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Estimation of child health production functions: Households' consumption of prevention goods and its interaction with public policies in developing countries

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ESTIMATION OF CHILD HEALTH PRODUCTION FUNCTIONS: HOUSEHOLDS' CONSUMPTION OF PREVENTION GOODS AND ITS INTERACTION WITH PUBLIC POLICIES IN DEVELOPING COUNTRIES

by

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ABSTRACT

ESTIMATION OF CHILD HEALTH PRODUCTION FUNCTIONS:
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by

Naing Oo

Adviser: Distinguished Professor Michael Grossman

The model developed, based on the utility maximizing framework, investigates salient features of public policies in provision of prevention goods in relation to child health production. The model has been empirically tested using international cross-sectional data for 92 developing countries.

In the first-stage, six reduced-form demand equations for prevention goods and services, namely; immunization, oral rehydration therapy, birth attended, family planning, calories, and water, were estimated. Heteroscedasticity is investigated by the Breusch-Pagan Lagrange multiplier test. The standard errors and t-ratios of the reduced-form equations are corrected by applying White's robust estimation method. The regression results show that consumption of prevention goods and services can be powerfully reinforced by improving households' capacity to consume, and establishing well-designed public policies.

The two stage least squares method is employed in the estimation of the structural child health production functions. The results of the structural regressions, with or without controlling other variables, consistently indicate that these prevention goods are statistically associated with reduction in IMR and U5MR. Application of the Wu-Hausman test for specification error confirms that these prevention goods are endogenous with respect to child health. The test for overidentifying restrictions was carried out for all structural equations. The test statistics suggest that it can not reject overidentifying restrictions.

The present analysis shows how the unacceptably high IMR and U5MR in developing countries could be reversed, and what policy changes would be required. The sustainability of consumption, and provision of the minimum package of essential prevention goods and services is addressed.

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For Khin Wit Yee and Ei Naing Oo

For U Lun Wai and Daw Khin Mar Mar

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I. INTRODUCTION

According to a recent estimate, about 30% of the population in developing countries is poor, i.e; more than one billion people.[1] Poor refer to those people who do not meet a minimal standard of living; which includes food, clothing, shelter, and access to education, health services, a safe and adequate water supply, sanitation, and so on.(World Bank 1990). The importance of these factors, commonly known as basic needs or human capital components, has long been recognized in economic literature. Nobel prize recipients Lewis (1954), and Schultz (1964) discuss the issue in a development context, and Becker (1962) examines it within a household utility maximizing framework. The critical role played by learning, skills formation, and the stock of knowledge; reflecting human capital, is a recent development in the theory of economic growth. {Lucas (1988) and Romer (1989)}.

One can witness the evolution of economic growth theories by looking at developing countries' economic policies and their outcome from a historical perspective. In the early decades of their independence, economic growth was the principal goal of the third world countries and the growth of physical capital received over-attention. Poor performance of the third world economies facilitated rethinking of the development concept. In response, in the early 1970s, the basic needs approach to development was popularized by the World Bank and ILO.[2] However, the macroeconomic crises of the 1980s led to a change of priority away from human development, and toward structural adjustment. This trend overwhelmingly

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[1]. Quoted from World Bank (1992 p.30).

[2]. See Streeten et. al (1981) for a detailed discussion.

dominated in policy making circles.[3] The forceful pressure on development planners became tighter than before, especially due to the international environment created by the end of the cold war. The resurgence of the basic needs concept was observed during the early 1990s. It was defined as a two-part strategy; provision of basic social services and stimulation of the poor's income by creating productive opportunities. Existing theories offer no objection to it. Empirically, the concept also enjoys strong support. For instance, Dixon's (1987) analysis on Latin America finds that economic growth is a necessary ingredient of development, although it needs to be properly channeled to qualify as a sufficient condition. As recently as 1990, Dreze and Sen (1990) argue that economic growth does not automatically lead to improvement in the well being of people in the less developed countries.

The achievement of sustained and equitable improvement in societal well being, or reduction in poverty, becomes the strategic issue. Very often, well being is expressed in terms of economic status (per capita income), attainment of social status (life expectancy), and achievement in composite measure (human development index). The most difficult question is concerned with production phenomena involving the well being of people. This research investigates development and health in developing countries. It focuses primarily on the production framework of child health, namely; under-five mortality rate (U5MR) and infant mortality rate (IMR).

U5MR is a new measure[4] of societal welfare which reflects the dimension and magnitude of poverty associated problems in the contemporary developing world. The most

---

[3]. For the impact of structural adjustment on health and nutrition in developing countries, see Cornia et al (1987), and Bell and Reich (1988).

[4]. U5MR is the number of children who die before the age of five for every 1000 live births. U5MR was introduced in 1987 by UNICEF. Since then it has been one of the principle indicators of the organization.

immediate health problems facing these countries are very different from those facing affluent, rich countries, and the U5MR gap between the two groups is still high. See table (1). The very real cost of negligence is reflected in mortality data. In 1991 negligence cost the lives of more than 12 million children. The two biggest killers are diarrhoea (23%), and pneumonia (28%). It can also be seen from table (2) that 16% of child death (or 2.1 million lives) is due to vaccine preventable diseases. The situation has forcefully created high private and social cost. No doubt an improvement in individual health not only benefits the household but also helps to reduce the aggregate economic burden imposed by illness. The global burden of disease (GBD) measured in units of disability-adjusted life years (DALYs) shows that 67 percent of all DALYs loss in the developing world was a result of premature death. (World Bank 1993).[5]

Of course, there are many low-cost but highly effective technologies to combat these killers. Oral rehydration therapy (ORT) for dehydration and various vaccines such as DPT, BCG, measles and polio, are well known available solutions to tackle these problems. Obviously, many other factors associated with public policies, private sector decisions, and household behavior directly or indirectly influence the outcome of production of good child health, through different channels. While the effects of preventive measures such as immunization and ORT are medically well established, the intensity of functional relationship between consumption of these goods and household and public policy factors, and its impact on child health production is only generally known and in vague terms. Systematic studies

---

[5]. The GBD is calculated by combining (a) losses from premature death, which is defined as the difference between actual age at death and life expectancy at that age in a low mortality population, and (b) loss of health resulting from disability. For a detailed derivation of GBD see the World Bank' WDR (1993): Investing in Health.

of the issue based on economic principle have never been undertaken yet.

The present research looks at the production framework of child health (U5MR and IMR). A greater emphasis than previous research will be put on public policy variables and their interaction with households, using international cross-sectional data. To be specific, the principle purpose of this research is to examine salient features of public policies in provision of prevention goods in relation to child health measured by IMR and U5MR. The sincere hope is that the study will contribute, both from theoretical and empirical perspectives, toward formulation and implementation of policies and programs for poverty alleviation, and improvement of the situation of the world's children.

Turning to the content of this research, chapter 1 represents an overview of the current tragic conditions in contemporary developing countries and outlines the major objective of the analysis. The review of micro-and macro-based studies on the economic models of child health production is carried out in chapter 2. Theoretical starting points that provide the framework for this research are presented in chapter 3. Chapter 4 is concerned primarily with the hypotheses of the study. A detailed econometric specification of the reduced-form system and structural equations are treated in chapter 5. Chapter 6 starts by characterizing the factors influencing demand for immunization services, ORT, birth delivery, contraception, nutrition and water supply and then shows the interaction between women's education and different policy variables. The focus of chapter 7 is the estimation of two structural equations. Production functions for IMR and U5MR are fitted separately with these prevention goods inputs. The final chapter deals with a discussion of the findings and draws a conclusion with special reference to policy implication for development planners and researchers.

Table (1) U5MR Differential in 1991

	U5MR
Developed countries	17
Developing countries	101
Sub-Saharan Africa	180
Middle East & North Africa	90
South Asia	131
East Asia & Pacific	42
Latin America & Caribbean	57

Source: UNICEF 1993 (p68).

Table (2) Causes of Under-Five Deaths in Developing Countries (1990)

Causes	No. Deaths (000)	Percentage
Diarrhoea	3000	23.3
Pneumonia	3560	27.6
Measles	880	6.8
Whooping Cough	360	2.8
Neonatal tetanus	560	4.3
Tuberculosis	300	2.3
Malaria	800	6.2
Other peri- & neo-natal	2470	19.1
Other	970	7.5
Total	12900	100

Source: UNICEF 1993 (p7).

II. REVIEW OF EMPIRICAL RESEARCH ON THE ECONOMIC MODELS OF CHILD HEALTH PRODUCTION

Since it is a relatively young measure, there is virtually no empirical analysis on economic models of under-five mortality. However, there is so much research on estimation of a child health production function (for instance, IMR and nutritional status) for developing countries that it is impossible to review all the studies in detail. Rather, an attempt will be made to examine the most recent works and the ones that are critically relevant to the present study.

Micro-based studies.

The vast majority of studies employ a household utility maximizing theoretical framework as a starting point for their analysis. Among the most recent micro-based studies, Aly (1991) has built a logit model to show the relationship between child mortality (under 10 and under 5 years of age) and certain proximate determinants based upon data drawn from a sample of Egyptian households. Major findings include a negative association between child mortality and availability of water supply, sewage facilities, and breastfeeding. Similar claims can be seen in the early study of Wolfe and Behrman (1982).

Using household survey data from Nicaragua and Bangladesh, Blau (1986), Wolfe and Behrman (1986), and Hossain (1990) focus on child quality and quantity trade-off. Mortality, nutritional status, and investment in schooling per child are treated as indicators that represent child quality. Exogenous variables are parental characteristics, residential location, wage level and labor market situation, usage of birth control, and ownership of

modern items. These researchers commonly agreed that mothers' education has a direct effect on child quality.

Lately, in the context of economic models of household behavior, researchers attempt to examine the interdependence of child survival and anthropometric outcomes. Height for age, and weight for height, believed to represent nutritional status in the long run and short run, respectively, are the most widespread measures of anthropometric outcomes. Thomas et. al. (1990) fitted the survival rate regression, the ratio of the number of children alive to the number ever born for each woman, based on Brazilian household expenditure survey data. Parental education is found to have a strong positive effect on survival probability which is consistent with many research findings elsewhere, both in developed [example: Corman and Grossman (1985)] and developing countries. Evidence of a significant and positive income effect on survival rates is observed; again, this supports the claims of the importance of increasing the income of the poor. [World Bank (1990)]. Interestingly enough, it was also found that the mother's nutritional status or genetic endowment, as a proxy by her height, had a positive effect on child survival.

A series of empirical analyses have also been conducted in the form of maternal behavior framework such as breastfeeding [Akin et al (1985) and Barrera (1991)] and usage of contraception. Since a link between breastfeeding and child health has been well documented in existing public health, nutrition, and medical literature, the economic models try to formalize it by using a household choice theoretical framework with a greater emphasis on mothers' schooling. The critical decision made by the mother with respect to the timing of introducing supplemental foods obviously becomes a focal point since breastfeeding which is "too long, too short or none" leads to a higher risk of child health.

Research has shown that the education level of mothers has significant influence on positive child health outcome. In other words, public policies concerned with provision of general and health education should be directed toward less-educated women, most of whom happen to reside in villages and slums throughout the third world.

Several studies take into account the increasingly critical role of public policies regarding health and health related infrastructure development in child health production. Health manpower and facilities, educational establishments, water supply and sewerage systems, and electricity, food prices and subsidies were fitted as public inputs in the child health production studies. Evidence has been accumulated, as these studies have covered a wide range of geographical areas: Rosenzweig and Wolpin (1982) for India, Moock and Leslie (1986) for Nepal, Hortan (1988), Barrera (1990), Senauer and Gorcia (1991) for Philippines, Strauss (1990) for Cote d'Ivoire, and Thomas and Strauss (1992) for Brazil. These studies confirm the influential role of public inputs in the production of good health.

An equally important component in reducing infant and childhood mortality risk is the use of contraception. Research has shown that family planning can contribute to saving the lives of children by reducing high-risk births at either extreme of a woman's child bearing age (too old or too young), and by lowering the total number of births per woman. {Miller et al. (1992) and Curtis et al. (1993)}. The impact of family planning will vary with the child's age and the mother's characteristics.

In some studies, emphasis has been placed on demand for and utilization of public services. Access to health facilities in rural areas of developing countries is often inadequate. The problem is compounded by the lack of an adequate transportation system, which in turn results in high opportunity costs of time, especially in agriculture seasons. Distribution of

health resources in equity fashion has been put forward as a policy implication. [Mwabu (1989) and Berman et. al (1989)]. Findings along the same line have been reported by Birdsall (1985) and Akin et. al. (1986). In the case of the Philippines, a group of researchers found that the low probability of consumption of prevention goods (eg. maternal and child health, and immunization services) by the poorest pregnant women was due to unavailability and inaccessibility of services.

Another line of research explores the effect of public policy related to macroeconomic crises on health and nutrition. During the 1980s many developing countries had to make a series of economic adjustments which included currency devaluation and cuts in government spending. In many cases, a discretionary fiscal policy responded by cutting spending in the most vulnerable areas; the social sectors[6]. Moreover, Thomas et al (1992) found that an increase in relative prices had adverse effects on the nutritional outcome in Cote d'Iovire.

Macro-based study.

A look at the existing macro-based empirical studies, ie., a cross-nation analysis, shows that there are not many works on estimation of a child production function. Inadequate and incomplete data on aggregate socio-economic variables may be one of the important factors in explaining fewer research works in this area.

To gain a better understanding of the causes of declining mortality in developing countries in this century, it is especially interesting to examine the work of Preston (1980). The results of two separate regressions reveal that both socio-economic development

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[6]. For impact studies see Cornia et. al (1987). Debate on the structural adjustment see Summers and Pritchett (1993).

