996 (Cote d'Ivoire & Ghana- LSMS)	OLS estimation	Household economic resources	(0.0285)*** **robust coefficient:** (1.11)
Easterlin [1999]	1999 (6-countries)	Cross-country analysis	New Health Technologies, Institutional & Labor Requirement	**n/a**
Wang [2003]	2003 60-LIC	Pooled-OLS	Electricity (urban) & Vaccination (rural)	**(- 0.742)** *** (0.387)**
Preston [2007]	1900 - 1960 (60-countries)	Logistic model	Wealth (Income per capita) on life-expectancy	**0.800** *** [in 1930] **0.847** *** [in 1960]
Soares [2007]	1960, 1990 & 2000 (LIC)	Model Life Tables	Public health infrastructure, & Immunization,	**(- 0.0069)** in 1990, **(- 0.0741)***** in 2000 & **(- 0.6133)***in 1990, **(- 0.036)** in 2000
COUNTRY-SPECIFIC STUDIES				
Woldemicael [1988]	1988 (Eritea-DHS)	3-Logistic model	Place of Residence & Economic Status	**Urban Residence: (0.62 , 1.14, 1.13)**
Aly and Grabowski [1990]	1990 (Egypt-WFS)	Logistic model	Source of Water & Sanitation	**All Households** (- 0.275)* **Rural residence** (- 1.41)*
Gangadharan et. al. [2000]	2000 Pakistan data	Probit Models	Gender (Female ages of 0-1) & Female Education	(- 0.832)***, (- 0.1889)*** (- 0.2513)***, (- 0.2898)**
Klaauw & Wang [2004]	1998 - 1999 (India-NFHS)	Weibull, Piecewise & Cox models	Women education & Poor Environment	**Marginal Effects:** 11.4, 18.0 25.0 **Robust Coefficient**:(1.7), (2.8), (3.8)
Derose and Kulkarni [2005]	2001/2002 (Zambia-DHS)	Multi-level Logistic & OLS model	Women education & Immunization	**Coefficient for Under-5 death** (0.099) ** & (2.431) ***
Blunch [2005]	2005 Ghana-DHS	Bivariate probit model	Formal Health Education	**Marginal Effects** (-0.27)
Nketiah-Amponsah [2010]	2010 Ghana-DHS	Wiebull Model	Supply-side factors	Significant at all levels

OLS: Ordinary Least Square, **NFHS:** India National and Health Survey **LIC:** Low-Income Countries, **WFS**: World Fertility Survey
LSMS: Living Standard Measurement Survey, **n/a:** Not Available (Qualitative study),

Source: Author's own elaboration

4. Research Hypothesis

As the study will endeavor to understand whether the PHC programme is bridging the health inequality gap between the rich and the poor, based on the research question stated in section (1.2), the study will hypothesize that: *wealth status is expected not to be associated with the prevalence of child mortality in Ghana due to the benefits poorer households receive from PHC programme*.

The hypothesis of the research will first help address the long-standing argument of wealth (income levels) intrinsically linked with improved levels of health status.

To add to that, the stated hypothesis will further help understand whether the PHC programme is effective in the vulnerable and poor regions who are likely to experience a high rate of U5MR as they may not be able to afford the expensive healthcare systems. The ultimate aim is to analyze whether the aforementioned hypothesis holds or not.

5. Methodology

This study employed a multiple dimension of research approach by considering the gathered data from Ghana-DHS. It then analyzes the effect of wealth status and the PHC determinants on child mortality in Ghana whilst simultaneously comparing with what literature says. The study adopts a quantitative data for a complete understanding of the research problem and backs it with previous research (Creswell, 2015).

Thus, the study utilizes a linear probability model to analyze this phenomenon. The linear probability model is selected in this study largely because the focus of the study is to predict the proximate determinants of why a child dies or survives. Similarly, other regression models like the probit and logistic models could be used with a binary response variable as a way to describe conditional probabilities (Long, 1997). However, the interpretation in the probit and logistic models are not definitive and easy to comprehend as the estimate are in the maximum log likelihood. To add to that, the Logit model is quite similar to the Probit model and is likely to yield the same results, thus it will be a repetition of estimates if both are employed.

This study first constructed a wealth index based on the DHS wealth index construction (see section 2.2) in Ghana. The study then analyzes how the theoretical arguments on supply-side factors from the Primary Health Care (like the interventions of vaccine and immunizations, government hospitals availability), as well as other socio-economic determinants, have influenced the child mortality rates in the poorer settings of Ghana. The result is then used

as a guide into measures to ascertain a quantitative data (Creswell 2015). These measures explained how the PHC intervention has been very beneficial to the populace in Ghana.

As the thesis aimed to also enquire whether the PHC is effective in the poorer regions, the methodology employed was to construct an interaction between the wealth and PHC variables. These interaction variables were created to give a detailed analysis of the study. The World Health Statistics in 2016 also confirms that presentation of results of large or complex datasets like the DHS should include interactive data and visualizations which can facilitate easier interpretation (WHO, 2016). Thus, the study employed interaction variables to examine if the PHC interventions (like the vaccinations) is evenly distributed amongst the different quintiles of wealth and very effective within the regions. The methodology adopted also analyzed the rate of vaccination and women education on community-level (regional-level), wealth index on household-level aggregated into regional wealth, and other proximate determinants (including individual vaccination in-take) on individual-level.

The flexibility of this methods ensures a comprehensive understanding of the study whilst at the same time exposing the regions with the low source of health funding.

5.1 Limitation of Method

The reason for incorporating the aforementioned method is to alleviate the limitations of the research. The inconsistency in African data on demography and population documentation in some years passed might underestimate the study. However, the collective strength of quantitative and the previous research

complements each other and allows for more broad analysis (Creswell, 2015).

Secondly, due to the inconsistency in years for the data utilized, there were breaks (gaps) in years (1988:1993:1998:2003:2008:2014). Hence, the data does not follow a sequential pattern. The challenge is, it is plausible other stimulating factors in-between years may be underestimated. Yet, these unseen influences if short-lived may not render the analysis void as the long-run effect is the main focus of the study thus utilizing surveys in different years.

To add to that, it is also possible, the linear probability model adopted may have problems of heteroscedasticity. However, this is controlled for with a robust test and the standard errors reported accordingly. This is to alleviate the problem of the heteroscedasticity. Although, there is the need to note, this will not entirely resolve the problem.

5.2 Data Analysis

Wang (2002) argues that the most comprehensive set of socioeconomic determinants of health was compiled by the World Bank in 2000 based on the Demographic and Health Surveys (DHS) data. The DHS dataset in itself provides variants of information base on the individual, household, and regional or community levels. This study employed the DHS dataset on Ghana due the above reasons stated and the prolific structure of this dataset. There is the need to also note, there are similar sources which provides similar information if not the same. However, the alternative data sources are not readily available and are not as extensive as the DHS data. Additionally, the expected results may not be reliable as compared to the DHS data which considers a wide range of variables and recommended by other credible data sources like the World Bank Database and World Development Indicators.

The analysis of the study focuses on the Under-5 mortality rate from the

20th century to the most current dataset available on Ghana-DHS as at 2018. The study employs information on both the direct and indirect characteristics of the respondents' children during the period 1988:1993:1998: 2003:2008:2014. As section (2) theoretically explained all the variables and why they were considered, this section will offload that duty and statistically analyze the main variables that would be considered in the study. The Wealth Index will also be analyzed accordingly. There is the need to also note, in this section of the study, all decimals are approximated (rounded up) to the nearest value.

During the period under observation, a total number of 22358 responses are received from respondents on their children. Out of this total observation, 10,959 are females and 11,399 are male children. Since the study seeks to analyze Under-5 mortality rate, the data considers children who were below 5 years old. This is to ensure that, a true reflection of the dataset is presented. Thus, the sample data considered is the individual birth recode of the children under 5 years in the DHS dataset labelled (GHKR00DT)-where: GH is the country code (Ghana), KR is the code for birth recode for under 5 children, 00 is the year under consideration and DT is the generic code for all the dataset. Similarly, in the Ghana-DHS dataset, the dataset labeled (GHBR00DT) also studies all children born to the respondent, however, since the study only considers children under 5 years, the KR dataset is the most appropriate to utilize.

A count of 15,312 represents the total number of respondents. However, in calculating for the household wealth children who are born by the respondent but do not live with them are not considered. This reduces the total households to 14,984. On the average, each women respondent has at least 1 child under 5 years (total respondent divided by the total children). The study considers 6 different years between 1988 and 2014 (1988, 1993, 1998, 2003, 2008, 2014). The early period reflected a high level of mortality rates. It is possible the HIV/AIDS epidemic (as argued in section 3.1) which affected the populace might be the

reason. Whilst in the latter years, especially from the 21st century the mortality rate declined.

