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**FOUR ESSAYS ON THE LINKS BETWEEN
POVERTY, INEQUALITY AND HEALTH WITH
EMPIRICAL APPLICATION TO DEVELOPING
COUNTRIES: AFRICA COMPARED TO THE REST
OF THE WORLD**

Amadou Bassirou Diallo

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Université d’Auvergne - Clermont-Ferrand 1, France
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**FOUR ESSAYS ON THE LINKS BETWEEN POVERTY,
INEQUALITY AND HEALTH WITH EMPIRICAL
APPLICATION TO DEVELOPING COUNTRIES:
AFRICA COMPARED TO THE REST OF THE WORLD.**

Par

Amadou Bassirou DIALLO

Thèse Nouveau Régime

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LISTE DES ACRONYMES

CI	Concentration Index
CWIQ	Core Welfare Indicators Questionnaire
DALY	Disability Adjusted Life Year
DHS	Demographic and Health Survey
EDE	Equally Distributed Equivalent
FA	Factor Analysis
FGT	Foster-Greer-Thorbecke
GDP	Gross Domestic Product
GE	General Entropy (inequality measure)
GLSS	Ghana Living Standard Surveys
GIE	Gini Income Elasticity
HDI	Human Development Index
HDR	Human Development Report (UND)
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
HR	Hazard Ratio
KMO	Kaiser-Meyer-Olkin
KM	Kaplan and Meier
LAC	Latin America Countries
MENA	Middle East and North Africa
MDGs	Millennium Development Goals
MGIE	Marginal Gini Income Elasticity
MICS	Multiple Indicators Core Surveys
NGO	Non Governmental Organization
OLS	Ordinary Least Squares
PCA	Principal Components Analysis
PG	Poverty Gap
PPP	Purchase Parity Power
PRS	Poverty Reduction Strategy
QALY	Quality-Adjusted Life Year
RoW	Rest of the World
SA	South Asia
SSA	Sub-Saharan Africa
SUREG	Seemingly Unrelated Test
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
WDI	World Development Indicators (World Bank)
WDR	World Development Report (World Bank)
WFS	World Fertility Surveys
WHO	World Health Organization

AVANT-PROPOS

Disons-le tout de suite. Cette thèse fut l'une des aventures les plus pénibles mais aussi la plus exaltante de ma vie. Mais elle m'a appris à me connaître, à connaître mes limites et les dépasser, mes forces et faiblesses. Comme beaucoup de thèses, le début fut chaotique, plein de changements, d'interrogations, de doutes, de questionnements, d'excitation, mais aussi de découragement et d'abattement. Le chemin fut plein d'embûches et de sacrifices voire de renoncements, tant au niveau personnel, professionnel et familial, que sur le plan du travail de recherches en vue d'aboutir à sa finalisation.

Le choix sur la santé et la pauvreté en Afrique tient du fait que ce sont des problèmes cruciaux sur le continent. Nulle part ailleurs on a vu une pauvreté aussi massive ni un état de santé aussi dégradé. Le fait que l'économie de la santé posât conceptuellement d'énormes problèmes constituait aussi un défi que j'ai voulu relever. Enfin, la disponibilité de nos directeurs de thèse ainsi que l'existence au Cerdi d'une école de pensée sur l'économie de la santé furent les facteurs qui me poussèrent dans cette étude.

Comme tout travail de recherches, elle n'est pas parfaite et les questions effleurées dans cet essai demandent dans le futur une investigation beaucoup plus poussée. Mais elle m'a aussi permis de mieux comprendre les questions explorées et de mesurer le chemin accompli en Afrique au Sud du Sahara en matière de développement socio-économique, et les défis qui se posent pour accélérer et rendre soutenable ce développement. Ces défis restent immenses, mais l'espoir est grand de voir le sous-continent rejoindre le train du développement à l'instar des autres parties du monde. Il en a les moyens, les ressources et les talents nécessaires.

Les résultats et recommandations de politique économique contenus dans cette thèse ne reflètent pas nécessairement la position du Cerdi et de l'Université d'Auvergne, son administration ou son personnel enseignant. Toute erreur contenue dans cette thèse reste évidemment l'entière responsabilité de l'auteur.

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*A Yacine, Sarah, Warda ainsi qu'à tous les membres de ma famille et nos descendants,
puissiez-vous tous être des hommes brillants et bénis à jamais...*

RESUME EXECUTIF

Cette thèse part d'un postulat simple : « l'amélioration du niveau de vie s'accompagne de l'amélioration de l'état de santé générale d'une population » et teste sa validité dans le contexte de l'Afrique au Sud du Sahara (ASS).