(reflected in income, calorie consumption, and water supply), and government social policy (literacy program) have contributed to the decline in mortality during 1940 and 1970.

A very similar analysis has been performed by Carrin (1984) for the year 1960 and 1980 The four health status indicators analyzed are the crude death rate, infant mortality rate, child death rate (aged 1-4), and life expectancy at birth. The variables considered as the health determinants are access to safe water, the population per physician, population per nurse, adult literacy rate, calorie consumption, fertility rate, and crude birth rate. The simple descriptive statistic analysis confirms the findings reported by Preston.

Sheehan and Hopkins (1979) employ a sophisticated multivariate statistical analysis method in their research on basic needs performance and its determinants. Factors which explain material (calorie consumption), and non-material (life expectancy, infant mortality, death due to infectious diseases) basic needs performance have been tested for the year 1960 and 1970. A positive influence of per capita GNP, and a strong negative association of population growth rate on basic needs performance have been identified. Their study also examines the inter-relationship between basic needs variables. It finds a strong relationship between education, and both life expectancy and infant mortality.

A basic needs fulfillment and economic growth study by Wheeler (1980) econometrically analyzed the impact of changes (1960-70) in per capita GDP, adult literacy, per capita calories available, population per doctor and population per nurse, upon changes in life expectancy. The simultaneous system result found all the signs of independent variables as expected.

A resurgence of research interest in determinants of child health has been noticed in recent years. It is accepted that drugs play a major role in the first line of defense against

diseases. In spite of their crucial importance, economic models of empirical study on the issue have long been neglected. However, one study attempts to examine the effect of consumption of pharmaceuticals on infant mortality, life expectancy, and child mortality. [Peters (1992)]. The finding reveals that gross pharmaceutical consumption facilitates reduction in infant mortality, but has no significant effect on child mortality.

The Lessons

In-depth knowledge on child health production (IMR and nutritional status) has been accumulated increasingly from micro-based studies. These studies were conducted in a wide range of developing countries in terms of geographical (Africa, Asia, Latin America), political (military, dictatorship, democratic), and socio-economic strata (rural/urban, income groups). However, caution must be taken in generalizing their findings since the majority of these empirical works have relied on sample survey data[7], and accordingly, coverage has been limited in nature. In addition, these studies confront problems of model specification and measurement errors. Furthermore, they have to give convincing explanations for unobserved and self-selection bias. Nevertheless, this does not mean micro-based studies are inapplicable in policy formulation. Since these kinds of research can be designed in accordance with local social, cultural, and politico-economic structure, very frequently the results manage to capture unexpected linkages. Moreover, they particularly contribute in helping to better understand macro-based studies.

Cross-nations research provides a broader view of the inter-relationship among variables. The most well known problem associated with macro works is, as already

[7] Censuses mortality and fertility questions have covered a sample of population.

mentioned, usage of aggregate data from the less developed countries. Another serious matter is concerned with model specification. At the aggregate country level some variables, usually put on the right hand side of a functional equation, should be treated as endogenous. This conveys the need to employ more comprehensive econometric techniques in the analysis. It is also observed that none of the previous works paid attention to the time lagged structure of the explanatory factors.

The combination of micro and macro analysis so far conducted offers much knowledge on interactions among political, socio-economic, and household behavior with respect to production of health. One can also gain lessons from strengths and weaknesses of the studies. Do the stylized facts laid out in this chapter provide sufficient information for development planning ? Unfortunately, today's problems are serious enough, as discussed in the introductory note, to call for more explanation and investigation. Nobody can deny the fact that the research will only be a significant public policy supporting tool if it is able to provide both theoretical and empirical results on how the complex relationship among these variables works. Obviously, there is room for improvement in the area of child health production in developing countries. For this to occur, still more research is needed for effective policy formulation and implementation.

III. THE THEORETICAL FRAMEWORK

Even in the simplest model of a closed economic system, one can see how government, as well as households and firms, interact in the resource allocation process. Households are sellers of resources in input markets but are buyers in product markets; private firms are buyers in input markets and sellers in output markets. Government not only participates in both markets but also provides public goods and services to society. See figure (1)[8].

This research will pay specific attention to public policies with special reference to social sectors. Development policy in general and social policy in particular is fundamentally about the well being of society. Of course, welfare does not depend solely on government policies, for the public sector is the most important channel which affects the welfare of households. Economic theory can be applied to demonstrate this extremely difficult and complex interrelationship. Households make decisions through their utility maximizing process. On the other hand, governments also make public policy decisions in the context of maximizing their utility (social welfare function[9]) subject to budget and political constraints. See figure (2).

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[8]. Cited from Hyman (1992), page 137.

[9]. Social welfare function represents aggregate preference of all households. Governments are supposed to fulfil the needs of society. However, it may sometimes be the case that a government has established its own preference and that will be maximized.

FIGURE (1) ECONOMIC SYSTEM

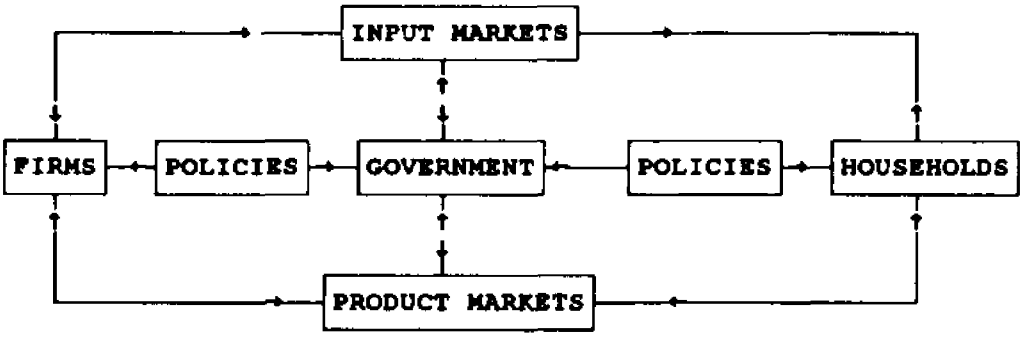


FIGURE (2) INTERACTION: PUBLIC SECTOR AND HOUSEHOLD

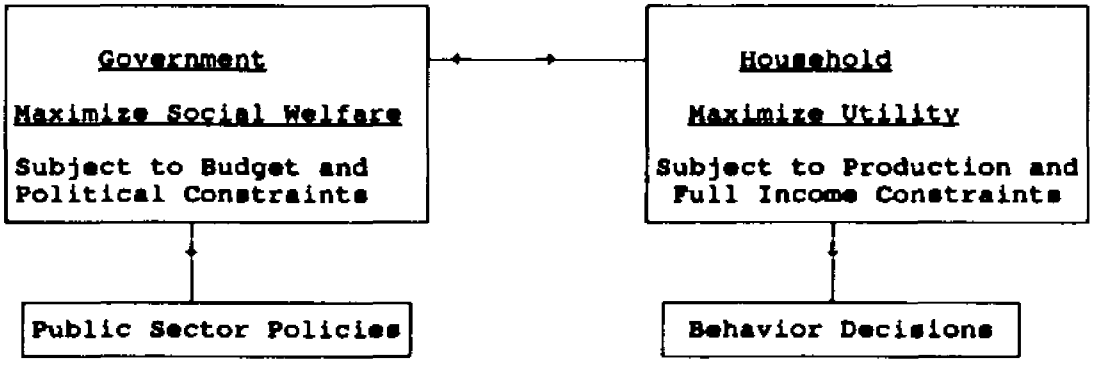
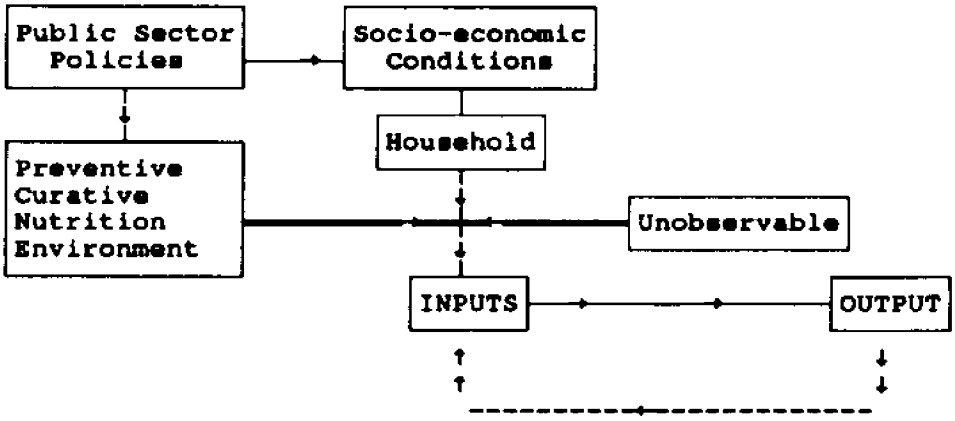


FIGURE (3) CHILD HEALTH PRODUCTION FRAMEWORK



Using the framework shown in figure (3)[10] as a starting point, one can illustrate their complex interaction. Inputs of child health production process are grouped into five sets, namely; curative, preventive, nutritional, environmental and household characteristics. The production phenomena in figure (3) shows how these inputs are converted into output, the child welfare[11].

One aspect of the process is critically influenced by public policies. These meso policies, as they are also called, cover health, education, environment, subsidies and transfers, pricing, and income distribution. Many of these policies depend on public expenditure for implementation. Some public decisions with respect to meso policies may be seen as commitments such as launching a national literacy campaign, universal immunization day, or a family planning decade. Well-structured, and designed, public policies could stimulate a rise in quantity and quality of inputs.

Obviously, there is a trade-off among public sector priorities. For instance, changes in the balance between rural-urban or preventive-curative priorities would definitely have an effect on child well being. Availability and accessibility combined with household characteristics such as income, knowledge, and perception would determine the level and pattern of consumption of these inputs. It indicates the interdependence of the policies and household factors. Improvement in one element complements another. Considerable special attention should be given to women's productive role in this framework. In particular,

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[10]. This production framework is comparable to that of Mosley and Chen's (1984) socio-medical approach. A major difference lies in the theoretical basis as a model of this research, developed based on a household choice approach.

[11]. There would be a feedback in the input-output process, since a rise or decline in child mortality affects both public policies and household behavior. The issue, however, is beyond the scope of this research.

mothers' allocation of their own time, level of education, health and health related practices would play a very significant part in every aspect of child health production. Better educated, well informed women and/or households would have more efficiency in consumption of these inputs. Hence, it highlights a vital role of public policies in the production process.

For an open economy context, it is assumed, for simplicity, that the country's national income and its growth rate reflect the outcomes that cover the international economic relation component. Moreover, there is good reason to believe that official development assistance (ODA) and its share to social sectors is also important[12], and hence that may be added into the production framework.

Next, an attempt will be made to formalize the input-output relationship inherent in the child health production function into an economic model of household choice. It is adopted from the works of Becker (1981), Becker and Lewis (1974), and Grossman (1972).

Following the traditional assumption that every household has the same utility function which is characterized as continuous, strictly concave, and twice differentiable, it can be expressed as;

$$U = u (X, Y, H) \text{ ---------- (1)}$$

where; X = a composite of goods which does not affect health

Y = a composite of goods which does affect health

H = health of household member

Household is assumed to maximize utility over a bundle of Becker-style commodities X and Y. Y can further be divided into Y_p, prevention goods, and Y_h, hazard goods.

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[12]. Most of the public health programs are initiated by international organizations, and their inputs and developed countries support play a critical role. The case of small pox was a good example.

Similarly, H can also be classified into H_a, adult health and H_c, child health.

Household maximizes equation (1) subject to two sets of constraints, namely; the production function, and full income of the household. Full income constraint limits the ability to consume X and Y. The time allocation pattern is incorporated into the budget constraint. Production function demonstrates that a lower health endowment or health stock should produce lower H, while a higher consumption of Y_y and well-designed, exogenously determined public policies Z should produce greater H.

Production constraint: $H = h (Y, Z, E)$ ——————————— (2)

where; Z = inputs for producing H (effect on utility through H)

E = endowment (genetic or general environment conditions)

Full income constraint: $I = P_x X + P_y Y$ ——————— (3)

where; I = full income = A + S

A = other asset, S = labor income = Wh. w

Wh = working hour, w = wage rate

P_x , P_y = prices of X, and Y respectively.

By substitution, equation (2) into (1) yields a derived utility function. The optimal solution is obtained by setting up the Lagrangean;

$L = U[X,Y, h(Y,Z,E)] + \lambda [I - P_x X - P_y Y]$

The first order conditions are;

$U_x = \lambda P_x$ ——————————————————— (4)

$U_y + U_h H_y = \lambda P_y$ ——————————— (5)

$I = P_x X + P_y Y$ ——————— (6)

Where: λ = Lagrangean multiplier

$$H_y = \frac{\partial H}{\partial Y}$$

U_x, U_y = marginal utility of X, and Y, respectively

Equation (5) needs to be interpreted carefully. It can be seen from equation (5), that consumption of Y not only has a direct effect on utility, but it also has an indirect effect through H. It should be noted that Z is not inherent in utility function, but as an intermediate variable it contributes utility through H.