In all, 10 regions in Ghana were considered. Within the period under study, the data shows a relatively even distribution. In the Northern part of the country, Upper East Region had 1,599 responses on children representing 7%, Upper West Region had 2,097 responses representing 9% whilst the Northern Region had 2,609 responses representing 12%. In the Southern part of the country, Greater Accra Region (the capital) had 1961 responses representing 9%. Whilst, the Central Region had 2,082 responses representing 10%, the Volta region had 2,023 responses representing 9%. The Middle-belt had the highest responses with the Ashanti Region attaining the most responses of 3,173 representing 14%. In the Brong-Ahafo region, the frequency of responses on children were 2,352 representing 11%. The Eastern Region had 2,328 responses with 10% as the percentage frequency. This can be seen in Table 3 in Appendix A.

The variables considered in this study is primarily based on the Mosley and Chen's framework as well as the previous research (example Wang, 2003: Klaauw & Wang, 2004: Derose & Kulkarni, 2005). However, in addition to this, the study also added the supply side factors emanating from the PHC programme (like the vaccine intake, children who access the government hospitals and children who own health cards). Consequently, an interaction is created with these variables and the wealth quintiles to help understand their association in estimating the child mortality rates.

5.2.1 Descriptive Analysis

Table 3 displays the total percentage frequency of respondent's children living in the urban center is 31% whilst 69% lives in the rural areas. To add to that, the total number of children who are dead from the population sample of 22,358 is 1,667 representing 7% with 93% of the children under-5 years alive

which represent 20691. The total under-5 children who are dead within the study period can be view in Table 3. There is the need to note, the dataset is a cross-sectional data of 6 different years with gaps within the years. Thus, although the total death is not wholly representative from all the years starting from 1988 to 2014, the focus of the analysis is to establish what determinants are most likely to influence the child to die or live across the years.

On the socio-economic factor – education and PHC factor – vaccination, the analysis of the study is made on regional-levels to understand how the education and vaccination rates are distributed within the regions vis-à-vis influence child mortality. On the total rate of education in regional levels, the concentration is on respondents with at least a secondary education and with no education. Whilst the rate of vaccination considers the total number of children who are vaccinated during the period under consideration within the regions as well as the first set of vaccines the child receives. Amongst the 15,312 respondents 2% representing 272 have received higher education, whilst, 28% representing 4252 have received secondary education. The total percentage frequency of respondent with primary education is 30%, which represents 4642 respondents. Whilst 40% representing 6146 respondents have no education. This can be seen in Table 3 in Appendix A.

In Regional-levels as depicted in Table 5. the rate of education was higher in the Southern part of the of the country than the Northern part of the country where the highest percentage of people with secondary education was below 2%, in 1988 compared to 31% in the Greater Accra region. This huge educational gap implores as to understand the argument of, why the majority of the respondent in the Greater Accra region are in the rich quintile which will be discussed in section (6). Similarly, the same region (Upper West) records the highest number of female respondents with no education of 27%. However, in the 21st century, although the level of education was still low in the Northern part of the country, the Upper East recorded an impressive, percentage frequency of 5% as at 2014 as against 11%

approximately recorded in the Greater Accra region. The highest recorded for respondent with at least a secondary education in 2014 was in the Ashanti region with a percentage frequency of 15%.

Vaccination, a variable argued as a key determinant of child mortality by Wang (2003) and Derose and Kulkarni (2005) is also considered in the analysis in this study. On individual-levels, the study considers the first set of vaccination given the children within the stated period. The first set of vaccines the child receives are Bacillus Calmette-Guérin (BCG) which is primarily used against tuberculosis, DPT a class of combination of vaccines used against infectious diseases like diphtheria, pertussis (whooping cough) and tetanus as well as polio vaccine used to prevent poliomyelitis (World Health Organisation, 2016). Table 4 shows that, on individual level, a total of 15,727 children took both the BCG and DPT vaccines. However, majority of the children took the BCG vaccines than the DPT vaccines with a count of 933 and 585 respectively. Comparatively, quite the same number of children took the first set of BCG and polio vaccines with a total count of 672 for BCG and 664 for the polio vaccines. Table 4 also indicate that, on individual levels, lesser children took the DPT vaccines in comparison to the polio vaccines as the survey recorded 551 polio vaccine in-take and 211 DPT vaccine intake.

On community-levels (regional levels), the study considers the rate of vaccination in the regions. The statistics show that, in 1993, with the exception of the Northern region (with 9% of children vaccinated), in the Northern part of the country, Upper West recorded the lowest with 3% of the children vaccinated respectively. However, the Upper East region was not far-fetched from the Northern region with 7% of the children vaccinated. In recent years of 2008 and 2014, children under-5 in Upper East and Upper West (highly vulnerable regions) received relatively same level of vaccination in comparison to the Southern part and Middle Belt. Although not conclusive, this descriptive analysis somewhat

indicates how selective the PHC programme operates. Comparatively, The Greater Accra region, Ashanti region and Brong-Ahafo region who belong to the wealthy quintiles (discussed in section 7.0) had an impressive 19%, 17% and 12% of children in those regions vaccinated respectively in 1988. This can be viewed in Table 5 in Appendix A.

The source of drinking water, an essential variable argued by Aly and Grabowski (1990) as a key determinant of child mortality is also considered in this study. Interestingly, within the regions, the percentage of households with a treated water source (good source of drinking water) is 45% representing 6,752 households. However, the total number of households with untreated water is 4065 which is of 27% of the sample. It is possible the government initiatives in the provision of pipe-borne water within these deprived regions maybe the reason for the impressive rate. Table 3 in Appendix A has details on this.

Analysis of the type of hospitals respondents receives treatment shows that the percentage of the respondent who received treatment in the government hospital was 40%, representing 8,963 children. Out of the sample, 2% receive treatment from Private hospitals. It is therefore evident that majority of the households seek for the subsidized health care centers than a private health treatment which may be somewhat expensive. Table 3 displays this in Appendix A.

5.3 Econometric Model

As discussed, the study will employ a cross-sectional linear probability model for the analysis. In linear probability regressions models the dependent variable can take only two values, for example, yes or no. The purpose of the model is to estimate the probability that an observation with particular characteristics will fall into a specific category. Furthermore, the observations are classified based on their predicted probabilities (Long, 1997).). This type of classification is called binary

classification model where "success" is denoted by "1" and "failure" denoted by "0" Wooldridge (2013).

A linear probability model is a popular specification for an ordinal or a binomial regression model Wooldridge (2013). As such it treats the same set of problems as does logistic regression and probit regression using similar techniques but does not find the log-likelihood as the probit and logit models Wooldridge (2013). Although, the choice of the Pooled (OLS) (called, linear probability model when the dependent is a binary) may exhibit errors in the (residuals) and violate the homoscedasticity and normality of errors assumptions of OLS. This could, however, be controlled by the robust test which put a restriction on the vector parameter. This will prevent the result from having invalid standard errors and hypothesis tests (Long, 1997).

Despite the aforementioned drawback, unlike the probit and logistic models, it becomes clear the extent to which each "predictor" is adjusted for the impact of the other "predictors" in the linear probability models. Thus, in linear probability models, the magnitude of the variable in predicting the event occurring (i.e. child surviving or dying) is easily predicted, unlike the logistic and probit models which take the logarithm form of the variable coefficient. Thus, the magnitude of the coefficient is difficult to interpret (Hellevik, 2007).

5.3.1 Interpreting the Model

In the model adopted for our study, our dependent variable (which is binary either; "1" or "0") will take two possible outcomes which will denote "success" or "failure". Thus, in the Ghana-DHS data utilized, should the answer from a respondent indicate "yes" the child is dead – the condition will be represented by "1" in the linear probability model. Whilst an answer as "no" will be represented by "0" in the model. The control variables "X" are determinants which will influence the

outcome is also considered as the vector of regressors. Basically, a binary model structured is as indicated below:

$$E(Y|X) = P(y = 1|x)$$

$$Y = \begin{cases} 1 & \text{if } Y > \tau \quad \text{- child dies} \\ 0 & \text{if } Y \leq \tau \quad \text{- child survives} \end{cases}$$

The conditional expectation:

*E (child is dead or alive) = 1 * P (child is dead or alive=1) + 0 * P (child is dead or alive = 0) = P (child is dead or alive = 1)*

where **E** is the conditional expectation, **P** denotes latent propensity that **Y** is "1" or "0", the parameters **ß** are typically estimated by maximum likelihood, and τ denotes the threshold. Four different panels consisting four models will be estimated. Below are the panels utilized.