Si cette hypothèse se vérifie en général dans le contexte de l'ASS en ce qui concerne le niveau (plus le pays est riche, plus sa population est en bonne santé), il l'est moins en ce qui concerne les dynamiques, du moins à court et moyen terme. Notamment, les pays qui connaissent une amélioration tendancielle de bien-être matériel ne connaissent pas forcément une amélioration de la santé de leurs populations. Ceci constitue un paradoxe qui viendrait invalider notre postulat. En écartant tout effet de retard ou de rattrapage qui pourrait l'expliquer car nous travaillons sur une période de 15 ans réparties en 3 sous-périodes (1990-1995, 1995-2000 et 2000-2005), nous expliquons ce paradoxe, toutes choses égales par ailleurs, par deux canaux principaux qui peuvent interagir :

- la performance du système de santé et
- l'inégalité en santé.

Si le premier est plus évident mais aussi plus difficile à prouver empiriquement du fait du manque de données sur des séries longues, ou du fait que ces données sont trop agrégées et éparpillées, le second canal est testable avec des bases de données adéquates qui, elles, sont disponibles au niveau microéconomique (ménages). Les bases de données que nous avons privilégiées sont les Enquêtes Démographiques et de Santé (EDS) du fait de leur comparabilité dans l'espace et le temps (mêmes noms de variables standardisées, même méthodologie d'enquête, mêmes modules, etc.). Ces atouts sont d'autant plus importants que les comparaisons de pauvreté et de bien-être basées sur les enquêtes de revenus ou de consommation butent sur de sérieux problèmes à savoir la comparabilité de ces enquêtes (méthodologies différentes, périodes de rappel différents, prix souvent non collectés de la même manière, etc.).

Pour montrer ces effets de l'inégalité de santé sur les niveaux et les tendances de la santé des populations et la pauvreté et le bien-être, nous avons axé notre recherche autour de 3 axes principaux :

1- Comment mesurer le niveau de richesse et donc le bien-être des ménages en l'absence d'information sur la consommation et le revenu ?

Les chapitres 1 et 2 de notre thèse se penchent sur cette question.

Nous avons privilégié, à l'instar de plus en plus d'économistes, l'utilisation des biens des ménages et les méthodes de l'analyse factorielle et d'analyse en composantes principales pour construire un indice de richesse. Cet indice de richesse est pris comme un substitut du revenu ou de la consommation et sert donc de proxy pour la mesure du bien-être. Bien qu'il comporte quelques lacunes (notamment le fait qu'il ne concerne que les biens matériels et durables du ménage alors que la consommation ou le revenu sont des concepts plus globaux de bien-être, il ne prend pas en compte les préférences des ménages, il ne comporte aucune notion de valeur car le prix n'est pas pris en compte, de telle façon qu'une petite télévision en noir blanc vieille de vingt ans est mise au même niveau qu'un grand écran plasma flambant neuf, etc.), il n'en demeure pas moins que d'un côté, avec les EDS, il n'y a pas moyen de faire autrement en l'état actuel des choses, mais aussi et surtout parce que ces données permettent d'éviter les problèmes évoqués plus haut, notamment celui de la comparabilité des données pour faire de la comparaison spatiale et inter-temporelle des données en matière de pauvreté.

Dans le premier chapitre, en nous basant sur cet indice et une ligne de pauvreté définie *a priori* à 60% pour la première observation dans notre échantillon (Benin, 1996), et en utilisant les données EDS et une analyse en composantes principales (ACP), nous avons pu mesurer la tendance de la pauvreté dite « matérielle » (en opposition à la pauvreté monétaire, basée sur la métrique monétaire). Cette méthode qui est privilégiée par des auteurs comme Sahn et Stifel est d'autant plus intéressante qu'elle donne non seulement les tendances de la pauvreté dans chaque pays, mais elle permet aussi une classification naturelle de ces pays par ordre de grandeur de pauvreté.

Cependant, dans la mesure où les biens des ménages et la dépenses de consommation sont disponibles, l'analyste devrait estimer les deux types de pauvreté (matérielle via l'indice de richesse et monétaire via le revenu ou la consommation) car les études montrent souvent que les biens matériels et la consommation ou le revenu ne sont pas très bien corrélés, et donc le choix de l'indicateur de bien-être est crucial en termes de politiques économique et de santé.

En effet, si l'indicateur sous-estime le vrai niveau de pauvreté ou d'inégalité (ou les surestime), les dépenses publiques qui en résultent peuvent être plus ou moins surévaluées, de même que les réponses apportées se révéler inadéquates. Donc dans la mesure du possible, il conviendrait de se pencher sur la question du choix de l'indicateur.