By assumption, it is permitted to satisfy the second order sufficient conditions. Then the implicit function theorem becomes applicable in the model [Chaing (1984)], and accordingly, one may write the functional form of the optimal value of X, and Y, as;

$$X = x \{ P_x, P_y, I, E \} \quad \text{——————————} \quad (7)$$

$$Y = y \{ P_x, P_y, I, E \} \quad \text{——————————} \quad (8)$$

The above set of household demand equations for X, and Y, are determined by prices of respective goods and services, income, and endowment. These are reduced-form equations since endogenous variables are expressed as a function of exogenous variables. Consequently, these can be estimated individually, and directly. The present research; however, will be focused only on the Y function (8). Recall the model Y function contains; Y_{pc}, child consumption of prevention goods, Y_{pm}, mother consumption of prevention goods, and Y_h, hazard goods.

Y_{pc} and Y_{pm} are the two demand functions that served as the backbone of the research. Therefore, P_x, the price of health neutral composite goods, can be excluded from

the model. On the other hand, the prices of Y are assumed to be associated with availability of such goods and services, denoted as B. Availability, in turn, depends upon public policies. Vector B captures both the extent of resources allocated to health, and health related infrastructure needed to produce Y_p, and the direct and indirect cost of these goods and services to the household. It is also necessary to consider household characteristics, S, for its role in efficiency in consumption of Y, and productivity in producing H. Presumably, endowment that includes the biological child-mother relationship is reflected in both B and S. Still, there may be factors such as abilities, motivations, norms, tastes, and other unobservable variables that can not be readily measured in empirical analysis. Define μ as the term representing such variables. The model yields two reduced-form functions to be estimated;

$$Y_{pc} = f_c (B_c, S, \mu_1) \quad \text{(9.a)}$$

$$Y_{pm} = f_m (B_m, S, \mu_2) \quad \text{(9.b)}$$

The health production function[13], in the light of the above discussion, depends upon two endogenous inputs, Y_{pc} and Y_{pm}; quantity and quality of public policies variable, Z; household characteristics, S; and random disturbances term, μ_3 .

$$H = h (Z, Y_{pc}, Y_{pm}, Y_h, S, \mu_3) \quad \text{(10)}$$

Three important points concerning Z should be noted. First, Z differs from B in the sense that B is targeted only for Y_p, but the former represents all inputs. Second, as Z includes a part of B, it has dual impact on H. It has an indirect effect through Ys, and direct

[13]. Y_h will not be included in estimation.

effect by entering into the production function. Third, resources allocated to Z and underlying magnitude of distribution reflect public priority given political structure.

It should also be noted that the production function (10) is a structural equation because vector Ys are endogenous in the system. The model suggests that straightforward ordinary least square (OLS) could result in biased and inconsistent parameter estimates. In this light, more comprehensive econometric techniques become appropriate for estimating the production function.

IV. HYPOTHESIS

Providing the meeting of certain fundamental social services is, indeed, not a new idea nor a sophisticated one. The policy declarations and development plans of almost every developing country have mentioned this theme implicitly or explicitly[14].

The theoretical framework outlined in the previous chapter clearly indicates the central role of the public sector. Therefore, the hypotheses suggested by the model can be given as below.

I. The public policies concerning provision of social services will lead to higher consumption of prevention goods and services.

To be specific, a desirable achievement in the level of consumption of prevention goods and services is the result of an interaction between public policies and household behavior. Using equations (9.a) and (9.b), the critical relationship can be written as follows[15]:

$$\frac{dY_{pc}}{dB_c} = f_{Bc} + f_S \frac{dS}{dB_c} \qquad (11)$$

$$\frac{dY_{pm}}{dB_m} = f_{Bm} + f_S \frac{dS}{dB_m} \qquad (12)$$

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[14]. One can review the constitution, and development plan documents of a country. More importantly, for social sectors, evidence can be obtained from WHO initiated Primary Health Care programs, and UNICEF' National Plan of Actions.

[15]. $d\mu_i/dB$ assumed to be zero.

II. The higher level of consumption of prevention goods is capable of producing more health.

Rewriting health production function (10) yields;

$$dH = h_z\, dZ + h_{Y_{pm}}\, dY_{pm} + h_{Y_{pc}}\, dY_{pc} + h_{Y_h}\, dY_h + h_s\, dS + h_\mu\, d\mu$$

Differentiating with respect to Y_p yields;

$$\frac{dH}{dY_{pc}} = h_z \left\{\frac{dY_{pc}}{dZ}\right\}^{-1} + h_{Y_{pc}} + h_s \left\{\frac{dY_{pc}}{dS}\right\}^{-1} \qquad (13)$$

$$\frac{dH}{dY_{pm}} = h_z \left\{\frac{dY_{pm}}{dZ}\right\}^{-1} + h_{Y_{pm}} + h_s \left\{\frac{dY_{pm}}{dS}\right\}^{-1} \qquad (14)$$

Since $d\mu/dY_p = 0$.[16] It can be observed from the equations (13) and (14) that the model's production function is designed to estimate both direct and indirect effects of public policies. The impact of prevention goods on child welfare will depend on;

(i) how policy vector Z enhances provision of Y_p,

(ii) the marginal product of prevention goods, and

(iii) the consumption efficiency of households.

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[16]. μ and Y_p may be correlated and that leads to $d\mu/dY_p \neq 0$. Consequently, regression coefficients become biased. It can be corrected by employing a two-stage procedure. See Rosenzweig and Schultz (1983) for more discussion on the issue.

III. As the wealth of a household increases, the welfare of the child will also increase.

The income effect on well being in general and health in particular have not been well established, as many debates and arguments surrounding the issue indicate. Hence, the role income effect plays in child health production is also a topic of this research.

V. ECONOMETRIC SPECIFICATION

Variable description and data sources are given in table (3). Data are gathered mainly from various publications of the United Nations organizations. An important advantage of the UNICEF/UNDP data is that as all measurement has been standardized, well known aggregate data problems can be minimized.

As the theoretical framework in the previous chapter outlined, the model has to be employed in a two-stage procedure. In the first-stage, the system of reduced form equations { 9(a) and 9(b) } will be estimated using the ordinary least squares method.

Endogenous variables: Reduced form equations

Equations 15(a) and (b) represent Y_{pm} , mothers' demand functions for prevention goods and services.

$$CON = \pi_1 B + \pi_2 S + \epsilon_3 \quad \text{---------} \quad (15.a)$$

$$BIRAT = \Theta_1 B + \Theta_2 S + \epsilon_4 \quad \text{---------} \quad (15.b)$$

Con, contraceptive prevalence rate, and BIRAT, births attended by health personnel, are two endogenous variables that proxied for maternal consumption of prevention and basic curative goods and services. Contraceptive prevalence rate refers to the percentage of married women of childbearing age who are using, or whose husbands are using, any method of contraception, modern or traditional. Consumption of contraception goods and services prevents newborns from entering the "critical zone". This can be defined as the situation when children are born too close to one another, too many, or the mother is too young or too old for safe delivery.

The BIRAT variable is assumed to reflect the level of provision of health care

"before", "during", and "soon after" pregnancy. BIRAT includes not only births attended by physicians, nurses, and midwives but also trained primary care health workers and trained traditional birth attendants.

Both of these endogenous variables enhance improvement of maternal health by preventing obstetric complications, and unwanted pregnancies. Accordingly, it stimulates a decrease in the risk of newborn babies.

Regarding child consumption of prevention goods and services, OLS regression will be fitted for two reduced-form equations.

$$IMM = \alpha_1 B + \alpha_2 S + \epsilon_5 \quad \text{---------} \quad (16.a)$$

$$ORT = \beta_1 B + \beta_2 S + \epsilon_6 \quad \text{----------} \quad (16.b)$$

The two endogenous variables are IMM: a proxy for fully immunized children, and Oral rehydration therapy (ORT). Both variables are indicators for prevention goods. Fully immunized status has operationally been defined as children with one dose of BCG, 3 doses of DPT, 3 doses of polio, and 1 dose of measles vaccine at the age of one year old. DPT coverage will be treated as IMM achievement. DPT is widely regarded as a good indicator of how well the immunization as a whole is working. {UNICEF (1990)}. ORT is the most effective measure to combat diarrhoea, the biggest single killer of children from the third world. It is an inexpensive, appropriate technology which embodies the principles of primary health care, eventually reflecting both preventive and curative intervention. ORT use rate can be defined here as the percentage of all cases of diarrhoea in children under five years of age treated with oral rehydration salts or an appropriate household solution.

An indicator for consumption of nutrients is also necessary in the model. Research by Wheeler (1980) treated it as an endogenous variable. Some argue that food availability

or nutrition status is determined by government policies, and hence it should be considered as endogenous at the aggregate level (Behrman and Deolalikar 1988). The theoretical framework of the present study and the model specification permit endogeneity of the food supply variable. This study adopts daily calorie supply per capita (CAL) as a proxy for households' intake of nutritional food.

Access to safe water supply covers a wide range of sources; from treated surface waters to untreated but uncontaminated water such as that from springs and sanitary dug wells and tube wells. Adequate and safe water supply and sanitation are principle components in the basic needs concept. Safe and adequate water is important in control of many diseases such as water borne and water related diseases. For a reasonable minimum standard of living, it is estimated that 20 to 50 liters (about 5 to 13 gallons) per person per day is needed for drinking, food preparation, and personal hygiene. (World Bank 1980). The analysis employs % of population with access to safe water supply as a proxy for water consumption (WAT), since, unfortunately, no other data sets are available.

$$CAL = \alpha_3 B + \alpha_4 S + \epsilon_5 \quad \text{---------} \quad (16.C)$$

$$WAT = \beta_3 B + \beta_4 S + \epsilon_6 \quad \text{---------} \quad (16.d)$$

Equation (16.c) is a demand function for nutritional foods and (16.d) is for water. CAL and WAT are important for protecting against illness as discussed by Chen (1981). Therefore, it is a good justification for examining the consumption of these goods in the model.

In the first stage, there are six endogenous variables representing prevention goods and services needed for production of child health. The exogenous variables are public policies vector B, and household characteristics vector S. The error term ϵs are included to

capture unobservable factors.

Endogenous variables : Structural equations

Estimation of child health production functions is the second-step in the procedure. Equation (10) can now be divided into infant and childhood health production functions, respectively.

$$H_{IMR} = \tau_1 \widehat{IMM} + \tau_2 \widehat{ORT} + \tau_3 \widehat{CON} + \tau_4 \widehat{BIRAT} + \tau_5 \widehat{CAL} + \tau_6 \widehat{WAT} + \epsilon_7 \qquad \text{(17.a)}$$

$$H_{U5MR} = \Omega_1 \widehat{IMM} + \Omega_2 \widehat{ORT} + \Omega_3 \widehat{CON} + \Omega_4 \widehat{BIRAT} + \Omega_5 \widehat{CAL} + \Omega_6 \widehat{WAT} + \epsilon_8 \qquad \text{(17.b)}$$

IMM, ORT, BIRAT, CON, CAL and WAT are predicted values of consumption of prevention goods and services obtained from the first-stage procedure. ϵs are random disturbances. The structural production function has to be estimated by using the two-stage least squares method.

U5MR, under five mortality rate, is a proxy for good health. It is supplemented by adding IMR, infant mortality rate, a conventional measure of well being.

It is interesting to note the quality of IMR and U5MR data. These are calculated by the United Nations population division based on information contained in censuses, ad hoc household surveys, and surveillance studies. Interpolations and extrapolations were then made to get time coverage data. It is believed that these estimated figures are reasonably accurate

for international comparison of levels of mortality across countries.[17]

Exogenous variables:

Household characteristics

The role of education in child survival, especially maternal education, has long been well established {for example, Caldwell (1979)}. It enhances general knowledge, and more importantly, efficiency in information gathering and usage of modern health technology. In this study, female primary (PRIF) and secondary enrollment (SECF) ratios (gross) were chosen as a proxy for maternal education. Gross enrollment ratio is defined as the number enrolled in a level of education, whether or not they belong in the relevant age group for that level, expressed as a percentage of the population in the relevant age group for that level.

The % of women in the labor force (WOLAB) is chosen because of the crucial role of their time allocation pattern in the welfare of children. In fact, it also reflects the status of women, for it defines the women's labor force as a percentage of the total labor force.

Per capita GNP (INC) is treated as the wealth of individual households in the study. It is interesting to explore the dimension of the income variable. Firstly, it reflects the husband's education and occupation. Secondly, it is argued that there may be a multicollinearity problem since household income is related to effective demand of the water supply system, sanitation, medical care and food. Carefully designed specification of the model helps in dealing with the problem. Thirdly, the income variable is a reasonably good indicator for comparing the development status of countries since it is expressed in terms of US$. Lately; however, in order to equalize price level differences across countries, it has

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[17]. Data sources and methodological notes regarding country specific information can be seen in the United Nations publication titled Child Mortality Since the 1960s: A Database for Developing Countries, 1992.

been argued that purchasing power adjusted income should be applied instead. (World Bank 1992). As the U.N. International Comparisons Program becomes fully materialized, the Purchasing Power Parity (PPP) income will be available for analysis. Finally, one should bear in mind that per capita GNP is not adjusted for family size.

Public Policies variables

Infrastructure development is regarded as an important determinant in the welfare of human beings. The number of television sets per 1000 population (INFRA) will be used as a proxy for infrastructure development. Television sets per 1000 population is a relatively new available indicator, particularly at the cross nations level. The major reasons for using this indicator are; (i) it serves as an acceptable proxy for assessing the extent of dissemination of information capacity, and (ii) its larger ratio can be considered, in general, as a good proxy for development of communication facilities and the higher coverage of electricity supply in particular. One may argue that INFRA indicator should be treated as household variables. The model specification formulated has shown convincingly that it represents more than mere modern items owned by households. In this research, TV ownership is treated not only as an infrastructure development but also as a political commitment in the strengthening of supporting services for childrens' well being.