Exogeneity Assumption:

$$P(y_i = 1|x_i) = \beta_0 + \beta_2 x_{2i} + .,. + \beta_k x_{ki} + \varepsilon_i$$

$P(\text{child is dead}_i = 1|x_i) = \beta_0 + \beta_2 \textit{wealth quintiles}_{2i} + \beta_3 \textit{demographic factors}_{3i} + \beta_4 \textit{socio-economic status}_{4i} + \beta_5 \textit{regional aggregates}_{5i} + \varepsilon_i$ ..... ***Panel 1***

$P(\text{child is dead}_i = 1|x_i) = \beta_0 + \beta_2 PHC_{2i} + \beta_3 \textit{demographic factors}_{3i} + \beta_4 \textit{socio-economic status}_{4i} + \beta_5 \textit{regional aggregates}_{5i} + \varepsilon_i$ ..... ***Panel 2***

$P(\text{child is dead}_i = 1|x_i) = \beta_0 + \beta_2 ix.interactions_{2i} + \beta_3 \textit{demographic factors}_{3i} + \beta_4 \textit{socio-economic status}_{4i} + \beta_5 \textit{regional aggregates}_{5i} + \varepsilon_i$ ..... ***Panel 3***

$P(\text{child is dead}_i = 1|x_i) = \beta_0 + \beta_2 ix.regional\ interactions_{2i} + \beta_3 \textit{demographic factors}_{3i} + \beta_4 \textit{socio-economic status}_{4i} + \beta_5 \textit{regional aggregates}_{5i} + \varepsilon_i$ ..... ***Panel 4***.

Where y is a binary dependent variable which determines whether the child dies or survives, β_0 represent the constant, X are the exogenous variables namely:

wealth quintiles, PHC, regional aggregates, the interactions (*ix.*), demographic factors and socio-economic status. Using the framework of Mosley and Chen (1984) as basis of selecting the variables. The parameters ß is the Marginal Effect of maximum likelihood (for instances how many children do not die when they are vaccinated) ε_i the error term. Thus, in an expanded form the Marginal Effects of a child dying or surviving is exhibited below:

$$\beta_j = P\,(y=1|x=0)$$

where β_j expected of a child dying when **y** changes by 1 unit, the parameters **P** is the maximum likelihood of the child dying or surviving and **X** is the independent variables.

The Marginal Effects helps in interpreting the magnitude of the coefficients. Thus, in this study, the marginal effect estimates are run in STATA. Interpretation of the marginal effects coefficients in Linear probability models is made by interpreting the change in the expected value of y when x changes by 1 unit, due to the influence from the proximate determinant ceteris paribus.

6. Main Results

6.1 Wealth Estimates

The study first constructed a wealth index in the estimation of the results for U5MR. As explained in section 2.2, the Principal Component Analysis (PCA) was utilized for the estimation of wealth index which was done in STATA. The estimates show that majority of the assets considered were explained as there were a few assets with their unexplained component below 0.5. The assets that exceeded this threshold were households with a car, direct source of drinking water (waterbodies), television and good quality floor (terrazzo). This can be seen in Table 8. The study further estimated the measure of sampling adequacy by use of the Kaiser-Meyer-Olkin estimates. The Kaiser-Meyer-Olkin estimate is to establish whether the total assets chosen for the analysis has a high overall value (preferably should be higher than 0.6) (Kaiser et al. 1974). The overall value estimated is 0.7326. This can be seen in Table 7 in the Appendix B. In comparison with the Ghana-DHS wealth dataset in 2008, the estimates from the component selected were not far-fetched as both series followed the same pattern. Figure 3 below depicts the comparison between the two components. The results below show that, the Principal Component Analysis of the Ghana-DHS and the component considered for this study follow the same pattern or correlation sign and magnitude in most of the asset. However, households with radio were slightly different. Yet, this does not undermine the study as the Kaiser-Meyer-Olkin estimate is middling (within the 0.70 thresholds) with a value of 0.7326 (see, Kaiser et al. 1974). Table 8 in Appendix B exhibits the exact values of the PCA for the Ghana-DHS and for the study in 2008.

Figure 3 Comparison of PCA of Study with Ghana-DHS PCA in 2008

Source: Author's own elaboration

The wealth index was included in the DHS dataset from the late 20th Century (DHS,2018). In the Ghana-DHS, due to the inconsistency in the data availability in the years considered, the study constructed the wealth index by applying the principal component analysis method which was recommended by the Demographic and Health Surveys.

6.2 Regression Estimates

The regression estimate run in STATA considered four linear probability models estimated using four different panels (Wealth, PHC, Interactions and Regional Interaction). Regression estimates are in Table 6 of Appendix A.

The first panel (Wealth), estimates the likelihood of a child dying considering the wealth index of the households. Using the households in the lowest quintile as the reference category, the estimates show that, associations were stable from Models I to IV. As individuals in all the quintiles with reference to the lowest quintile are less likely to die with negative coefficients units of -0.01201, -0.01028, -0.015095, -0.029913 for the second, middle, fourth and highest quintile

respectively in the first model. Although the negative correlation in the household quintiles was consistent throughout the four models, the significant level was not consistent (varies in some models). However, the highest quintile maintained a 1% significant level throughout all the models. This indicates that the quintiles are not very dependent on the socio-economic controls employed. Additionally, children that have health cards are less likely to die with a negative coefficient of -0.0376 and -0.0397 for the third and fourth model respectively. Similarly, a household that accesses health care in government hospitals is also less likely to die with a coefficient of -0.00741 and -0.00794 at 5% significance level. There is the need to note, a robust test is conducted for the standard errors to check for the heteroscedasticity problem of the linear probability model. The robust standard errors for the children with health cards are 0.00501 and 0.00505.

In the second panel, the study considered the PHC variables. These include children who own health cards, the respondent who access government hospitals for healthcare and children who receive the first set of BCG, DPT and polio vaccines. In the first model of the second panel, the first set of vaccines all yield a negative correlation with coefficients of -0.01513, -0.00304 and -0.01932 for BCG, DPT, and polio respectively. Amongst these vaccines, BCG and polio vaccines were consistently significant in reducing U5MR at all levels (but 5% for polio in model four) when controlled. On the other hand, DPT attains no significant level in all the models. However, unlike the first model, a child that has a health card and access government hospital has a positive correlation with U5MR. The coefficients for the variable (child has a health card) are 0.0293, 0.02891, 0.03511, 0.03528 and 0.00949, 0.00854, 0.00886, 0.0086 for the variable: respondent uses government hospital in Models I, II, III and IV. Both variables attain significance at all levels.

Geographical settings (rural or urban) on the other hand was consistently positive at 0.00391 for the third model and 0.00347 for the fourth model. Again, a respondent who has a female child is less likely to witness the child dying with

negative coefficients of -0.00139, -0.00146 and -0.00142 but not significant in all the models.

On regional levels, estimates on the log rate of vaccination in the regions shows that if the child receives vaccination, the child is less likely to die with a coefficient of -0.00052 percentage points and significant at 10% compared to when the child does not receive vaccination (coefficient of 0.000027 percentage points).

Further estimation was conducted to help in answering the research question. Thus, interactions were created on regional levels to give a complete understanding. In the third panel, interactions were made between the Wealth variables and PHC variables. The interaction variables created were: Households in the 5-quintiles of wealth who receives regional vaccination and compared with those who do not receive the regional vaccination. With households in lowest quintile and receives no regional vaccination as well as receives regional vaccination as the reference category. The interaction created estimated that, all households who belongs to the other quintiles and receives regional vaccination has a significant effect in reducing U5MR in all the four models in panel 3 compared to those who do not receive the vaccination. In the first model, the coefficient for the households that receive regional vaccination were -0.00059, -0.00163, -0.000167 and -0.00273 for the second, middle, fourth and highest quintiles respectively. Amongst all the quintiles, the highest quintile attains significant levels in the second and third model at 1% for both. The coefficients of highest quintile who receives regional vaccination were -0.00273, -0.00092, -0.00127 and -0.00106 units for the Models I, II, III and IV. The robust standard errors estimated for the children in highest quintile who receives the regional vaccination are 0.00066, 0.00035, 0.00035 and 0.0004.

The last panel considers the specific regional interaction. Primarily, this is aimed at analyzing the association of wealth status in the regions whilst

simultaneously controlling with other PHC variables. Findings show that, there is the likelihood that, children in the Upper West region who do not receive the regional vaccination dying with coefficient units of 0.00499 as compared to -0.00226 for those who receive the regional vaccination in the first model. Similarly, in the Ashanti region, the coefficient estimated for a child in that region who is not vaccinated is 0.00042 units compared to those vaccinated is -0.001499 in the first model. Consistently, the Greater Accra region attain negative correlation and significant levels for children who receive the regional vaccination at 5%, 1%,1% and 5% in Models I, II, III, IV respectively. The robust standard errors estimated for this region were also at 0.00163, 0.00053, 0.00059 and 0.0006 for Models I, II, III, IV respectively.