Les résultats de notre méthodologie montrent que l'ASS reste la région la plus pauvre du monde en termes de possession d'actifs. La région orientale de l'ASS est la plus pauvre au monde (75%) suivie de l'Asie du Sud (64%), le Sud de l'ASS (61%), l'Afrique Centrale (57%), l'Afrique de l'Ouest (55%), l'Asie de l'Ouest (40%), l'Asie du Sud-Est (19%), l'Amérique Latine (18%), les Caraïbes (17%), l'Afrique du Nord (6%), l'Asie Centrale (2%) et l'Europe de l'Est (1%).

Notre analyse nous montre que la pauvreté baisse dans l'ensemble des pays Africains au Sud du Sahara (sauf la Zambie), à l'instar des autres pays du monde dans l'échantillon. En effet, en considérant les trends, nous voyons que la moyenne de l'ASS passe de 63% de pauvreté matérielle entre 1990-1995 à 62% en 1995-2000 et 58% entre 2000 et 2005. La baisse est modeste et lente mais non négligeable et surtout, elle est en accélération sur les 2 dernières périodes. Mais elle demeure toutefois beaucoup plus marquée dans le reste du monde. Concomitamment à la baisse de la pauvreté, nous observons aussi une baisse de l'inégalité.

Nous terminons ce chapitre par une réflexion sur l'effet de la transition démographique sur la croissance économique et la pauvreté en ASS et dans les autres pays en développement. En effet, la chute de la fertilité et de la mortalité couplées à un exode rural font que le nombre de famille se démultiplie du fait de la transition vers des tailles plus réduites. Ceci impose plus de

contraintes (et donc peut avoir un impact négatif) sur la croissance économique et risque de sous-estimer le niveau réel de pauvreté.

Il convient, une fois que la pauvreté matérielle et ses tendances ont été bien calculées avec les biens durables (et la transition économique prise si possible en compte), de tester la validité de cette méthode en la confrontant avec les résultats issus de l'analyse monétaire de la pauvreté. Les EDS ne comportant pas données d'information sur la consommation, nous nous sommes tournés vers une autre source de données.

Dans le chapitre 2, nous avons testé la robustesse de notre méthode dans le cas particulier du Ghana, en utilisant les enquêtes du Questionnaire Unifié sur les Indicateurs de Base de Bien-être (QUIBB), et en confrontant les résultats issus de la méthode ACP avec ceux issus de la méthode traditionnelle monétaire et trouvons grosso modo les mêmes résultats (10% de baisse avec la méthode monétaire traditionnelle et 7% avec notre méthode sur la période 1997-2003). Ceci valide donc le fait que la méthode que nous proposons (à savoir, mesurer le bien-être et la pauvreté par les biens durables des ménages) est tout aussi valide que la méthode plus traditionnelle utilisant des métriques monétaires.

Une analyse fine dans le cas du Ghana montre que la baisse de la pauvreté est due à une croissance économique particulièrement pro-pauvre mais aussi à des dynamiques intra et intersectorielles (réallocation des gens des secteurs moins productifs vers ceux plus productifs) et aussi une forte migration des campagnes vers les villes. Nos simulations montrent que les migrants ruraux ont aussi bénéficié de cette croissance dans les villes où ils trouvent plus d'opportunités.

2- Une fois établie que la pauvreté est en recul en ASS, nous avons voulu mesurer la tendance de la santé de sa population (approximée par les taux de mortalité infantile et infanto-juvénile).

Nous discutons dans le chapitre 3 de trois méthodes pour estimer et comparer les taux de mortalité des enfants :

- la méthode des cohortes fictives (sur laquelle l'équipe de l'EDS se base pour estimer les taux « officiels » de mortalité),
- la méthode non paramétrique (Kaplan et Meier) que privilégient un certain nombre d'économistes et
- la méthode paramétrique (Weibull) de plus en plus utilisée pour sa souplesse et sa robustesse.

Les deux premières méthodes ont tendance à sous-estimer le vrai niveau de mortalité et de ce fait nous avons privilégié le Weibull. De plus, avec cette dernière, nous pouvons évaluer l'effet de chaque variable spécifique (comme l'éducation ou l'accès à l'eau) sur le niveau de mortalité.