Another two indicators directly linked to health policy are population per doctor (DOC) and population per nurse (AUX). Doctors include both physicians and other medical practitioners. Nurse covers western-style nurses, paraprofessional health workers, first aid, traditional birth attendants, and so on. DOC and AUX provide for assessing health manpower policy. Since a large proportion of the public health sector budget goes to the wages and salary category these two measures also serve as a proxy for public expenditure.

Population density (DEN) is also an explanatory variable in the model. It measures number of inhabitants per 1000 hectares of land in a country. This variable has to be taken into account because it may capture unobservable phenomena. It may also capture possible scale and congestive effects. Other factors being equal, less geographical fragmentation enables a country with low infrastructure development to attain high coverage in health services delivery.

For almost every developing country external assistance is an important source for a development program. AID is defined as the percentage of official development assistance that goes to the social sectors.

For detailed analysis of consumption of family planning goods and services, the following three dummy variables were developed. Policy and stage-setting activities score (FPP) is calculated based on government policy, statement, and regulation concerning family planning activities. Family planning services and services-related score (FPS) is obtained by summing items such as adequate training programs for staff, coverage and frequency of mass media messages about family planning programs, and involvement of private sector and non-governmental organizations. FPA refers to scores on availability and accessibility of various contraception devices, and it measures how easy it is to access these goods and services. All information regarding scores for each component is obtained from Ross et. al (1992). By using a cut-off point score of 50, dichotomous dummy variables for each of the family planning components were constructed.

The right hand side variables can be grouped into vectors B and Z, policy factors, and vector S, household characteristics. It should also be noted that all endogenous variables from reduced-form equations will be employed as explanatory factors in the second-stage

estimation.

The Model Identification

Since the concept of identification is related to consistent estimation of the parameters, it is important to check whether the model's equations are in accordance with theoretical considerations. The model specified from the preceding discussion can be rewritten as follows:

Reduced-form equations.

$$Y_{pi} = \alpha_0 + \alpha_1 \text{INFRA} + \alpha_2 \text{DEN} + \alpha_3 \text{AID} + \alpha_4 \text{DOC} + \alpha_5 \text{AUX} + \alpha_6 \text{INC} + \alpha_7 \text{PRIF} + \alpha_8 \text{SECF} + \alpha_9 \text{WOLAB} + \epsilon_1$$

Y_{pi} = prevention goods and services (IMM, ORT, BIRAT, CON, CAL, and WAT)

Structural equation.

$$\text{MOR} = \phi_0 + \phi_1 \widehat{\text{IMM}} + \phi_2 \widehat{\text{ORT}} + \phi_3 \widehat{\text{BIR}} + \phi_4 \widehat{\text{CON}} + \phi_5 \widehat{\text{CAL}} + \phi_6 \widehat{\text{WAT}} + \epsilon_2$$

where: MOR = mortality that represents IMR and U5MR

Order condition.

There are 7 endogenous and 9 exogenous variables. Since k (number of variables excluded form the equation under consideration) is greater than (g-1 = 6) in the structural equations, these are over-identified.

Rank condition.

The procedure that checks necessary and sufficient conditions for identification has also been carried out by applying the method discussed by Maddala (1992). It is found that rank condition is met in all structural equations.

By order and rank conditions, all equations are estimatable.

Table (3) Variable Description

Variable	Definition and Source
U5MR	Under five mortality rate, 1990, UNICEF (1992)
IMR	Infant mortality rate, 1990, UNICEF (1992)
ORT	Oral rehydration salt use rate, 1987-89, UNICEF (1992)
IMM	% fully immunized against diphtheria, pertussis (whooping cough), and tetanus, (1 year old) 1988-89, UNICEF (1991)
CON	Contraceptive prevalence rate, 1985-90, UNDP (1993)
BIRAT	% of births attended by trained health personnel, 1988-89, UNDP (1993)
CAL	Daily calorie supply per capita, 1988-90, UNDP (1993)
WAT	% of population with access to safe water supply, 1988-90, UNICEF (1992)
FPP	dichotomous dummy variable equal to 1 if score on family planning policy and stage setting is > = 50, 0 otherwise, 1989, Ross et al (1992)
FPS	Dichotomous dummy variable equal to 1 if score on family planning service and service-related effort is > = 50, 0 otherwise, 1989, Ross et al (1992)
FPA	Dichotomous dummy variable equal to 1 if score on availability and accessibility of fertility control supplies and services is > = 50, 0 otherwise, 1989, Ross et al (1992)

Continued:

DOC Population per doctor, 1984-89, UNDP (1993)

AUX Population per nurse, 1984-89, UNDP (1993)

INFRA No. of television sets per 1000 population, 1988 UNICEF (1992)

DEN Population density per 1000 hectares, 1988, UNDP (1990)

AID Official development assistance to social sectors (%), 1988-89, UNDP (1992)

PRIF Primary enrollment ratio (Female), 1986-89, UNICEF (1992)

SECF Secondary enrollment ratio (Female), 1986-90, UNICEF (1992)

INC Per capita GNP, US$, 1988, UNICEF (1991)

WOLAB Women labor as % of total labor force, 1988, UNDP (1990)

Table (4) Descriptive Statistics

Variable	Mean	Std. Dev.
U5MR	120.902	75.61
IMR	77.29	42.096
IMM	64.337	23.039
ORT	40.359	25.009
BIRAT	55.043	29.473
CON	28.913	24.26
CAL	2408.42	432.104
WAT	60.09	22.89
DOC	10369	15289
AUX	1689.8	1748.7
INFRA	65.413	102.54
DEN	1321.1	4970.1
AID	18.761	13.739
PRIF	79.533	31.38
SECF	33.12	26.007
INC	1426.4	2439.7
WOLAB	30.053	11.982

VI. ESTIMATION OF REDUCED-FORM SYSTEM

Even after the model has been carefully specified, it is extremely important to consider expected problems associated with estimation. Multicollinearity can be ruled out because of the result of a correlation matrix of the independent regression variables (see table 12).

A more serious trouble is concerned with heteroscedasticity. Due to the cross-sectional nature of this study, the greater likelihood of having widely differing variance of the errors is understandable. Thus, it would not satisfy one of the conditions, a constant error variance, for the Gauss-Markov theorem. Usual practice in empirical analysis is to test the null hypothesis of homoscedasticity, and if it is detected to apply a remedy measure in estimation. Unfortunately; however, there is no universal agreement on a method of testing for heteroscedasticity. Very often one test result contradicts another.[18]

The present study tackles these problems in the following manner.

(i) A Lagrange multiplier test has been carried out for every equation of the reduced-form system. The Breusch-Pagan Lagrange multiplier test indicates the invalidity of the homoscedasticity assumption in CON and CAL regressions. However, in IMM, ORT, BIRAT, and WAT regressions, the size of LM statistics do not exceed the 95% critical chi-squared value for appropriate degree of freedom, so one could not reject the null hypothesis of homoscedastic errors.

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[18]. While the Breusch-Pagan, Koenker and Basset, and White tests indicate presence of heteroscedasticity, Goldfeld-Quandt statistics accept the null hypothesis of homoscedasticity. See for example, Greene (1993), p 395.

(ii) Instead of trying to perform another test, the study employs White's robust estimation method.[19] The justifications are: (a) the results of all tests for heteroscedasticity may differ according to underlying procedure, (b) even if heteroscedasticity were detected, its precise form would not be known, and (c) although it is inefficient, OLS estimation with heteroscedasticity still produces unbiased estimators.

By applying White's heteroscedasticity consistent variance estimator, one would obtain the same OLS coefficients with corrected standard errors. This method improves accuracy in performing significant tests. The results are given in tables (5) through (10).

Childrens' consumption of immunization services is positively associated with infrastructure development, population density, household income, female education and labor force participation and external assistance. Lowering population per doctor or increasing the availability of health services enhances consumption of preventive measures.

Womens' education, and population density remain quite important in the consumption decision of ORT, but unexpected signs were observed for INFRA, DOC and INC. Womens' labor market participation has a negative effect on children consumption of ORT.

All household characteristics parameters such as income, education (especially secondary level) and womens' labor force ratio are positively associated with BIRAT, birth attended by trained health personnel. Health policy variables display correct signs, but only population per physician is significant. Infrastructure development as measured by TV sets

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[19]. The usual estimated variance matrix $\sigma^2 (X'X)^{-1}$ is no longer suitable under the presence of heteroscedasticity. By applying White's method it became $n(X'X)^{-1} S (X'X)^{-1}$, where $S = 1/n \Sigma e^2 xx'$, and e = ith least square residual. For proof and detailed explanation consults White, H. A Heteroscedasticity Consistent Covariance Matrix Estimator and A Direct Test for Heteroscedasticity, Econometrica, 48, 1980, p817-838.

per 1000 population also has significance in the decision to get birth delivery services.

The result of the contraceptive prevalence regression also reveals the positive and significant role of women's education. See table (8.a) and (8.b). The contraceptive demand equation for the reduced form system is given in table (8.a). The results from model I confirm that educated, and working women have a higher likelihood of using birth control methods. Decrease in population per physician and auxiliary health worker, hence the higher coverage of health services, are associated with increased usage of contraception. As in the ORT demand equation, the income coefficient is negative and relatively small in size.

Owing to a plausible assumption of women allocating more time to child rearing than men do, a microeconomic model (example. Schultz 1981) predicts that women's market production will decrease time spent on child care. Particular caution must be taken in application of such models in developing worlds. Women may be self-employed, or seasonal workers, or engaged in the informal sector. Wage is definitely not equal to marginal product of labor-time in this case. Moreover, extended family structure where elder persons or relative help is readily available should be taken into account. The argument is that women's labor market participation should be regarded as indicating the status of women in the society. The sign of WOLAB coefficients in IMM, BIRAT, and CON suggest that the status of women in terms of education and economics must be raised, if childrens' consumption of preventive goods and services such as immunization, is to be increased.

In order to stimulate fruitful discussion, contraception regression was run separately with another set of dummy explanatory variables. See table (8.b). The influence of secondary level education appears to be greater than primary schooling in the decision to use birth control method. Both DOC and AUX have negative coefficients indicating that the lower the

population per health worker the higher will be the usage of contraception. Household income has a negative sign and is statistically significant. Even when birth control usage has been fitted with only the income variable, it is found that R-squared is extremely low (0.02), and the coefficient is positive and insignificant. Its insignificant positive effect seems to disappear when one controls for women's education. (Result not shown). Looking at the family planning variables, {see table (8.b)} it is quite remarkable that all have contributed to higher consumption of contraception. Political commitment (FPP) is not significant, it is noted. It is obvious that political support is one of the determining factors, but it needs to be exploited to create favorable treatment for family planning services. Lip-priority alone is undoubtedly not sufficient to promote higher usage of contraception. The strong influence of FPA, family planning services accessibility and the availability parameter emerges. They not only facilitate contraceptive usage but also contribute to continuity of use. FPS, family planning services and the services-related component are also critical in directing to achieve a desirable outcome. Although particular attention needs to be paid to integrated or vertical program debate, the argument is beyond the scope of this research.

AUX, SECF, and INC coefficients are statistically significant in the CAL demand equation. However, only SECF is significant in the WAT regression.

Analysis on interaction terms:

Variation in public policy variables may affect the role of household factors in demand for consumption of prevention goods and services. The situation can be explored by developing an interaction term, a product of two explanatory variables. It should be noted that interpretation of the term requires some caution due to the nature of displaying an unexpected sign. The regressions with an interaction term have been run separately.

Model II of table (5) provides two interaction effect coefficients for consumption of immunization services. PRIF.INFRA coefficient is negative and significant but PRIF.AUX is positive and insignificant. To explore the degree of the contribution of women's education in consumption decision of preventive services under different levels of infrastructure development and health coverage, it is useful to develop the partial slope of IMM with respect to PRIF. From model II of table (5),

$$\frac{\partial IMM}{\partial PRIF} = 0.33 - 0.004\ INFRA + 0.00002\ AUX$$

Evaluated at high infrastructure level, 100 TV sets per 1000 population, and high coverage of health facilities, 1,000 population per physician, yield the marginal effect of women's education on immunization services of (-.78). In a situation where both infrastructure and coverage is low, the marginal effect of women's education is recorded as (0.27). See table (11). It is known that distribution of health facilities between urban-rural areas is skewed. As the present study employs population per health worker as a proxy for health services facilities, it can be hypothesized that the higher education level of women may compensate for this skewed pattern distribution of health facilities. To put it differently, the lower coverage of health facilities and underdevelopment of infrastructure make health information dissemination difficult, and accessibility and service delivery inefficient. One can argue that children from educated mothers may enjoy a higher likelihood of getting immunization services even though accessibility is low. By comparing two partial slopes, it becomes apparent that a greater contribution of education exists in lower levels of infrastructure and health coverage. Straightforward policy implication is that for a typical developing country where the health delivery system is poor and infrastructure is not well

developed, investing in female education emerges as the most effective way to create demand for attaining universal immunization coverage.

Regarding ORT consumption, it appears that both of the interaction terms are not significant. Moreover, the marginal effect of PRIF on ORT evaluated at different levels of INFRA and AUX do not support the hypothesis that the lower the infrastructure development and health coverage the higher will be the effect of mothers' education. In order to extend ORT packages to unreachable segments of population, basic and voluntary health workers are required.