Further interaction variables in the fourth panel estimated the households in Upper West region who belong to the lowest quintile and do not receives regional vaccination compared to the households in the Ashanti region who belongs to the lowest quintile and do not receives regional vaccination. The interaction is to estimate whether the vulnerable regions (like the Upper West) are able to offset the disadvantages of not being able to afford for health care due to the timely intervention of the PHC programme. This is will also help to ascertain whether the regional rate of vaccination was very effective in these specific regions. Estimates shows that, children in both regions are more likely to have higher U5MR if they do not receive the vaccination. The likelihood coefficient units were, 0.00461 and 0.007316 for both the Upper West and Ashanti region respectively in Model I. However, when controlled, the coefficient attains a negative correlation with those in the Ashanti region more likelihood of reducing U5MR with coefficient units of -0.00894, -0.0086 and -0.00869 compared to those in the Upper West region with -0.0121, -0.01175 and -0.01305 coefficient units in Models II, III and IV. In the third and fourth model of panel 4, when the PHC variables (like children who own health card and access government hospitals) were included, they attained a negative correlation but only significant for children who own health

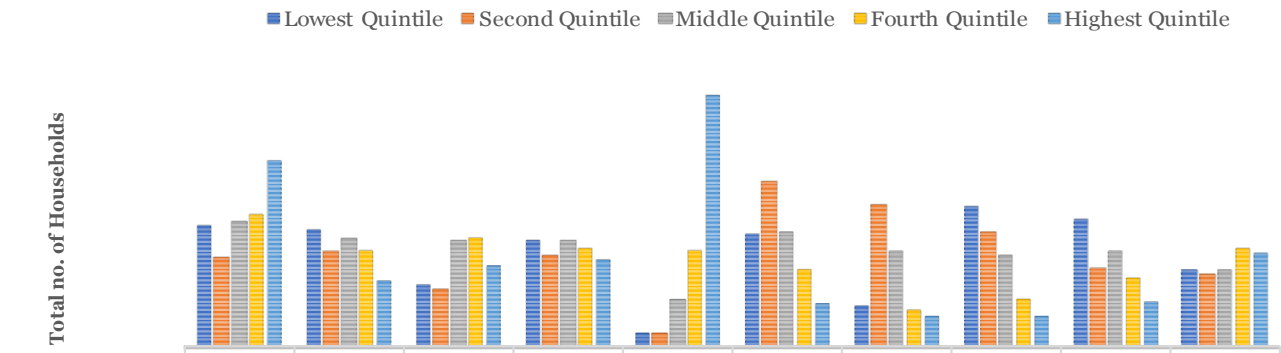
card at 1% for Models III and IV. The robust standard errors were also estimated for this variable (children who own health card) as 0.02068 and 0.00278.

7. Discussion

7.1 Wealth Analysis

Figure 4 below displays a 5-Quintile of household wealth index, aggregated into regional levels for the cross-sectional data. The highest quintile (5) is the level where a household may be considered "richer" according to the principal component analysis. Thus, this level shows that the frequency of households that own the majority of the weighted number of assets. The wealth status below also indicates that the majority of the households that own most of the assets considered are in the Greater Accra Region (capital city) and Ashanti Region belong to the wealthy quintile (4th and 5th). In a sharp contrast, the Northern part of the country (Northern, Upper West and Upper East Regions) are relatively poor in comparison with the capital city, Ashanti Region as well as the other regions. This is depicted in the graph with the vast majority of households in those regions falling within the 1st and 2nd Quintiles. Although, the graph somewhat depicts a gap in the wealth status between the Northern Regions and Southern part of the country (Greater Accra and Ashanti), the Middle belt regions (Brong-Ahafo and Eastern), on the hand have an even distribution of wealth with the vast majority of households either in the 3rd or the 4th Quintile.

Figure 4 5-Quintle of Household Wealth Index in Ghana



	ashanti	brong ahafo	central	eastern	greater	northern	upper east	upper west	volta	western
Lowest Quintile	394	378	201	347	45	366	134	449	411	246
Second Quintile	291	309	187	297	46	534	460	371	259	236
Middle Quintile	402	349	347	346	154	373	311	294	308	251
Fourth Quintile	426	308	348	319	310	248	123	155	224	316
Highest Quintile	599	217	265	284	810	140	101	102	148	301

Regions

Source: Author's own elaboration

Similarly, Table 9 and Figure 5 in Appendix B also shows the year by year distribution of the wealth distribution. The distribution shows that majority of households across all the six years were mostly in the second quintile in 1988, 1998 and 2003. However, consistently households in the lowest quintile were comparatively higher than other quintiles across all the years. Interestingly, the distribution in Figure 5 also displays a fair number of households in the highest quintile in some years (1988 and 1998) comparatively high.

7.2 Regression Analysis

Table 6 displays estimates of the association between the different wealth quintiles as well as PHC determinants and other socio-economic determinants of child mortality in the linear probability regression run in STATA. The result shows that, significantly, household in all the quintiles are less likely to have high rate of child mortality in the first model of the first panel (Wealth). The estimates in panel 1 also shows that the correlation sign (negative) is stable across all the models for

all the wealth quintiles without being influence by other control variables. In addition, households in the highest quintiles consistently attained a high significant level in comparison with the other wealth quintiles. The consistency of households in the highest quintile somewhat proves how wealth status have a direct influence on child mortality reduction (improved health status) as argued by Preston (2007). As the stability was consistent even when controlled with other variables. However, there is the need to note, further interactions between the wealth quintiles and the other health determinants were created before drawing a conclusion.

In analyzing the supply side factors vis-à-vis the influence emanating from PHC programme, the study considered the type of hospital the women visited for both the prenatal and post-natal treatment (i.e. before and after the child was born), the total number of children with health card and the first set of vaccines the child was given (BCG, DPT, and polio). There is the need to note, in Ghana, compared to private hospitals, in the government hospitals and clinics the cost of health care is subsidized to make it affordable for all. Similarly, under the auspices of the government initiative to provide health officers to communities with fewer hospitals and clinics, village health workers are provided for such communities who are deprived with such facilities (Demographic and Health Surveys Journal, 1988). Despite the findings on the first panel (wealth) indicating that, a respondent who ensured they use their health cards, negatively correlated with child mortality and consistently significant at all levels. However, in the second panel, there was a positive correlation between the respondent who has health cards and access government hospitals with U5MR. These findings negate the earlier findings in the first panel. Yet, the Demographic and Health Surveys Journal (1988) also confirmed that, most children with health card had at least one immunization which is likely to improve the immune system of the child and resistant to most of the childhood killer diseases. Notwithstanding, other variables emanating from the PHC (like the first set of vaccines given to the child) were considered to establish

the importance of the PHC programme.

Vaccination in-take of the children was estimated in regional and individual levels to ascertain how effective the vaccination rate in the country has helped reduce the U5MR in the regions over the period under study. Furthermore, this will help understand whether the PHC is achieving the Triple Aim of providing health for all especially to the more vulnerable regions and individual households. The Ministry of Health in Ghana recommends the first set of vaccines: Bacille Calmette-Guerin (BCG) is given soon at birth or soon after, DPT 1 and Polio is given 6 weeks after birth (Demographic and Health Surveys Journal, 1988). The linear probability regression estimate shows that, with a high rate of vaccination (especially the BCG and polio vaccines) on individual levels, children under 5 years are less likely to die and significant at all levels. Except for the DPT vaccine which is not significant in all the models estimated. This confirms earlier research by Derose & Kulkarni (2005) who utilized the Multi-level logistic model to estimate the importance of immunization for children under 5 years. Similarly, using cross country data of 60 countries Wang (2003) also found the importance of immunization on children. In addition, Soares (2007) found that, in LIC, the importance of immunization is clearly established. It therefore becomes evident that, the importance of immunization cannot be underestimated especially in LIC like Ghana.

Interestingly, unlike the first panel when most of the wealth quintiles were stable across all the models, the second panel change correlation of all the wealth quintiles with U5MR except for the highest quintile which was negative only in the fourth model. Yet, all the wealth quintiles were not significant at any level. This indicates, the influence the PHC variables have on the wealth. Additionally, these findings also show that, although high wealth status can enable the household to attain quality health care, in poorer households, the presence of subsidized cost of healthcare and vaccination programme emanating from PHC can reduce the

U5MR of poorer children.

To take the analysis into a considerable detail, interaction variables were created between all the wealth quintiles and regional vaccination rate. This yields a positive correlation for all the wealth quintiles who do not receive the regional vaccination and negatively correlated with all the wealth quintiles who receive the regional vaccination. Yet, it should also be noted, the households in the highest quintile receive the significant levels. Given these estimations, it is possible to establish that, vaccination programme (immunization) plays a pivotal role in the vulnerable or poorer children, but this is not substantive as the significant levels were not attained. Thus, it becomes evident that there is the need for further interaction variables created with the regions in perspective to establish whether vaccination rate is effective when estimated on the specific region.