Table (7), model II shows the regression result of consumption of health services for birth delivery. PRIF.AUX coefficient displays a meaningful sign which expresses the essential role of certain forms of preventive services. Female education may create pressure to acquire health and medical technologies before, during, and soon after delivery. The lower coverage of health workers undermines effective demand. The marginal effect of BIRAT with respect to PRIF evaluated at different levels of INFRA and AUX clearly indicates that the stronger the overall infrastructure and health care delivery system, the larger the contribution of maternal education will be. See table (11).

The pattern persists in the case of demand for family planning services. The contribution of female education is higher under the strong infrastructure and high health services coverage.

Concerning family planning policy, two interaction terms were constructed based on the model II, table (8.b). FPPAA, a product of family planning policy (FPP) and availability and accessibility of contraceptive services (FPA), is intended to test the hypothesis of importance of political commitment. The product of household income and infrastructure

development, INC.INFRA, another interaction term, allows assessment of the income effect under different stages of infrastructure development.

The partial slope of CON with respect to FPA yields;

$$\frac{\partial CON}{\partial FPA} = 19.62 - 2.342\ FPP$$

Under strong political commitment;

$$\frac{\partial CON}{\partial FPA} = 17.28$$

Under weak/no political commitment;

$$\frac{\partial CON}{\partial FPA} = 19.62$$

It can easily be seen from the partial slope that with the presence of strong political commitment, the contribution of the accessibility and availability factor to contraception becomes smaller. Political commitment includes strong public statements, appropriate financial allocations, and adequate rules and regulations. Even though services are available, they may not be easy to access due to government regulations on both users and providers of the programs. Restrictions on who can prescribe contraceptives or perform procedures are good example of regulations that imposed on providers. Restrictions on the users' side include the setting of multiple eligibility criteria and establishing of tight application procedures to get permission to use certain forms of family planning methods.

The partial slope of contraception with respect to income evaluated at infrastructure development above the mean (i.e.; 100, high development) yields;

$$\frac{\partial CON}{\partial INC} = .0008 - .00001\,(100) = -.0002$$

and the respective numerical value below (i.e.; 10, low development) the mean is (.0007).

The higher the degree of infrastructure development, the lower the income effect on the use of contraception. Strong infrastructure can stimulate lowering the price of traveling time. In addition, it helps to reduce cost of information gathering[20]. To get more in-depth knowledge on its effect, income elasticities were calculated. Income elasticity evaluated from the equation with interaction term is estimated as (-0.005), whereas the value obtained without the interaction term is recorded as (-0.05).

It is not a surprising finding. DeGraff (1991) finds the possibility of increasing contraceptive use in Matlab, Bangladesh despite conditions of pervasive poverty and economic stagnation. The World Bank (1993.b, p28) observes that in some countries with initial per capita GNP as low as $200 (below the average for low-income economies), increases in contraceptive prevalence is as rapid as countries with several times that income level. It does not necessarily means that contraception is treated as an inferior good. In other words, it reveals an essential role of demand for contraception which in turn is influenced by possible direct association between desire for children and household wealth. Research in Kenya finds a strong and positive relationship between desire for no children and contraception use. (Njogu 1991). The implication to policy makers, a majority of whom overemphasize supply side forces, is that factors relative to demand for children need to be addressed in a serious manner if family planning goals are to be achieved in the developing

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[20]. Data on price of various contraception are provided in Ross et. al (1992). Different in time coverage and number of countries hamper an attempts to estimate price elasticity.

world. Indeed, it is an important enough topic to examine separately.[21]

The analysis of the reduced-form demand equations provides evidence of the effect of household and public policy factors on preventive services. Deriving demand relationships from cross-sectional data is one of the limitations of this analysis. Indirect costs are reflected in availability of health services, but the study is unable to trace distribution patterns which are believed to differ within each boundary. Nevertheless, it provides certain information about the specific modes of behavior that affect the consumption decisions of households. It seems clear that general infrastructure development and women's educational attainment often have desired effects on consumption behavior. The findings provide certain clues about efficient ways of dealing with obstacles for implementing health programs.

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[21]. The issue has been addressed in the recent round of discussion at the high level policy making cycle. See recommendation from Population Policies and Programs, United Nations, 1993.

Table (5) Demand Equation : Dependent Variable :IMM

	Model I			Model II		
	Coeff.	Std.Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	32.23	8.98	3.587	21.65	10.05	2.15
Infra.	.0278	.0131	2.124	.436	.088	4.95
Den.	.00004	.0002	.187	.00035	.0002	1.96
Aid	.0195	.139	.14	.0651	.1289	.506
Doc.	-.00031	.00023	-.726	-.00014	.00022	-.623
Aux.	.00102	.00213	.757	.00062	.0021	.297
Inc.	.0011	.00065	1.65	.0008	.0005	1.447
Prif.	.2829	.0923	3.065	.3327	.1267	2.62
Secf.	.1516	.1023	1.483	.2265	.0985	2.30
Wolab.	.028	.1962	.143	.1053	.190	.553
Prif.Inf	-	-	-	-.0042	.0009	-4.55
Prif.Aux	-	-	-	.00002	.00004	.399
R-squared	.45	-	-	.49	-	-
N	92	-	-	92	-	-
F	-	7.41	-	-	7.18	-
LM		6.4529				

Table (6) Demand Equation : Dependent Variable : ORT

	Model-I			Model-II		
	Coeff.	Std.Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	30.22	10.95	2.76	30.51	14.32	2.13
Infra.	-.010	.0272	-.37	-.234	.237	-.986
Den.	.0012	.0003	3.80	.0011	.00034	3.15
Aid	.0052	.1891	.03	-.034	.1916	-.179
Doc.	.0002	.00016	1.27	.00018	.00015	1.19
Aux.	-.0017	.0012	-1.38	.00075	.0033	.229
Inc.	-.0021	.0016	-1.89	-.0019	.001	-1.84
Prif.	.2363	.1161	2.03	.299	.1619	1.85
Secf.	.1278	.1637	.781	.057	.1641	.351
Wolab.	-.3412	.2325	-1.47	-.3634	.2309	-1.57
Prif.Inf	-	-	-	.0023	.0024	.93
Prif.Aux	-	-	-	-.00005	.00006	-.919
R-squared	.20	-	-	.22	-	-
N	92	-	-	92	-	
F	-	2.32	-	-	2.14	-
LM		6.0863				

Table (7) Demand Equation : Dependent Variable : Birth Attended By Trained Health Workers

	Model I			Model II		
	Coeff.	Std. Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	4.93	10.14	.486	-7.64	13.04	-.586
Infra.	.0667	.0137	4.86	.2820	.1011	2.79
Den.	.00037	.00017	-2.11	-.0002	.0002	-.925
Aid	.0642	.1348	.476	.0698	.1349	.518
Doc.	.00038	.00013	-2.92	-.00036	.00014	-2.64
Aux.	-.00085	.0011	-.80	.0018	.0028	.65
Inc.	.0029	.00077	3.78	.0027	.0008	3.40
Prif.	.0433	.1121	.387	.1844	.1659	1.11
Secf.	.4457	.0958	4.65	.4482	.1044	4.29
Wolab.	.9332	.2034	4.589	.9995	.2062	4.85
Prif.Inf	-	-	-	-.2276	.0011	-2.09
Prif.Aux	-	-	-	-.00005	.00005	-1.02
R-squared	.59	-	-	.61	-	-
N	92	-	-	92	-	-
F	-	13.57	-	-	11.24	-
LM		5.8291				

Table (8.a) Demand Equation : Dependent Variable:
Contraceptive Prevalence Rate

	Model I			Model II		
	Coeff.	Std. Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	-1.86	6.03	-.308	5.18	7.73	.67
Infra	.0066	.028	.232	-.3464	.1232	-2.81
Den	.0009	.00025	3.80	.0007	.0003	2.56
Aid	-.0772	.1075	-.718	-.1220	.1061	-1.15
Doc	-.0002	.0001	-2.003	-.0002	.0001	-2.23
Aux	-.0002	.0007	-.225	.001	.0015	.716
Inc	-.0031	.0012	-2.49	-.0029	.001	-2.86
Prif	.1892	.0641	2.95	.1803	.0983	1.83
Secf	.5503	.0880	6.26	.4746	.0841	5.64
Wolab	.1281	.1505	.851	.069	.1522	.453
Prif.Inf	-	-	-	.0036	.0012	2.93
Prif.Aux	-	-	-	-.00003	.00003	-1.06
R-squared	.67	-	-	.71	-	-
N	92	-	-	92	-	-
F	18.98			18.07		
LM	21.2207					

Table (8.b) Demand Equation : Dependent Variable:
Contraceptive Prevalence Rate

	Model I			Model II		
	Coeff.	Std. Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	-8.03	4.081	-1.97	-1.646	2.46	-.668
Infra.	.0081	.022	.365	.0643	.0441	1.46
FPP	.5288	2.651	.200	4.142	2.773	1.50
FPS	5.024	3.403	1.47	4.093	3.554	1.15
FPA	21.32	4.22	5.05	19.62	7.13	2.75
Inc.	-.00094	.0010	-.89	.0008	.00125	.635
Prif.	.0847	.0591	1.43	.0923	.0523	1.77
Secf.	.413	.0795	5.20	.3430	.0891	3.85
Wolab.	.2592	.1112	2.33	-	-	-
Inc.Infr	-	-	-	-.00001	.00001	-1.41
FPP.FPA.	-	-	-	-2.342	5.95	-3.94
R-squared	.76	-	-	.77	-	-
N	92	-	-	92		
F	-	33.78	-	-	30.45	-
LM		19.6653		26.09089		

Table (9) Demand Equation : Dependent Variable: CAL

	Model I			Model II		
	Coeff.	Std. Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	2534.44	140.2	18.07	2550.8	163.8	15.57
Infra	-.1942	.4560	-.426	-.1528	2.84	-.054
Den	.0044	.0033	1.34	.0044	.0048	.902
Aid	-2.136	2.179	-.981	-2.086	2.288	-.912
Doc	-.0025	.0020	-1.25	-.003	.002	-1.28
Aux	-.0572	.0166	-3.44	-.064	.034	-1.86
Prif	-.1910	1.604	-.119	-.4712	2.04	-.231
Secf	4.4577	1.872	2.382	4.557	2.05	2.23
Inc	.0398	.0148	2.681	.04	.0146	2.73
Wolab	-4.828	3.224	-1.49	-4.88	2.047	1.51
Prif.Infra	-	-	-	-.00035	.0304	-.120
Prif.Aux	-	-	-	.000014	.00006	.252
R^2	0.46			0.46		
F	7.79			6.12		
N	92			92		
LM	27.07					

Table (10) Demand Equation : Dependent Variable: WAT

	Model I			Model II		
	Coeff.	Std. Err	t-Stat.	Coeff.	Std.Err	t-Stat.
Constant	55.60	6.44	8.63	63.64	9.23	6.89
Infra	-.0007	.028	-.02	.0158	.133	.119
Den	.0004	.0002	1.51	.00035	.00024	1.45
Aid	-.1611	.1260	-1.28	-.1371	.1239	-1.11
Doc	.00004	.0002	.19	.00004	.0002	.215
Aux	-.0008	.0016	-.49	-.0043	.0018	-2.33
Prif	.0171	.0698	.24	-.1196	.1047	-1.14
Secf	.4419	.0996	4.43	.4896	.1024	4.78
Inc	.0013	.0007	1.86	.0014	.0007	1.87
Wolab	-.3271	.1665	-1.97	-.3548	.1670	-2.12
Prif.Infra	-	-	-	-.00014	.0014	-.097
Prif.Aux	-	-	-	.000068	.00003	2.00
R^2	0.53			0.55		
F	10.54			8.97		
N	92			92		
LM	6.56					

Table (11) Marginal Effect of Women's Education with INFRA. and AUX Interaction Terms

	INFRA. and AUX Status	
	High	Low
$\frac{\partial IMM}{\partial PRIF}_{\mid Infra,Aux}$ =	-.78	0.273
$\frac{\partial ORT}{\partial PRIF}_{\mid Infra,Aux}$ =	0.48	-.11
$\frac{\partial BIRAT}{\partial PRIF}_{\mid Infra,Aux}$ =	-.09	-.41
$\frac{\partial CON}{\partial PRIF}_{\mid Infra,Aux}$ =	0.52	0.06

Note: 100 and 50 are the numerical values used for INFRA. For AUX, it is 10,000 and 1000.

Table (12) Correlation Matrix

	PRIF	SECF	INC	WOL	TV	DEN	AID	DOC	AUX
PRIF	1.00								
SECF	.71	1.00							
INC	.26	.45	1.00						
WOL	-.11	-.30	-.40	1.00					
TV	.37	.51	.54	-.36	1.00				
DEN	.12	.19	.31	.015	.30	1.00			
AID	-.02	-.11	-.28	.134	-.08	-.15	1.00		
DOC	-.56	-.53	-.27	.44	-.34	-.07	.095	1.00	
AUX	-.50	-.49	-.31	.093	-.36	-.00	.085	.524	1.00

VII. ESTIMATION OF STRUCTURAL EQUATION: CHILD HEALTH PRODUCTION FUNCTION

Production of child health requires inputs from households, publicly provided goods and services, and unobserved endowments, as defined in equation (2). More specifically, a household consumes preventive aspects of maternal and child health services[22] as inputs in a production framework. These endogenously determined inputs include immunization, oral rehydration therapy, birth delivery, family planning goods and services, nutritional food, and water. In addition, household and public policy variables will also be incorporated in the production framework. The following steps will be carried out in the estimation of a structural equations system.

Child health = c { Y_p, MCH } ——————————— (18.a)

Child health = c { Y_p, All Endogenous } ——————————— (18.b)

Child health = c { Y_{pi}, B, Z } ——————————— (18.c)

Where; Y_p = consumption of prevention goods and services

MCH = Maternal and Child Health Inputs

B = household characteristics (PRIF, and SECF)

Z = policy variables (DOC, and AUX)

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[22]. In general, preventive care can be classified as purely public goods and curative care as purely private goods. However, because of externality and spillover effect, demarcation is not always clear. For example see Thet. (1993) Bamako Initiative for Family Planning Programs.

The econometric model on which the subsequent analysis is based is composed of three child health production equations. The first two equations determine the gross effect of prevention goods, and the third equation investigates the effect of each prevention good while controlling household and policy variables.

From equation (18.a), an estimate of the gross effects of consumption of MCH-prevention goods and services can be obtained. By comparing structural equation (18.a) with (18.c), one can assess the extent to which consumption of maternal and child prevention goods and services effectively operate through the proxied household socio-economic and policy variables. Health production functions for infancy (IMR) and early childhood (U5MR) are examined separately.

The regression results of equation (18.a) are shown in tables (13) and (13.A). Both U5MR and IMR show that consumption of prevention goods, i.e., immunization, oral rehydration solution, birth delivery, and family planning, enter into the production function with the expected signs when B and Z vectors are not controlled. Both ORT and CON coefficients are rather weak and insignificant. Nevertheless, one could say that all endogenously determined MCH goods and services estimated in the reduced-form system are critical inputs in producing good health. Put very simply yet forcefully; the higher the level of consumption of preventive goods and services, the lower the risk of infancy and early childhood mortality. In addition, the result establishes the importance of the integrated strategy of Maternal and Child Health (MCH) effects on welfare of children.

Stronger effects of IMM on 1-5 child health were noticed[25]. However, the results

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[25]. Let z be the under five mortality rate, y be the infant mortality rate and w be the mortality rate of children between the ages of 1-5. Then $z = y + w$, if it is assumed that births pertain to the same year as deaths. Since linear regressions are estimated, one can calculate the regression coefficients of w by

of tables (13) and (13.A) show that the negative effect of CON on mortality is almost the same for 1-5 mortality and IMR. The effects of ORT and BIRAT, however, are larger for IMR than 1-5 child health.

The estimation of a complete structural equation[24] (equation 18.b) is performed combining all prevention goods inputs. See tables (14) and (14.A). The usual statistics indicate that the model is statistically consistent with expectation. In particular, all coefficients, except WAT, display a sign which does not contradict the model hypothesis that consumption of prevention goods are helping to improve childrens' well being. Hausman's (1983) chi-squared test for overidentifying restrictions suggests that it can not reject overidentifying restrictions[25].

It is useful to perform Wu-Hausman endogeneity tests[26] for the model. The tests were performed for tables (13), (13.A) as well as tables (14) and (14.A). To do the test, the model from these tables can be written as:

$$H = \phi_0 + \phi_1 \text{ IMM} + \phi_2 \text{ ORT} + \phi_3 \text{ BIR} + \phi_4 \text{ CON} + \alpha_i \mu_i + \epsilon \qquad \text{(a)}$$

$$H = \phi_0 + \phi_1 \text{ IMM} + \phi_2 \text{ ORT} + \phi_3 \text{ BIR} + \phi_4 \text{ CON} + \phi_5 \text{ CAL} + \phi_6 \text{ WAT} + \alpha_i \mu_i + \epsilon \qquad \text{(b)}$$

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subtracting coefficients of y from z.

[24] Exactly identified structural equation would not be estimated because of apparent correlation between prevention goods and others explanatory variables. As a result the exactly identified 2SLS coefficients have a large standard errors and insignificant t-ratios.

[25]. Hausman test requires, first, to obtain residual from tables (13a) & (14a) regressions; $\hat{\epsilon} = y - Z\hat{\phi}$. Then, regress $\hat{\epsilon}$ on all of the predetermined variables in the model, and get R-squared. The test statistic, nR^2, is asymptotically distributed as chi-squared with (K-M) degree of freedom, where; K is the number of exogenous variables excluded from equation, and M is the number of endogenous variables included in the same equation.

[26] See Wu (1973) and Hausman (1978). For application see, for example, Corman et al (1987).

where; μ_i = residual of the ith reduced-form equation.

Null hypothesis will be; $\alpha_i = 0$. In other words, acceptance of the null hypothesis is that $E(\alpha\epsilon) = 0$ is equivalent to the restriction that $\alpha_i = 0$. Since Wu-Hausman statistics is significant in both equations (a) and (b), one can not accept the null hypothesis of zero correlation between the error terms and the prevention good inputs, the regressors. This reveals the inconsistency of OLS estimates.

The second version of the Hausman (1978) specification test for possible simultaneity bias is also run. Under the null hypothesis, both β_{ols}, the least squares estimator, and β_{iv}, the instrumental variable (2SLS) estimator, are consistent estimators of β, but only the least squares is efficient. The alternative hypothesis is that only β_{iv} is consistent[27]. The Hausman test statistics indicate that one could reject the null hypothesis of $\{\text{plim } (\beta_{ols} - \beta_{iv}) = 0\}$.

Both versions of the Hausman test thus lead to the conclusion that the OLS estimator is indeed inconsistent. More importantly, the tests confirm that these prevention goods are endogenous with respect to child health measured by U5MR and IMR. Accordingly, further discussion will rely on the results of the two-stage least squares.

The analysis focuses on the contribution behavior of the consumption of MCH prevention goods and services on child health production. It is found that the effect of MCH goods remains in function even after CAL and WAT are introduced. However, it can be seen from tables (14) and (14.A) that the inclusion of nutrition, and water supply variables reduces both the size and significant level of coefficients of ORT and BIRAT. In particular, the size of ORT coefficients are reduced by approximately 60% and 50% in U5MR and IMR

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[27] $H = d'[V_1 - V_0]^{-1} d$, where; $d = \beta_{ols} - \beta_{iv}$, V_1 = asymptotic covariance matrix of IV, and $V_0 = s^2 (X'X)^{-1}$. Note that s^2 is the estimate of σ^2 obtained using the IV estimator.

regressions, respectively. The evidence suggests that a considerable proportion of effect of consumption of ORT on child health operates through household nutritional and environmental status. This proposition is consistent with widespread epidemiology patterns of developing countries.

Only the IMM variable remains basically unchanged. Regressing with or without controlling CAL and WAT, has little impact on IMM coefficients since they are significant in all U5MR models. The size of CON coefficients is larger. CON coefficients are more or less increased as indicated by their size and t-statistics of tables (13) and (14). Efficiency of these two estimated coefficients is independent of inclusion or exclusion of other variables.

The difference in the magnitude of effect of the IMM component on two age groups should be noted. The coefficient of IMM is larger (in absolute value) in 1-5 than 0-1. It shows that the effects of immunization services go beyond the targeted under-one age group. A similar generalization can also be drawn for the effect of CON, mothers' consumption of prevention good. On the other hand, ORT and BIRAT have a stronger effect on 0-1 than on 1-5.

By fitting two household and two public policy variables; female primary and secondary education, population per physician, and population per health workers, into a regression, equation (18.c) is obtained. From these regressions, one can see the effect of each of the prevention goods while women's education and availability of health facilities and services are controlled. In all regressions, all coefficients of the prevention goods, except CON and WAT, displayed the signs predicted earlier. See tables (15s).

An unexpected finding in the CON regression is that the sign of the CON coefficient became positive. The fact that this finding is contrary to the hypothesis needs to be

explained. The literature on usage of birth control methods reveals that prevalence of use is dependent on many factors. While public policies affect usage through prices, information and availability of methods, and location of services; other religious, cultural, and psychological factors, as well as understanding and communication between partners, appear to be influential variables. (Ringheim 1993). In some cases, even without adequate governmental support, usage of family planning services is widespread. A recent cross-country survey found that 50% of countries in Africa have no specific policy to influence fertility. (United Nations 1993). In Myanmer, (Burma) although the annual population growth rate is recorded at over 2%, there had been no official policy to address the issue for 50 years. However, a household survey conducted in 1987 showed high contraceptive prevalence rate among married women of ages 15-49. (Oo 1988). The influence of the above unobservable factors upon CON consumption may explain the change in sign of CON.

The WAT coefficient became negative, which is in accordance with expectation. It should be noted that the WAT coefficient is positive in tables (14) and (14.A). It can be seen from tables (14) and (14.A), that the negative influence of WAT disappears when the effects of all prevention goods are considered together.

On the one hand, regressing with or without controlling B and Z has impact on CON and WAT coefficients since their signs are reversed. On the other hand, one may urge that efficiency of other estimated coefficients is independent of inclusion or exclusion of other variables. It should be borne in mind that a constant term has a large absolute value in all models. It suggests there may be some other omitting variable in this production framework such as proximate determinants of Mosley and Chen (1984). For example, these may include age of mother, number of pregnancies, and number of living children. Taste of health in

general and prevention goods in particular may also differ. In general, one can conclude that the model specification is good. The result strongly supports the theoretical specification, as all explanatory variables display expected signs.

Reduced-Form Model

The OLS results of the reduced-form model are given in table (16). Generally speaking, all the estimated coefficients of both U5MR and IMR are in accordance with expectation. The findings provide four interesting features. (1) women's education appears as a powerful factor in mortality reduction. Moreover, economic status seems to operate an important role in child welfare. (2) Domestic health policy variables, DOC and AUX, indicate the need to improve availability and accessibility of health services in developing countries. (3) Infrastructure, as proxied by TV sets per 1000 population, displays a negative sign indicating that higher infrastructure development can lower the risk of a 0-5 year old child dying. (4) Increases in development assistance, AID, are encouraging because the coefficient displays the desirable direction.

Surprising findings are associated with the income variable. The size of INC is small and not significant. In order to see gross effect of income, regressions were run with only INC while omitting all other factors of the model.

$$\text{U5MR} = 137.34 - 0.0103\ \text{INC} \qquad R^2 = 0.17$$
$$(16.31) \quad (-4.12) \qquad F = 18.3$$

$$\text{IMR} = 86.77 - 0.0059\ \text{INC} \qquad R^2 = 0.18$$
$$(18.71) \quad (-4.23) \qquad F = 19.8$$

The t-ratios are in parentheses. Both standard errors (not shown) and t-ratios are corrected for heteroscedasticity. Three interesting points have emerged; (1) a highly significant negative income effect on mortality rates, (2) not controlling all other factors resulted in an increase in gain from income, and (3) the strength of income effect is about the same for 0-1 and 1-5 child health, respectively. The present research confirms the statement of "Wealthier is Healthier". (Pritchett and Summers 1993). Then an important question is to what extent income effect operates through other household variables, to be specific, women's education. To clarify that point, other regressions were run incorporating PRIF.

U5MR = 269.95 - 0.0057 INC - 1.76 PRIF R^2 = .67
(25.15) (-3.97) (-13.56) F= 89.75

IMR = 156.84 - 0.0035 INC - 0.93 PRIF R^2 = .63
(27.31) (-4.1) (-12.3) F= 75.9

Inclusion of women's education resulted in a 50% decrease in income coefficients. Therefore, it is reasonable to say the income effect operates through women's education, and also has a negative and significant effect on infant and childhood mortality. Again, the regressions demonstrate the important role played by women's education.

Going back to the specification of the model, considering the evidence given in the reduced-form estimation, one could conclude that the ideas and methods presented in the study are guided by appropriate theoretical background. Approximately 80% of the variation in the IMR and U5MR differential is explained by the right-hand side variables. See R-squared from table (16). Judging by F statistics, it can be maintained that the entire set of explanatory variables included in the model jointly influences infancy and early childhood mortality.