Estimation shows that, on regional levels, for the Upper West, Ashanti, Greater Accra and Brong-Ahafo regions, the effectiveness of the PHC programme is somewhat not very effective in some of the regions. Interestingly, regions like the Greater Accra, Ashanti, Brong-Ahafo but not the Upper West region, attains a significant level in some of the models with a negative correlation with U5MR. The implication of this findings maybe that, although the importance of the regional vaccination cannot be underestimated it is possible the regional vaccination rate is not evenly distributed in the regions. The descriptive statistics on the regional rate of vaccination clearly exhibits this uneven distribution (see, Table 4). This contributes to the research by Walsh and Warren (1980) who indicate how the PHC is selective in its operation sometimes. Despite, this drawback, by far, the estimates have underscored the importance of the Primary Health Care programme through the effectiveness of vaccination on individual levels and in some regions which is also confirmed by literature. This confirms the hypothesis of the research question as it can be expected that wealth status is not associated with the prevalence of child mortality in Ghana due to the benefits poorer households receive from PHC

programme.

Considering the demographic determinants of child mortality, the children who reside in the urban center in reference to those who reside in the rural areas have no significant effect in reducing U5MR. Although, this negate research by Woldemicael (1988), it must be noted the negative correlation is not significant when controlled in other panels. Additionally, on regional levels, educational level of a woman with at least a secondary education is less likely to witness the death of their child under-5 years. Whilst significantly, women with no education have a positive correlation with child mortality. Thus, this confirms the aforementioned argument on the influence educational level have on the child mortality rates (see, Blunch, 2004: Klaauw & Wang, 2004 and Gangadharan and Maitra (2000).

8. Conclusion

The purpose of this study was to analysis how the new influences emanating from the PHC programme has help reduce mortality rates in Ghana and evaluate whether wealth status is still associated with the mortality as historically argued by proponents of the Preston Curve. A cross-sectional linear probability model was employed for this analysis using the Ghana-DHS data.

In brief, the result exhibits that, there were indeed other factors that affected the U5MR not necessarily the wealth status. Education of female respondent to a larger extent was more likely to reduce U5MR whilst geographical settings if controlled was not consistent in reducing U5MR.

Vaccination on individual-levels exhibits strong negative correlation in U5MR especially for the BCG and polio vaccines. However, when aggregated to regional levels, vaccination rate was not consistently significant, although the estimates exhibit a negative correlation for some poorer regions and significant for some regions. Further, findings show that, individuals from the Lowest Quintile and in the Upper West Region (vulnerable regions) had no effective response to their children survival when the regional vaccination is considered. This somewhat establish doubt on the importance of the PHC programme. However, there is the need to note, on individual levels, the BCG and polio vaccines show significantly that, children are less likely to die if the first set of vaccines is taken by the child. Additionally, households in the Ashanti region and Greater Accra region (highest quintile) who receive the regional vaccination effectively increase the survival of their children and significant when controlled with children with health card and access government hospitals. These findings exhibit the importance of the PHC and confirms what literature says (see, Wang, 2003: Derose & Kulkarni, 2005: Soares, 2007). Apart from the major importance vaccination provides to the child survival, another key finding was individuals who access health care in government

hospitals and have health cards.

In brief, the findings gave a clearer understanding of the need for more government initiatives in provision of hospitals, health systems and health campaigns to be evenly distributed within the regions to bridge the North-South (regions in the northern and southern part of the country) health inequality gap in Ghana. As it was evident the richer regions significantly, were more likely to have their children surviving in comparison to the poorer children.

Arguably, the constructive analysis in this thesis is not sufficient to acclaim all is accounted for. At least, the limitation of the study (which indicates gaps in the data) foretells there are some determinants which might still be obscured. However, as Musgrove (1996, p. 14) rightly stated, "the World Bank admits should the immunization programme had been left to private markets during the last few decades (around 1996), it is inconceivable that today some 80 per cent of the world's children would be immunized against the six major-vaccine- preventable childhood diseases." This establishes that, the importance of the PHC programme can never be underestimated.

8.1 Future Research

The findings from this study adds to literature on some country-specific determinants of child mortality. For instance, the regional estimates of vaccination which by far has not been incorporated by most studies is very relevant to studies on child mortality. Notwithstanding, future research can also delve into the relationship between the nutritional levels of children and child mortality. Although, I must be quick to add studies by Fogel (2004) looks extensively into such studies in different countries. Yet, country-specific studies in this area may not be entirely covered and might be an addition to research. As it will help find out how the nutritional levels of children using country specific data will minimized the risk of high child mortality rate.

8.2 Chapter Summary

The preceding chapters in this study concentrated on child mortality and its association between the wealth status and other PHC determinants. The chapters draw out a constructive argument on the Preston curve to understand whether in modern developing economies like Ghana, the association between wealth and health still exist.

In chapter 1, the background of the study was given to expound the argument and elaborate on the need for such a research to be conducted. The background section clearly established the arguments and why it may not hold in modern developing economies. The next sub section concentrated on the aim of the research and the research question. This section elaborated on the need for the research and why it should be conducted. Thereafter, a research question was stated to streamline the study towards answering that question. Subsequently, the outline was briefly discussed.

In chapter 2, the theoretical framework was established using Mosley and Chen's (1984) concepts. This section was to primarily help explain why some variables were considered in the study. The section also delves into the Wealth Index and explained why and how it was constructed. The importance of this section is seen as the foundation of the study as it established the need for the variables utilized.

Chapter 3 looks into the previous research and findings. This section discusses what literature says on the subject of study and analyzed the findings whether there is any contradiction to other literature or not. Eventually, this section is segregated into two (cross-country and country-specific findings) with a table reported accordingly.

Chapter 4 briefly states the research hypothesis of the study and the need to

establish whether the hypothesis will hold or not.

Chapter 5 discusses the methodology of the study. This chapter elaborates on the main method applied, why the method was used and how the method is executed. In addition, the sub-sections discuss the limitation of the study and how they were resolved, the data analysis which looks at the data employed and the descriptive statistics. Within this chapter, the econometric model utilized is also discussed in detail with an interpretation of how the model works.

Chapter 6, discusses the main results for the wealth estimates and regression estimates. The wealth estimates discuss the estimated sampling adequacy and compares the PCA of the study with the DHS PCA in 2008. The reports on the regression estimates are presented in their maximum likelihood coefficient estimates with the robust standard errors reported accordingly.

Chapter 7 focuses on the discussion of the results from chapter 6. On the wealth analysis, the result on the wealth quintiles is reported in Figure 4. Whilst the regression analysis discusses the results on the regression estimates. This chapter confirmed the hypothesis of the study to be valid and simultaneously confirmed with what literature says.

The discussions in this study, concludes with the key determinants and implications as well as the need for future research into other areas.