Table (13) Gross Effect of MCH Prevention Goods on Child Health: U5MR

	2SLS			OLS		
	Coeff.	Std.Er	t-ratio	Coeff.	Std.Err	t-ratio
Constant	355.04	37.38	9.50	274.01	13.45	20.37
IMM	-2.02	.91	-2.23	-1.09	.2610	-4.19
ORT	-.98	1.17	-.84	-.1897	.1579	-1.20
BIRAT	-.97	.5525	-1.76	-.7226	.1820	-3.97
CON	-.37	.7529	-.488	-1.217	.2064	-5.89
				R^2=0.74	F=62.62	

Wu-Hausman* 9.92
Test for over-identified restriction** = 4.86 Hausman*** 16.47
Sample size = 92
Note: * 95% significant level, df=4,83, F= 2.482
** 95% significant level, df=4, Chi-squared = 9.49
*** 95% significant level, df=4, Chi-squared = 9.49

Table (13.A) Gross Effect of MCH Prevention Goods on Child Health: IMR

	2SLS			OLS		
	Coeff.	Std.Err	t-ratio	Coeff.	Std.Err	t-ratio
Const.	201.11	21.11	9.52	161.56	7.33	22.33
IMM	-.8237	.5122	-1.61	-.5998	.1413	-4.24
ORT	-.6396	.6586	-.971	-.0746	.0927	-.805
BIRATT	-.7318	.3120	-2.34	-.4139	.1040	-3.98
CON	-.1634	.4252	-.384	-.6877	.1142	-6.02
				R^2=0.74	F=62.27	

Wu-Huasman* = 8.3635
Test for over-identified restriction** = 4.26 Hausman*** = 14.31
Sample size =92
Note: * 95% significant level, df=4,83, F= 2.482
** 95% significant level, df=4, Chi-squared = 9.49
*** 95% significant level, df=4, Chi-squared = 9.49

Table (14) Estimation of Structural Equation: U5MR

	2SLS			OLS		
	Coeff	Std.Err	t-ratio	Coeff	Std.Err	t-ratio
Constant	465.35	81.31	5.72	340.30	18.72	18.17
IMM	-1.828	.9328	-1.96	-.8701	.2553	-3.41
ORT	-.3952	1.161	-.340	-.0122	.1581	-.143
BIRAT	-.5371	.5858	-.917	-.5963	.1631	-3.65
CON	-.9322	.7989	-1.17	-1.212	.1988	-6.10
CAL	-.0876	.0582	-1.50	-.0401	.0110	-3.63
WAT	.9424	1.076	.876	.0348	.2386	.15
				R^2=0.77	F=48.60	

Wu-Hausman* 6.9195
Test for over-identified restriction** = 2.4941 Hausman*** = 14.58
Sample size = 92

Note: * 95% significant level, df=6,79; F= 2.216
** 95% significant level, df=2, Chi-squared = 5.991
*** 95% significant level, df=6, Chi-squared = 12.59

Table (14.A) Estimation of Structural Equation: IMR

	2SLS			OLS		
	Coeff	Std.Err	t-ratio	Coeff	Std.Err	t-ratio
Constan	253.12	43.00	5.88	196.41	10.51	18.68
IMM	-.6485	.4933	-1.32	-.4732	.1401	-3.38
ORT	-.3265	.6142	-.532	.0136	.0923	.147
BIRAT	-.5034	.3098	-1.62	-.3395	.0942	-3.60
CON	-.4401	.4225	-1.04	-.6749	.1115	-6.05
CAL	-.0412	.0381	-1.34	-.0205	.0060	-3.40
WAT	.3126	.5688	.550	-.0264	.1342	-.197
				R^2=0.77	F=47.63	

Wu-Hausman* 5.6709
Test for over-identified restriction** = 2.2724
Hausman*** = 14.01
Sample size = 92

Note: * 95% significant level, df=6,78; F= 2.216
** 95% significant level, df=2, Chi-squared = 5.991
*** 95% significant level, df=6, Chi-squared = 12.59

Table (15) Effect of Immunization: 2SLS

	U5MR			IMR		
	Coeff.	Std.Er.	t-ratio	Coeff.	Std.Er.	t-ratio
Const.	286.65	40.6	7.06	170.15	24.44	6.96
IMM	-2.12	1.03	-2.05	-1.31	.6217	-2.11
PRIF	-.2236	.34	-.66	-.011	.2047	-.05
SECF	-.7965	.3419	-2.33	-.4761	.2058	-2.31
DOC	.00012	.0004	.33	-.00001	.00024	-.050
AUX	.008	.003	2.69	.0049	.00177	2.805
Test for over-identified restriction*	.9568			1.38		

Table (15.A) Effect of ORT: 2SLS

	U5MR			IMR		
	Coeff.	Std.Er	t-ratio	Coeff.	Std.Er	t-rati
Const.	211.65	18.73	11.3	123.34	11.05	11.16
ORT	-.0434	.59	-.07	-.0093	.348	-.027
PRIF	-.7837	.21	-3.59	-.362	.1288	-2.811
SECF	-1.31	.22	-5.85	-.7953	.1316	-6.043
DOC	.0005	.003	1.63	.00022	.00019	1.212
AUX	.006	.0026	2.56	.00422	.00154	2.736
Test for over-identified restriction*	6.36			7.45		

Table (15.B) Effect of BIRAT: 2SLS

	U5MR			IMR		
	Coeff.	Std.Er	t	Coeff.	Std.Er	t
Const.	230.29	18.47	12.47	137.49	10.92	12.55
BIRAT	-.5785	.33	-1.73	-.4261	.1976	-2.15
PRIF	-.7173	.1765	-4.06	-.3081	.1044	-2.95
SECF	-1.02	.263	-3.88	-.5866	.1555	-3.734
DOC	.0005	.0003	1.64	.0002	.00017	1.197
AUX	.0048	.0027	1.76	.00283	.00162	1.746
Test for over-identified restriction*	3.827			3.31		

Table (15.C) Effect of Family Planning CON: 2SLS

	U5MR			IMR		
	Coeff.	Std.Er	t	Coeff.	Std.Er	t
Const.	211.69	15.75	13.44	123.43	9.185	13.43
CON	.1674	.4987	.336	.05261	.2909	.181
PRIF	-.8338	.2182	-3.82	-.3767	.1273	-2.961
SECF	-1.388	.3092	-4.49	-.8202	.1804	-4.548
DOC	.00053	.0003	1.63	.0002	.00018	1.217
AUX	.0066	.0027	2.47	.00419	.00165	2.68
Test for over-identified restriction*	5.88			6.44		

Table (15.D) Effect of CAL: 2SLS

	U5MR			IMR		
	Coeff.	Std.Er	t	Coeff.	Std.Er	t
Const.	271.25	71.94	3.77	156.59	42.8	3.657
CAL	-.0247	.0288	-.857	-.0137	.0171	-.796
PRIF	-.8309	.1745	-4.76	-.3848	.1038	-3.706
SECF	-1.137	.2859	-3.98	-.6991	.1701	-4.11
DOC	.0004	.00033	1.17	.00016	.00019	.793
AUX	.0053	.0029	1.8	.00345	.00176	1.951
Test for over-identified restriction*	6.274			7.45		

Table (15.E) Effect of Water supply WAT: 2SLS

	U5MR			IMR		
	Coeff.	Std.Er	t	Coeff.	Std.Er	t
Const.	235.61	30.75	7.66	136.11	18.07	7.53
WAT	-.521	.5679	-.918	-.2722	.3337	-.816
PRIF	-.8236	.175	-4.71	-.3799	.1028	-3.695
SECF	-1.008	.3896	-2.58	-.6368	.2289	-2.78
DOC	.0004	.0003	1.43	.00019	.00018	1.042
AUX	.006	.0025	2.53	.00407	.00149	2.724
Test for over-identified restriction*	5.924			7.36		

Note: Critical value for table (15) - (15.E):
* 95% significant level, df=3, Chi-squared = 7.82

Table (16) Reduced-Form Demand For Health Model

	U5MR			IMR		
	Coeff.	Std.Err	t-ratio	Coeff.	Std.Err	t-ratio
Const.	221.08	19.5	11.34	131.93	11.15	11.83
Infra	-.0850	.0239	-3.54	-.0503	.0139	-3.60
Den	-.0004	.0004	-.998	-.0003	.0002	-1.30
Aid	-.1716	.2102	-.816	-.1050	.1248	-.841
Doc	.00053	.0003	1.704	.00028	.0002	1.67
Aux	.0059	.0032	1.82	.0036	.0017	2.08
Inc	-.0011	.0010	-1.05	-.0009	.0006	-1.38
Prif	-.7908	.1721	-4.60	-.3498	.1028	-3.40
Secf	-1.237	.1907	-5.96	-.6977	.1116	-6.25
Wolab	-.1398	.3695	-.378	-.1905	.2193	-.869
	R^2=0.80	F=36.08	n=92	R^2=0.78	F=31.85	n=92

Note: Standard errors and t-ratios are corrected for heteroscedasticity.
Critical t-ratios for a two-tailed statistical significance: 1% = 2.63, 5% = 1.98 and 10% = 1.66.

VIII. DISCUSSION AND CONCLUSION

In late 1990, the World Summit for Children was held, and the goals that were to be attained by the year 2000 were adopted. One of the seven major goals is: "a one-third reduction in under-five death rates (or a reduction to below 70 per 1000 live births, whichever is less)". Specific and sectoral goals related to maternal and child health, nutrition, and basic education are also outlined. Among these supporting goals, the following are relevant to the present analysis. (UNICEF 1991). These are;

-family planning education and services to be made available to all couples, { contraceptive prevalence rate, CON },

-all women to have access to pre-natal care, a trained attendant during childbirth and referral for high risk pregnancies and obstetric emergencies, { % of births attended by trained health workers, BIRAT },

-85% immunization coverage of one year old children, eradication of polio, neonatal tetanus, and a 95% reduction in measles death, { % fully immunized one year old child, IMM }, and

-halving of child death caused by diarrhoea, { % of oral rehydration therapy usage, ORT }.

-There are also goals related to nutrition and safe water supply. {CAL and WAT}

The endogenous variables, and their notation applied in the analysis are shown in parentheses. These six variables are treated as prevention goods and services[28].

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[28]. It can be argued that ORT and BIRAT are basic curative goods. By definition, these two can be classified as tertiary preventive measure. See Cohen and Henderson (1988, p4).

Consumption of prevention goods

In the first-stage, these six endogenous variables have been estimated. A reduced form system of equations was developed within the household utility maximizing framework. Economic theory explains how rational consumers make consumption decisions based on a given set of constraints including time and information. Grossman (1972) has shown that individuals make efficient consumption decisions about health care (both preventive and curative) on the basis of age, education, wealth, and income (wage). Looking at the utility derived from consumption of prevention goods, Cohen and Henderson (1988) classify two types, namely; utility-in-anticipation and utility-in-use. Utility-in-anticipation, or utility obtained from expectation of reducing risk of dying, is associated with the perceived effectiveness and outcome of the prevention goods, and the individual's personal time preference rate. Clearly, a preventive measure such as immunization provides utility-in-anticipation. Microeconomic principles indicate that households will consume a good if the marginal utility exceeds its price (cost).

Following the theoretical concept, one can argue that any policy that either reduces price (cost) or speeds up distribution of information about effectiveness of the program, is an essential step in facilitating consumption of prevention goods. It implies the active role that can be played by government. Moreover, there are other valid theoretical justifications for government's responsibility to assist consumers in making welfare maximizing choices, particularly in the case of goods that affect health[29]. Imperfect information, and externalities or spillover effect often lead to sub-optimal solutions in the utility maximizing process. Moreover, the public sector is the sole provider of prevention goods in today's developing

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[29]. It is true for all hazardous and prevention goods.

countries. In other words, the household utility model offers valuable insights into the interaction between consumption behavior and public policies. The unquestionable advantage of a household choice model built on utility maximizing framework is that it serves as a powerful tool to derive policy implication at the macro level. (Becker 1993).

In the estimation of a reduced form system, the study used lagged values of the six above mentioned prevention goods. There is no scientifically defined time lag structure for the variables, but common sense based on practical experience suggests one to two years will be needed for analysis[30].

Discussion begins with findings of the reduced form system.

Health policy variables, DOC and AUX, proxied for accessibility and availability, are not significant in IMM, ORT, and WAT reduced form equations. To make matters worse, one of the two variables always displays the wrong sign. On the other hand, these two health policy variables display correct signs in BIRAT, CON and CAL equations. Family planning policy variables, FPP and FPS, reveal the expected sign but are insignificant.

The one possible explanation lies in the extent of resources allocated to, and distribution within, the health sector. According to recent data, public real per capita health expenditure exhibits either a downward or stagnated trend, and intra-sectoral allocation is notoriously inequitable in many developing countries. (Oo 1993). Another explanation is particularly related to primary health care (PHC) approach. Since the inception of PHC 15 years ago, many voluntary health workers (VHW) were trained. Their manpower has been accounted for in the AUX variable. In the ORT, BIRAT, CON, and WAT equations, AUX coefficients agree with expectation. The panel survey data conducted in rural areas of

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[30]. This point has been suggested by David Parker and Santosh Mehrotra both from UNICEF.

Southern Thailand reveals that use of ORS is positive and significantly related to service provider activities, in particular, programs promoting activities of Village Health Volunteers and Village Health Communicators. (Jintaganont, Stoeckel, and Butaras 1992). In the IMM regression AUX has the wrong sign. It reflects lack of proper and efficient utilization of VHWs. Especially in the age of accelerating pressure on health budgets, more productive use of VHWs becomes even more critical than ever before.

It is not unreasonable to expect international development assistance to social sectors, AID, to be positively linked to the provision of prevention goods. (IMM, ORT, and BIRAT) Vaccines, cold storage chain, oral rehydration salt packages, and other logistics are supported by international agencies and donors. The challenge to the international community is to adopt explicitly dynamic strategies and plans that would cause more resources to be directed toward priority social sectors.

A fundamental distinction of the third world is concerned with infrastructure development. The level of infrastructure development has power to determine, both directly and indirectly, efficiency and speed of service delivery, and other socio-economic, political, and cultural activities. Because education does not have to come from formal sources, exposure to radio, television, and newspapers, etc. can impart knowledge and utilization of available modern health technology. By definition of a proxy for infrastructure it can be reasonable to add electricity coverage in the term INFRA. A statistically significant effect of INFRA has been found in IMM and BIRAT equations. Although it is not significant, INFRA still has the right sign in the CON regression.

The role of income might be expected to influence the consumption decision of households. The results from the reduced form system suggest; however, the relative

unimportance of the income variable in accounting for prevention goods. Only two of the six reduced form equations have positive income coefficients. The income coefficient of IMM is small (.001) and statistically insignificant (t=1.65). The finding is not uncommon. For instance, Mehrotra (1992) presents the successful story about achievement of high immunization coverage in low income countries. It should be noted that two endogenous prevention goods variables, IMM and ORT, have no monetary cost to consumers, but CON, BIRAT, and WAT may incur some user charge. To the extent that these two endogenous variables have a positive association with income, inclusion of other explanatory variables makes income effect smaller or even reversed and insignificant. Therefore, it can be argued that income effect operates through other variables. Unfortunately, there are no data sets to assess the precise path.

In all reduced form equations, it is found that consumption of prevention goods is positively related to women's education level. The effect of PRIF on consumption of immunization services and oral rehydration salt is large and statistically significant even when other explanatory factors are introduced. On the other hand, female education appears to have a strong and significant effect only at the secondary education level in BIRAT, CAL, and WAT equations. Again, it should be recalled that PRIF and SECF are indirect measures of maternal education. Precise quality and quantity of schooling can only be provided through micro analysis.

To describe the women's role completely, the study takes into account labor market participation of women. In IMM, BIRAT, and CON equations, the WOLAB coefficients display a positive sign with significant effect in BIRAT regressions.

Therefore, there does appear to be a strong effect of women's status upon making

welfare decisions related to health-enhancing goods and services. Better educated, income earning mothers have a capacity to take advantage of available health-enhancing technology. Recall that working mothers have less time to devote to child care: the phenomenon commonly known as substitution effect in economic theory. A working mother is capable of generating income; consequently, she creates more economic resources that can be used in the consumption of prevention goods; the phenomenon is entitled income effect. These two effects go in opposite directions. In this analysis positive income effect may be stronger than negative substitution effect since WOLAB coefficients are positive in three reduced form equations.

It is of particular interest to determine the strength and mechanism of maternal education effect on consumption decisions by exploring interaction terms.

Discussion begins with the interaction between women's education on the one hand and infrastructure and the health care delivery system on the other. From the results of regression with interaction term, it is observed that the effect of maternal education operates through infrastructure and the health care delivery system. The partial slope of IMM with respect to PRIF shows a smaller effect of education under a strong infrastructure and high coverage of health services. In other words, one can argue that the effect of mothers' higher education levels on immunization services may off-set under-development in overall infrastructure. A different mechanism operates in ORT, BIRAT, and CON. Women's education and infrastructure development and coverage of health workers go hand in hand in the utility maximizing process. To put it simply, women's education has a greater effect when it occurs under high infrastructure development.

In general, one can infer that the effect of maternal education on usage of health-

enhancing goods depends to a certain extent upon the overall infrastructure development. Developing infrastructure and increasing coverage of health facilities and manpower can stimulate demand for prevention goods in communities where women's educational level is low. Striking evidence obtained from the analysis of interaction terms indicates the unquestionable importance of the role played by women's education. Limitation of this study prevents the exploration of a detailed differential effect of education on demand for prevention goods. An individual level study conducted in Indonesia (Streatfield et al. 1990) found that the effect of formal education on the probability of a child's being fully immunized disappears when mothers have correct knowledge of the vaccine. Similarly, Behrman & Wolfe (1987) argue that specific health knowledge may have the potential to raise usage of health-enhancing goods and services. The implication of said principle is that effective health education campaigns are needed for successful implementation of preventive programs in regions where women's education level or literacy rate is low. As mentioned above, this cross-country analysis can not offer a solution for variations in education level. However, the result is still powerful enough to encourage policies intended to maintain momentum and/or raise the consumption of prevention goods.

Production of child health

In the second-stage procedure, two child health production functions have been estimated. These structural equations are estimated by applying a two stage least squares

method.[31] In addition, household characteristics and public policy variables are taken into account as controlled factors in the production functions. Indeed, the input-output production relationship between MCH prevention goods and child health is the subject of this research.

This research is able to present clear empirical evidence that IMR and U5MR have a statistically significant response to preventive inputs.

These results are consistent with both the individual and aggregate level findings. UNICEF (1992) has claimed that the lives of 3.2 million children a year were saved by immunization efforts, and an additional 1 million due to ORT. Analysis of longitudinal data from rural Bangladesh found that measles vaccinated children experienced risks of death as much as 46% lower than unvaccinated children. (Koenig et al.1990). Their report suggests that the EPI strategy should be expanded up to 2 and 3 years of age. The present cross-country study also finds a large effect of IMM upon the 1-5 age group.

The contribution of contraceptive input needs to be elaborated. Based on the micro-based findings which emphasize characteristics of the mother (age, number of pregnancies, number of children, birth interval) and mortality risk of children at different ages, Bongaarts (1987) questions the theoretical mechanism of the effect of family planning upon lowering infant and child deaths.[32] In contrast to Bongaarts' view, the present cross-nation study indicates that contraceptive services as a part of a minimum integrated MCH package have a consistent and negative effect on both IMR and U5MR. It should be remembered that the

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[31]. There may be feed back mechanisms operating in the child health production process. For instance, an increase in a child survival probability may have an effect on the decision to use a family planning method or other form of household' resource allocation. Since it is beyond the scope of this model, the study does not address that point.

[32]. Trusell (1988) made a counter argument on the question raised by Boongaarts. See; Does family planning reduce infant mortality ? An Exchange. Population and Development Review. Vol.14, No. 1.

analysis is not able to address the effect of breastfeeding on birth intervals and hence its consequent impact on child survival. The structural regression results trace effects of nutrition level (calorie consumption per capita), and environmental situation (access to water supply).

Therefore, the results provide enough evidence to argue that externally initiated, technologically efficient, limited public health interventions have profound impact on the welfare of the third world'children. This argument dates back to the early 1980s when WHO and UNICEF, two leading international organizations accelerated their ORT and immunization programs in developing countries. In contrast, Ruzicka and Hansluwka (1982) and Foster (1984) argued that externally initiated, technologically sophisticated, limited public health interventions could not bring about sustained mortality decline and have warned about possible substitution effects in mortality and morbidity. The present cross-nations analysis, conducted nearly a decade after these arguments, finds no evidence to support their proposition.

The findings do not necessarily imply that child health is solely determined by these externally initiated limited public health interventions. It can be inferred that a key underpinning of successes in mortality reduction is a direct outcome of complex interactions between household and public policies related to preventive health intervention. The utility maximizing model predicts the extremely important role played by these preventive inputs. Accordingly, sustainability of consumption and provision of prevention goods become a central theme in the production process of child health.

Sustainability issue

This study examines the effect of four health intervention programs on child welfare, measured in terms of IMR and U5MR. The health intervention entailed vaccination against six diseases, oral rehydration therapy, pregnancy care, and family planning; all were dominant components of primary health care for child survival revolution. To ensure the substainability of these preventive programs requires more than an increased supply of these goods and services. It calls for attention to be placed on both users and providers. From the analysis of reduced form demand equations, one can specify household and policy factors as major determinants of consumption of prevention goods. Recognition of the influential position of these two factors leads to fruitful and insightful discussion on sustainability issuing from each of the dimensions.

The results of the model indicate the extremely important role played by women's education in explaining consumption of prevention goods and mortality reduction. This is consistent with results from a large number of research findings.

The finding of this analysis implies that tremendous emphasis needs to be put on improving women's status in order to sustain household consumption of health-enhancing goods. Since the decision unit within a household is the parent, their characteristics, and especially women's education, are important. Education makes it easier for women to appreciate the role of prevention goods. In other words, lack of awareness of these benefits may result in a low demand for prevention versus curative goods and services in the market setting. Summers (1992) maintains that money spent increasing the education of girls is the most socially productive outlay in developing countries.

This implies a clear need for increased attention and expenditure to be focused on

social and related infrastructure sectors in general and education in particular. Implementation of health and other development programs are hampered by inadequacy of basic infrastructure such as roads and electrification. The United Nations (1993.b) warns about the longer term adverse consequences of low public sector investment in infrastructure in developing countries. There may be another challenging problem to the development planners which is associated with equity issues. Therefore, in an attempt to improve the coverage of socially-oriented infrastructure, a distributional equity needs to be emphazied.

Still, there is a range of constraints that may possibly hinder sustainability. If changes in public policies, i.e., correct skewed distribution, and increased provision of health, education, and its related infrastructure, are to increase consumption of prevention goods, there are requirements for changes in household behavior which must be satisfied. If household behavior is not responsive to policy changes, it is highly unlikely to increase and/or continue consumption of prevention goods. For instance, households may decide not to consume family planning services because of traditional belief. Similarly, they may not use immunization services because of lack of information about place, time, and schedule of the program. Thus, it is obvious that the development planners should not overlook households' behavior. Combined effort at price (cost) reduction and improved awareness of the "true value" would therefore need to be part of any strategy to increase consumption of prevention goods. In accordance with economic theory, these research findings indicate that well-informed economic agents will make rational choices as long as utility from consumption of health-enhancing goods exceeds its costs.

An inescapable generalization could be formed on the basis of the present investigation and on the body of previous work that these four MCH preventive measures

have a significant effect on the reduction of child mortality. It calls for consideration of a minimum essential package for maternal and child health services. Based on a quasi-experimental research finding from Togo, Africa, Huntington et al. (1993) report that an effectively integrated package of family planning and expanded immunization programs lead to a decrease in the number of missed opportunities and an increase in the continuity of service use. The health budget in developing countries, almost without exception, is quite small. Therefore, it is especially important for health programs to be directed at those areas where impact is the greatest. Regional differences in components of packages are to be expected because of differences in disease prevalence. But given the most recent information on cause of child death {table (2)}, the potential gains from expansion of these four essential components will not decline in the near future. Given economic resources, prioritization within each country (example; targeting the urban poor, and rural areas) may be necessary in the formulation of a minimum essential package. The longer term explicit advantage of an essential package may to a certain extent depend upon the absorptive capacity of this network in relation to the new health programs. A strong, and well-designed network can easily expand into different kinds of program. For instance, a reliable out-reach immunization network can integrate family planning and AIDS prevention programs.

All these policies measured, denoted as Z, enter the utility function through a reduced form system and the structural health production function. According to the model construction, the successful implementation of these policies improve welfare through higher levels of consumption of prevention goods, either as a result of price reduction[33] or an

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[33]. If the services are provided free of charge, price reduction will still have effect in both monetary and non-monetary terms.

increased realization of the "true" value of prevention goods. Consequently, an alternative policy for sustainability may include imposing some form of user charge on consumption of prevention goods[34]. The alternative policy may prevent slow down and/or cancellation of health intervention programs when external assistance is terminated.

Research agenda

More research is needed to characterize price and rationing rules for preventive care as their features transform from "public goods" into "private goods".[35]

The analysis sheds a great deal of light on the reason for the importance of an integrated approach, at least for maternal and child health intervention. Note that three out of four prevention goods considered are solely or largely supported by external donor agencies. Vertically oriented, selective health intervention is favored by many donors and governments. More needs to be known in the debate between integrated/vertical dichotomy on the one hand and comprehensive and selective intervention on the other.[36]

Going back to the model, it is obvious that there are many missing variables that should be treated as endogenous, for instance, breastfeeding, pre-and post- natal care, use of medical services, food supplement practices, and consumption of hazardous goods. If data availability permit, they should be exploited to provide a complete picture of the production

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[34]. The analysis will not go into a lot of detail on cost recovery themes because its contents are so wide and need to be examined from many perspectives. A user charge on consumption of prevention goods and services may not be feasible in the current setting of developing countries. Even in highly developed country like U.S., with the cost of complete private sector immunization at about $448, the national coverage rate was recorded as only 59%. (Frankel 1993).

[35]. Hammers (1993) presents price and rationing rules for public health services. However, the analysis isn't done in terms of preventive or curative care.

[36]. World Bank identifies a limited package of public health measures to reduce DALY on the basis of cost-effectiveness . Also they specify essential clinical services which are aimed at tackling disease burdens of developing countries. World Bank (1993,p8).

process. The effect of country-specific unobservable variables should also be traced.

Although certain variables could not be addressed by this analysis, it has nevertheless contributed from a wide range of theoretical and empirical perspectives. The most valuable insights of the present analysis regard factors influencing the demand for prevention goods and its effect on the production of child health. The deeper interactions between female education and public policy, as well as off-setting mechanisms under different circumstances, have been identified. MCH prevention goods have been shown as a key factor in mortality reduction. Sustainability became a central theme throughout the analysis. The considerable uncertainty surrounding the sustainability of consumption and provision of these goods and services has been investigated, followed by some useful deductions for further actions. The purpose of this analysis has been to facilitate the development of programs specifically for improving childrens' health in developing countries. This research offers some solutions and suggestions for the achievement of the goals established by the World Summit for Children.

Appendix (1) List of Sample Countries

Africa	Asia	Latin America
ANGOLA	AFGHANISTAN	ARGENTINA
ALGERIA	BANGLADESH	BOLIVIA
BENIN	BHUTAN	BRAZIL
BOTSWANA	CHINA	CHILE
BURKINA FASO	EGYPT	COLOMBIA
BURUNDI	INDIA	COSTA RICA
CAMEROON	INDONESIA	CUBA
CONGO	IRAN	DOMINICAN REP.
C.AFRICA REP.	IRAG	ECUADOR
CHAD	JORDON	EL SALVADO
COTE D'LVOIRE	KOREA,DEM	GUATEMALA
ETHIOPIA	KOREA,REP	HAITI
GABON	KUWAIT	HONDURAS
GHANA	LAOS	JAMAICA
GUINEA	LIBYAN	MEXICO
GUINEA BISSAU	MALAYSIA	NICARAGUA
KENYA	MAURITIUS	PANAMA
LESOTHO	MYANMAR	PARAGUAY
LIBERIA	NEPAL	PERU
MALAWI	OMAN	URUGUAY
MALI	PAPUA NEW GUINEA	VENEZUELA
MADAGASCAR	PAKISTAN	
MAURITANIA	PHILIPPINES	
MOROCCO	SAUDI ARABIA	
MOZAMBIQUE	SINGAPORE	
NIGER	SYRIA	
NIGERIA	SRI LANKA	
RWANDA	THAILAND	
SENEGAL	TURKEY	
SIERRA LEONE	U.A.E	
SOMALIA	VIET NAM	
SUDAN	YEMEN	
TANZANIA		
TOGO		
TUNISIA		
UGANDA		
ZAIRE		
ZAMBIA		
ZIMBABWE		

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