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APPENDIX A

Table 2	Summary of Main Variables	
Variable	**Description**	**Units**
Individual-Level		
Child is dead	Dependent and Binary variable predicts whether a child lives or dies (0 = child lives/1= child dies)	binary value yes =1/no= 0
Respondent Uses Government Hospital	Respondent and child access government hospital	binary value yes =1/no= 0
Child has a Health Card	Child has a health card to access hospital and record immunization dosages	binary value yes =1/no= 0
urban	Child lives in urban area	binary value yes =1/no= 0
rural	Child lives in rural area	binary value yes =1/no= 0
female	Child is a female	binary value yes =1/no= 0
male	Child is a malle	binary value yes =1/no= 0
bcg1st	Child takes first set of in bcg vaccines	binary value yes =1/no= 0
dpt1st	Child takes first set of in dpt vaccines	binary value yes =1/no= 0
polio1st	Child takes first set of in polio vaccines	binary value yes =1/no= 0
Age of the Child	Age of child	categorized into (0-1, 2-3 and 4 - 5)
Regional-Level		
Log rate of no education (mother)	Log of regional rate of secondary education	Proportions (% frquency)
Log rate of secondary education (mother)	Log of regional rate of no education	Proportions (% frquency)
Log rate of no regional vaccination	Log of regional rate of no vaccination	Proportions (% frquency)
Log rate of regional vaccination	Log of rate of regional vaccination of children	Proportions (% frquency)
Wealth Index Variables		
Pit Latrine	child lives in a household that uses Pit Latrine	weighted
No Facility	child lives in a household that has no toilet facility	weighted
Flush Toilet	child lives in a household that has flush toilet	weighted
Ventilated Public Toilet	child lives in a household that has ventilated public toilet	weighted
Untreated Source of Water	child lives in a household that has untreated source (example: well and tankers)	weighted
Treated Source of Water	child lives in a household that has treated source (protected water and treated pipe-borne water)	weighted
Direct Source of Water	child lives in a household that has direct source (waterbodies : rivers, lakes, streams, ponds)	weighted
Has a car	child lives in a household that has a car	weighted
Has a motorcycle	child lives in a household that has a motorcycle	weighted
Has a bicycle	child lives in a household that has a bicycle	weighted
Has a refrigerator	child lives in a household that has a refrigerator	weighted
Has a television	child lives in a household that has television	weighted
Has a radio	child lives in a household that has a radio	weighted
Has a electricity	child lives in a household that has electricity	weighted
Good quality floor	child lives in a household that has good quality flooring (terazzo, carpet, concrete floor)	weighted
Wealth Quintiles		
Lowest Quintile	Household in the Lowest Quintile	
Second Quintile	Household in the Second Quintile	
Middle Quintile	Household in the Middle Quintile	
Fourth Quintile	Household in the Fourth Quintile	
Highest Quintile	Household in the Highest Quintile	
Interactions		
Lowest quintile and receives regional vaccination	Children in the Household belongs to the Lowest Quintile and recieves regional vaccination	
Second Quintile and receives regional vaccination	Children in the Household belongs to the Second Quintile and recieves regional vaccination	
Middle Quintile and receives regional vaccination	Children in the Household belongs to the Middle Quintile and recieves regional vaccination	
Fourth Quintile receives regional vaccination	Children in the Household belongs to the Fourth Quintile and recieves regional vaccination	
Highest Quintile receives regional vaccination	Children in the Household belongs to the Highest Quintile and recieves regional vaccination	
Lowest quintile and receives no regional vaccination	Children in the Household belongs to the Lowest Quintile and recieves no regional vaccination	
Second Quintile and receives no regional vaccination	Children in the Household belongs to the Second Quintile and recieves no regional vaccination	
Middle Quintile and receives no regional vaccination	Children in the Household belongs to the Middle Quintile and recieves no regional vaccination	
Fourth Quintile receives no regional vaccination	Children in the Household belongs to the Fourth Quintile and recieves no regional vaccination	
Highest Quintile receives no regional vaccination	Children in the Household belongs to the Highest Quintile and recieves no regional vaccination	
Regional Interactions		
Upper West and Lowest Quintile and receives regional vacc.	Children in the Upper West Region who belong to the Lowest Quintile and receives regional vaccination	
Ashanti Reg. And Lowest Quint. recieves regional vaccination	Children in the Ashanti Region who belong to the Lowest Quintile and receives regional vaccination	
Ashanti Regional And recieves regional vaccination	Children in the Household belongs to the Ashanti Region and recieves the regional vaccination	
Greater Accra Reg. And receives regional vaccintion	Children in the Household belongs to the Greater Accra Region and recieves the regional vaccination	
Brong-Ahafo Reg. And recieves regional vaccination	Children in the Household belongs to the Brong-Ahafo Region and recieves the regional vaccination	
Upper West Reg. And recieves regional vaccination	Children in the Household belongs to the Upper West Region and recieves the regional vaccination	
Ashanti Regional And recieves no regional vaccination	Children in the Household belongs to the Ashanti Region and recieves the no regional vaccination	
Greater Accra Reg. And receives no regional vaccintion	Children in the Household belongs to the Greater Accra Region and recieves the no regional vaccination	
Brong-Ahafo Reg. And recieves no regional vaccination	Children in the Household belongs to the Brong-Ahafo Region and recieves the no regional vaccination	
Upper West Reg. And recieves no regional vaccination	Children in the Household belongs to the Upper West Region and recieves the no regional vaccination	

Table 3	Descriptive Analysis		
Description	**Frequency**	**Percent**	**Cummulative**
Type of Residence for children			
Rural	15524	69.43	69.43
Urban	6834	30.57	100
Total	22358	100	
Highest educational level			
Higher	272	1.78	1.78
No education	6146	40.14	41.91
Primary	4642	30.32	72.23
Secondary	4252	27.77	100
Total	15312	100.01	
Sex of Child			
Female	10959	49.02	49.02
Male	11399	50.98	100
Total	22358	100	
Regional Distribution of Children			
ashanti	3173	14.19	14
brong ahafo	2352	10.52	25
central	2082	9.31	35
eastern	2328	10.41	45
greater	1961	8.77	54
northern	2609	11.67	66
upper east	1599	7.15	73
upper west	2097	9.38	82
volta	2023	9.05	91
western	2134	9.54	100
Total	22358	100	
Respondent Uses Government Hospital			
0=no	13395	59.91	59.91
1=yes	8963	40.09	100
Total	22358	100	
Household Source of Drinking Water			
Others	154	1.03	1.03
Direct Source	4011	26.77	27.8
Treated Source	6752	45.07	72.87
Untreated Source	4065	27.13	100
Total	14982	100	
Child is dead			
0 = alive	20691	92.54	92.54
1 = dead	1667	7.46	100
Total	22358	100	
Age at death			
1 year	217	13	13.02
2 years	125	7.5	20.52
3 years	52	3.12	23.64
4 years	16	0.96	24.6
0 year	1,257	75.4	100
Total	1667	100	
5-Quintile of Wealth			
1 = Lowest	2,971	20.02	20.02
2 = Second	2,990	20.15	40.17
3 = Middle	3,135	21.13	61.29
4 = Fourth	2,777	18.71	80.01
5 = Highest	2,967	19.99	100
Total	14840	100	

Table 4: Individual Level Vaccination Distribution

1ST BCG VACCINE	1ST DPT VACCINE		
	NO	YES	TOTAL
NO	1697	585	2282
YES	933	15142	16075
TOTAL	2630	15727	18357
1ST BCG VACCINE	1ST POLIO VACCINE		
	NO	YES	TOTAL
NO	1618	664	2282
YES	672	15402	16074
TOTAL	2290	16066	18356
1ST DPT VACCINE	1ST POLIO VACCINE		
	NO	YES	TOTAL
NO	2079	551	2630
YES	211	15514	15725
TOTAL	2290	16065	18355

Table 5 Rate of Education and Vaccination in Regional Level

Region	Regional Educational Level				Regional Vaccination			
1988								
	no educa	%frequency	secondar	%frequency	no vaccination	%frequency	yes vaccination	%frequency
ashanti	151	14.436	21	20.000	43	24.294	174	16.747
brong ahafo	154	14.723	8	7.619	19	10.734	130	12.512
central	150	14.340	14	13.333	10	5.650	91	8.758
eastern	108	10.325	17	16.190	31	17.514	155	14.918
greater	70	6.692	38	36.190	19	10.734	202	19.442
upper west	325	31.071	2	1.905	14	7.910	78	7.507
volta	126	12.046	17	16.190	14	7.910	151	14.533
western	113	10.803	9	8.571	27	15.254	58	5.582
1993								
ashanti	107	15.552	18	22.500	99	16.098	300	18.916
brong ahafo	63	9.157	5	6.250	56	9.106	153	9.647
central	66	9.593	11	13.750	69	11.220	162	10.214
eastern	54	7.849	9	11.250	54	8.780	184	11.602
greater	29	4.215	32	40.000	30	4.878	169	10.656
northern	202	29.360	2	2.500	118	19.187	137	8.638
upper east	111	16.134	3	3.750	32	5.203	116	7.314
upper west	51	7.413	3	3.750	23	3.740	54	3.405
volta	59	8.576	8	10.000	74	12.033	165	10.404
western	53	7.703	7	8.750	60	9.756	146	9.206
1998								
ashanti	73	7.404	182	27.164	63	14.351	360	13.921
brong ahafo	58	5.882	75	11.194	30	6.834	172	6.651
central	63	6.389	87	12.985	35	7.973	236	9.126
eastern	54	5.477	155	23.134	50	11.390	298	11.524
greater	44	4.462	111	16.567	23	5.239	247	9.551
northern	196	19.878	15	2.239	80	18.223	226	8.739
upper east	245	24.848	14	2.090	24	5.467	319	12.336
upper west	169	17.140	14	2.090	44	10.023	217	8.391
volta	67	6.795	98	14.627	53	12.073	216	8.353
western	90	9.128	101	15.075	37	8.428	295	11.408
2003								
ashanti	88	8.333	192	31.373	54	10.425	475	15.770
brong ahafo	106	10.038	119	19.444	62	11.969	362	12.019
central	44	4.167	50	8.170	25	4.826	196	6.507
eastern	51	4.830	96	15.686	39	7.529	255	8.466
greater	48	4.545	141	23.039	31	5.985	286	9.495
northern	348	32.955	18	2.941	143	27.606	426	14.143
upper east	163	15.436	10	1.634	40	7.722	239	7.935
upper west	188	17.803	22	3.595	37	7.143	293	9.728
volta	45	4.261	72	11.765	48	9.266	200	6.640
western	63	5.966	84	13.725	39	7.529	280	9.296
2008								
ashanti	41	5.783	185	30.032	24	9.877	388	15.210
brong ahafo	70	9.873	90	14.610	21	8.642	233	9.134
central	29	4.090	69	11.201	10	4.115	198	7.762
eastern	28	3.949	99	16.071	15	6.173	230	9.016
greater	22	3.103	131	21.266	7	2.881	257	10.074
northern	241	33.992	29	4.708	89	36.626	343	13.446
upper east	114	16.079	13	2.110	19	7.819	198	7.762
upper west	120	16.925	34	5.519	14	5.761	250	9.800
volta	45	6.347	77	12.500	14	5.761	224	8.781
western	40	5.642	74	12.013	30	12.346	230	9.016
2014								
ashanti	44	3.803	240	18.032	20	6.920	540	10.179
brong ahafo	117	10.112	184	13.824	9	3.114	619	11.668
central	80	6.914	208	15.627	35	12.111	537	10.123
eastern	45	3.889	197	14.801	39	13.495	475	8.954
greater	24	2.074	180	13.524	6	2.076	441	8.313
northern	410	35.436	75	5.635	109	37.716	732	13.798
upper east	161	13.915	86	6.461	6	2.076	528	9.953
upper west	188	16.249	60	4.508	19	6.574	456	8.596
volta	63	5.445	134	10.068	14	4.844	445	8.388
western	69	5.964	207	15.552	32	11.073	532	10.028

Table.6 *PANEL 1*

Linear Probability Models				
WEALTH INDEX				
Child is Dead	Model I	Model II	Model III	Model IV
Wealth Category				
Second Quintile	-0.01201**	-0.01161**	-0.01872***	-0.01894***
	(0.00597)	(0.00591)	(0.00617)	(0.00618)
Middle Quintile	-0.01028*	-0.00797	-0.01713***	-0.01611**
	(0.00595)	(0.00589)	(0.00629)	(0.00629)
Fourth Quintile	-0.015095***	-0.01171**	-0.02403***	-0.02257***
	(0.00599)	(0.00593)	(0.00669)	(0.06723)
Highest Quintile	-0.029913***	-0.024612***	-0.03978***	-0.03796***
	(0.005497)	(0.00543)	(0.00723)	(0.00737)
Demographic Determinants				
female		- 0.00717 **	-0.00755**	-0.00724**
		(0.0035)**	(0.00349)	(0.00325)
Age Category				
Age of child (2-3)		-0.05886***	-0.06134***	-0.06151***
		(0.00319)	(0.00324)	(0.00325)
Age of child(4-5)		-0.06374***	-0.06630***	0.06659***
		(0.0037)***	(0.00376)	(0.00379)
Social Economic Status (SES) Determinants				
Urban			0.00186	0.00051
			(0.00482)	(0.0049)
Child has a Health Card			-0.0376***	-0.0387***
			(0.00501)	(0.00505)
Respondent Uses Government Hospital			-0.00741**	-0.00794**
			(0.00353)	(0.00354)
Regional Aggregate				
Log rate of no education (mother)				0.00188***
				(0.0004)
Log rate of secondary education (mother)				0.001398**
				0.00058)
Log rate of no regional vaccination				0.00098***
				(0.00034)
Log rate of regional vaccination				-0.00103
				(0.00105)
R-Squared	0.0020	0.0206	0.0244	0.0257
Number of observations	14840	14840	1480	14840
Constant	0.0622	0.0869	0.10507	0.0912

*Robust standard errors in parenthesis, ***p<0.01, **p<0.05, *p<0.1,*

PANEL 2

PRIMARY HEALTH CARE (PHC)				
Child is Dead	Model I	Model II	Model III	Model IV
Child has a Health Card	0.02934***	0.02891***	0.03511***	0.03528***
	(0.00587)	(0.00584)	(0.00678)	(0.00388)
Respondent Uses Government Hospital	0.00949***	0.00854***	0.00886***	0.00869***
	(0.01513)	(0.00122)	(0.00138)	(0.00162)
Child revieces first bcg vaccine	-0.01513***	-0.01617***	-0.01386***	-0.01423***
	(0.00287)	(0.00289)	(0.003182)	(0.00349)
Child revieces first dpt vaccine	-0.00304	-0.01731	0.00051	-0.00066
	(0.00257)	(0.00255)	(0.003684)	(0.004261)
Child revieces first polio vaccine	-0.01932***	-0.01731***	-0.01107***	-0.01081**
	(0.00309)	(0.00301)	(0.00379)	(0.00457)
Demographic Determinants				
female		-0.00139	-0.00146	-0.00142
		(0.00129)	(0.00154)	(0.00155)
Age Category				
Age at death (2 - 3)		-0.01158***	0.00824***	-0.008246
		(0.00108)	(0.00101)	(0.00171)
Age at death (4 - 5)		-0.01195***	-0.00757***	-0.00771
		(0.00998)	(0.00093)	(0.00296)
Social Economic Status				
Urban			0.00391**	0.00347
			(0.00199)	(0.00204)
Wealth Category				
Second Quintile			0.00416	0.00406
			(0.00345)	(0.00263)
Middle Quintile			0.00119	0.00076
			(0.00316)	(0.00263)
Fourth Quintile			0.00277	0.002137
			(0.00311)	(0.0029
Highest Quintile			0.00049	-0.00059
			(0.00314)	(0.003156)
Regional Aggregate				
Log rate of no education (mother)				0.0003574
				(0.00022)
Log rate of secondary education (mother)				0.00047
				(0.00024)
Log rate of no regional vaccination				0.000273
				(0.00015)
Log rate of regional vaccination				-0.00052*
				(0.00047)
R-Squared	0.0453	0.0494	0.0442	0.0447
Number of observations	18355	18355	12642	12642
Constant	0.03451	0.04009	0.02371	0.02434

*Robust standard errors in parenthesis, ***p<0.01, **p<0.05, *p<0.1,*

PANEL 3

INTERACTIONS				
Child is Dead	Model I	Model II	Model III	Model IV
Second Quintile and receives no regional vaccination	0.00011	0.000325	0.0002	-0.0002
	(0.00042)	(0.00023)	(0.00024)	(0.00026)
Middle Quintile and receives no regional vaccination	0.00101	0.0001	0.0001	-0.00018
	(0.00057)	(0.00027)	0.00026	(0.0003)
Fourth Quintile receives no regional vaccination	-0.00072	0.00037	0.00038	0.00012
	(0.00051)	(0.000267)	(0.00031)	(0.00033)
Highest Quintile receives no regional vaccination	-0.00075	0.00011	0.00015)	-0.0001
	(0.00589)	(0.000301)	(0.00023)	(0.00026)
Second Quintile and receives regional vaccination	-0.00059	-0.00496	-0.00049	-0.00033
	(0.00071)	(0.00036)	(0.00035)	(0.00035)
Middle Quintile and receives regional vaccination	-0.00163	0.00001	-0.00005	0.00016
	(0.00075)	(0.00037)	(0.00039)	(0.00044)
Fourth Quintile receives regional vaccination	-0.000167	-0.00044	-0.00064	-0.00044
	(0.00075)	(0.00036)	(0.0004)	(0.00043)
Highest Quintile receives regional vaccination	-0.00273	-0.00092***	-0.00127***	-0.00106
	(0.00066)	(0.00035)	(0.00035)	(0.0004)
Demographic Determinants				
female		-0.00069	-0.00003	0.00005
		(0.00175)	(0.00175)	(0.00175)
Age Category				
Age at death (2 - 3)		0.01892***	0.00189***	0.01895***
		(0.00201)	(0.00201)	(0.00162)
Age at death (4 - 5)		0.009334***	0.00908***	0.00913***
		(0.00256)	(0.00256)	(0.00182)
Social Economic Status				
Child has a Health Card			-0.0103	-0.00991***
			(0.1046)	(0.00271)
Respondent Uses Government Hospital			-0.00302*	-0.00327*
			(0.00179)	(0.00179)
Urban			0.00423*	0.00463*
			(0.00236)	(0.0024
Regional Aggregate				
Log rate of no education (mother)				0.00017
				(0.00017)
Log rate of secondary education (mother)				0.00043**
				(0.00016)
R-Squared	0.0019	0.0077	0.0082	0.0079
Number of observations	14840	14274	14274	14274
Constant	0.0579	0.002	0.00325	-0.0029

*Robust standard errors in parenthesis, ***p<0.01, **p<0.05, *p<0.1.*

PANEL 4

REGIONAL-LEVELS INTERACTIONS				
Child is Dead	Model I	Model II	Model III	Model IV
Upper West and Lowest Quintile and receives no regional vacc.	0.00461	-0.0121	-0.01175	-0.01305
	(0.01411)	(0.00917)	(0.00919)	(0.0092)
Ashanti Reg. And Lowest Quint. recieves no regional vaccination	0.007316	-0.00894	-0.0086	-0.00869
	(0.01624)	(0.00698)	(0.00702)	(0.00702)
Ashanti Reg. And recieves no regional vaccination	0.0042	0.00152**	0.00153***	0.00146**
	(0.00118)	(0.0007)	(0.0007)	(0.0007)
Greater Accra Reg. And receives no regional vaccintion	0.00594*	0.00236*	0.00263**	0.0019
	(0.00325)	(0.00122)	(0.00124)	(0.0013)
Brong-Ahafo Reg. And recieves no regional vaccination	0.003028**	0.00131*	0.00142*	0.00147**
	(0.00146)	(0.00069)	(0.0007)	(0.0007)
Upper West and recieves no regional vaccination	0.00499	0.00371	0.00394**	0.00375
	(0.00446)	(0.00263)	(0.0019)	(0.00269)
Ashanti Reg. And recieves regional vaccination	-0.001499	-0.00120**	0.000344**	-0.0012**
	(0.00119)	(0.00058)	(0.00057)	(0.00061)
Greater Accra Reg. And receives regional vaccintion	-0.00359**	-0.00152***	-0.00169***	-0.00131**
	(0.00163)	(0.00053)	(0.00059)	(0.0006)
Brong-Ahafo Reg. And recieves regional vaccination	-0.00191**	-0.00068	0.00079	-0.0008
	(0.0011)	(0.00048)	(0.00049)	(0.00049)
Upper West and recieves regional vaccination	-0.00226	-0.00168	0.00187	-0.0018
	(0.00357)	(0.00198)	(0.00197)	(0.00197)
Demographic Determinants				
female		-0.00005	-0.00003	0.00023
		(0.00175)	(0.00175)	(0.00175)
Age Category				
Age at death (2 - 3)		0.0189***	0.01889***	0.01897***
		(0.00201)	(0.0016)	(0.00162)
Age at death (4 - 5)		0.00879***	0.00869***	0.00884***
		(0.00178)	(0.00177)	(0.00177)
Social Economic Status				
Child has a Health Card			-0.00891***	-0.00847***
			(0.02068)	(0.00278)
Respondent Uses Government Hospital			-0.00282	-0.0028
			(0.00177)	(0.00177)
Urban			0.000311	0.00061
			(0.002068)	(0.00209)
Regional Aggregate				
Log rate of no education (mother)				0.00033
				(0.00013)
Log rate of secondary education (mother)				0.000157
				(0.00022)
R-Squared	0.0073	0.0076	0.0085	0.0089
Number of observations	14840	14274	14274	14274
Constant	0.04643	-0.00188	0.00024	-0.00524

*Robust standard errors in parenthesis, ***p<0.01, **p<0.05, *p<0.1.*

APPENDIX B

Table 7

Kaiser-Meyer-Olkin (kmo) Measure of Sampling Adequacy

Variable	kmo
Has Pit Latrine	0.4594
No Toilet Facility	0.3025
Has Flush Toilet	0.5364
Ventilated Public Toilet	0.7484
Untreated Source of Water	0.7895
Treated Source of Water	0.7442
Direct Source of Water	0.4549
Has car	0.8686
Has motorcycle	0.718
Has bicycle	0.6968
Has refrigerator	0.8591
Has television	0.8143
Has radio	0.838
Has electricity	0.8434
Good quality floor	0.8973
Overall	0.7326

Kaiser-Meyer-Olkin (kmo) Measure of Sampling Adequacy is a test to estimate whether the data is suited for Factor Analysis (Kaiser et al. 1974). Kaiser indicates an overall value within 0.70 is "middling" and appropriate for Factor Analysis. Thus, in this study with an overall value 0.7326 it is appropriate to use for factor analysis.

Table 8

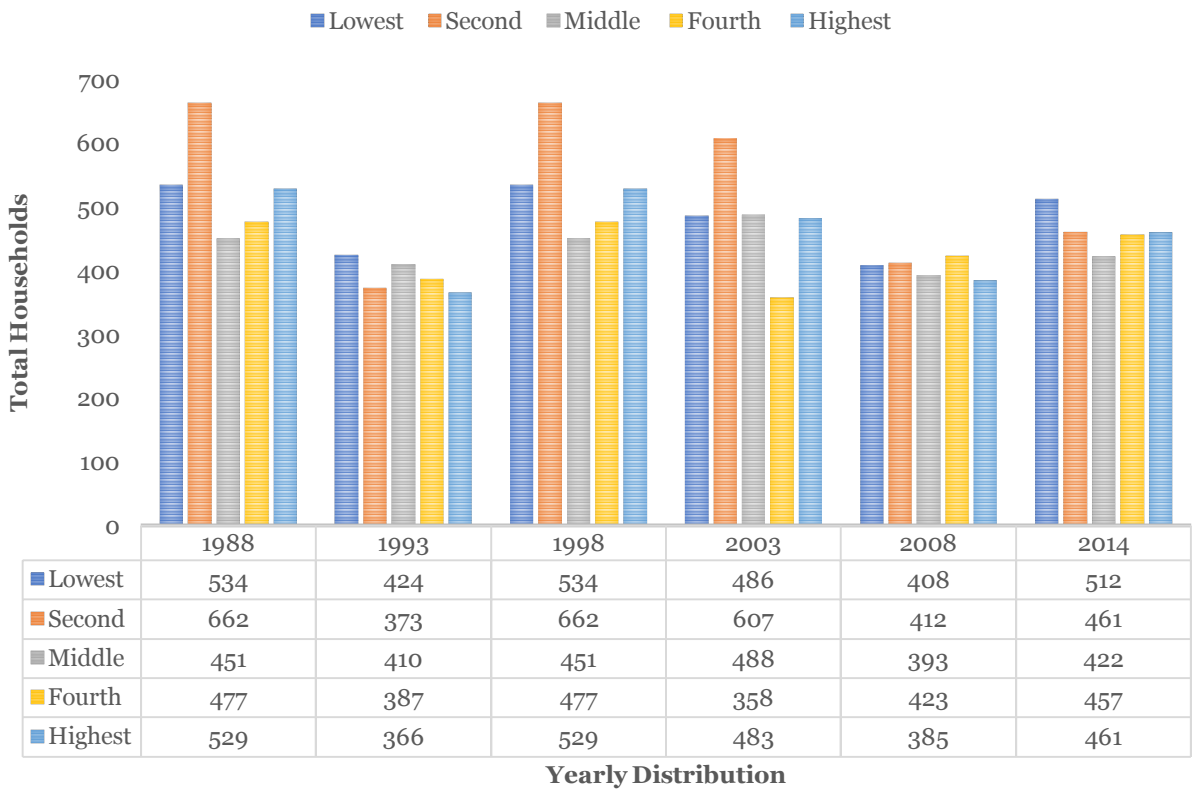
Comparison of the PCA with DHS PCA in 2008

Assets	PCA of study	DHS PCA in 2008
Ventilated Toilet	0.135	0.115928424
Flush Toilet	0.028	0.027221464
Pit Latrine	-0.043	-0.038485984
No Facility	-0.1	-0.1
Untreated Source of Water	-0.049	-0.057319376
Treated Source of Water	0.117	0.085088785
Direct Source of Water	-0.047	-0.042575468
Household has a car	0.0801	0.046
Household has Motorcycle	0.012	0.006
Household has Bicycle	-0.178	-0.23
Household has Refrigerator	0.147	0.127888749
Household has Television	0.051	0.083
Household has Radio	0.02	0.036
Household has electricity	0.0811	0.078
Good Quality Floor	0.0981	0.1

Table 9

Yearly Distribution of 5-Quintiles of Wealth			
5-Quintiles of Wealth	**Frequency**	**Percent**	**Cumulative**
1988			
Lowest	534	20.13	20.13
Second	662	24.95	45.08
Middle	451	17	62.08
Fourth	477	17.98	80.06
Highest	529	19.94	100
Total	**2653**	**100**	
1993			
Lowest	424	21.63	21.63
Second	373	19.03	40.66
Middle	410	20.92	61.58
Fourth	387	19.74	81.33
Highest	366	18.67	100
Total	**1960**	**100**	
1998			
Lowest	534	20.13	20.13
Second	662	24.95	45.08
Middle	451	17	62.08
Fourth	477	17.98	80.06
Highest	529	19.94	100
Total	**2653**	**100**	
2003			
Lowest	486	20.07	20.07
Second	607	25.06	45.13
Middle	488	20.15	65.28
Fourth	358	14.78	80.06
Highest	483	19.94	100
Total	**2422**	**100**	
2008			
Lowest	408	20.19	20.19
Second	412	20.39	40.57
Middle	393	19.45	60.02
Fourth	423	20.93	80.95
Highest	385	19.05	100
Total	**2021**	**100**	
2014			
Lowest	512	22.14	22.14
Second	461	19.93	42.07
Middle	422	18.24	60.31
Fourth	457	19.76	80.07
Highest	461	19.93	100
Total	**2313**	**100**	

Figure 5. **Yearly Distribution of Household Wealth**



	1988	1993	1998	2003	2008	2014
Lowest	534	424	534	486	408	512
Second	662	373	662	607	412	461
Middle	451	410	451	488	393	422
Fourth	477	387	477	358	423	457
Highest	529	366	529	483	385	461