Une étude des déterminants de cette mortalité montre qu'outre l'effet attendu de l'éducation des mères, l'accès aux infrastructures de santé (soins médicaux et surtout prénataux durant et lors de l'accouchement) et sanitaires (accès aux toilettes et dans une moindre mesure à l'eau potable) en sont les principaux facteurs. L'effet de richesse joue peu en ASS (mais pas dans le reste du monde), une fois que nous contrôlons pour le lieu de résidence (urbain) et le niveau d'éducation. Ce résultat nous surprend quelque peu, même s'il a été trouvé dans d'autres études.

Ensuite, nous avons calculé la mortalité prédite des enfants.

De toutes les régions du monde, l'ASS a le niveau de mortalité le plus élevé (par exemple en moyenne 107 décès pour la mortalité infantile contre 51 pour le reste du monde, soit plus du double). Ce résultat était toutefois attendu. Par contre nous avons été quelque peu surpris en ce qui concerne les tendances.

Le constat est que sur les 15 ans, la mortalité des enfants a très peu ou pas du tout baissé dans le sous-continent africain (et est même en augmentation dans certains pays, alors qu'ils enregistrent une baisse de la pauvreté matérielle sur la même période). En moyenne, considérant les enfants de moins d'un an, les taux sont passés de 95‰ à 89.5‰ pour remonter à 91.5‰ pour les 3 périodes 1990-1995, 1995-2000 et 2000-2005. Ainsi sur 15 ans, la mortalité infantile n'a baissé

que de 3 points et demie en moyenne et surtout, elle remonte sur la période 1995-2005. Un examen des taux de malnutrition des enfants confirme ces tendances.

On pourrait dire que ces résultats sont plutôt encourageants et normaux si on fait une analyse d'ensemble du sous-continent. En effet pour l'ensemble de l'ASS, cette légère baisse semble en conformité avec la baisse de 5 points des taux de pauvreté matérielle (63% en 1990-1995 à 58% en 2000-2005). Mais l'ordre de grandeur est faible en termes de magnitude, et surtout si compare au reste du monde où on observe une baisse de la mortalité beaucoup plus conséquente.

Mais c'est l'arbre qui cache la forêt. Une analyse plus fine par pays montre en effet une situation plus contrastée. Notre postulat de départ nous dit que sur une période suffisamment longue, une amélioration de bien-être s'accompagne d'une amélioration de la santé. Or on constate que certains pays qui connaissent une baisse de la pauvreté matérielle connaissent également une recrudescence de la mortalité des enfants.

Pour une même année, ce résultat peut être normal, traduisant un simple décalage pour que l'amélioration de bien-être se traduise par un meilleur état de santé de la population. Mais à moyen terme (période de 5 ans), nous observons la même absence d'effet. Nous sommes donc face à un paradoxe qu'il nous faut comprendre et tenter d'expliquer.

Une des pistes pour comprendre ces résultats est d'analyser la performance des systèmes de santé en Afrique.

Les facteurs qui expliquent notamment cette performance sont : des facteurs « classiques » comme la performance économique des périodes passées, les montants et l'allocation des dépenses de santé, l'organisation des systèmes de santé, la baisse de la fourniture de services de soins de santé (vaccination, assistance à la naissance, soins prénataux, soins curatifs, ...), la malnutrition, le SIDA, les guerres, la fuite des cerveaux notamment du personnel médical, etc., à côté de facteurs plus « subtils » ou ténus car moins saisissables comme les crises financières des années 1990s qui ont plombé certaines des économies de la sous-région, la qualité des soins, la corruption et les dessous-de-table, l'instabilité de la croissance économique (même si elle est positive), etc.

La seconde voie que nous examinons pour expliquer le manque de résultat en santé dans certains pays concerne l'inégalité en santé et ceci fait l'objet de notre dernier chapitre.

3- Expliquer l'absence de lien entre santé et pauvreté dans certains pays de l'ASS : l'effet de l'inégalité en santé.

Dans le chapitre 4, nous émettons l'hypothèse que le fort niveau d'inégalité dans l'accès aux services de santé et d'assainissement couplé à la faible performance du système de santé (avec en toile de fond l'impact du Sida) peuvent servir à expliquer en partie notre paradoxe.

Nous considérons deux types de services :

- soins de santé (vaccination, assistance médicale à la naissance et traitement médical de la diarrhée) et
- hygiène et assainissement (accès à l'eau potable et à l'électricité, accès aux toilettes propres).

Le choix de ces services est motivé par le fait que le modèle Weibull dans le chapitre 3 nous montre que toutes choses égales par ailleurs, ils sont cruciaux pour la survie des enfants, en particulier en Afrique.

Les niveaux d'accès montrent une baisse tendancielle des taux pour les services de santé (surtout pour la vaccination) et une légère augmentation de l'accès à l'électricité et dans une moindre mesure à l'eau potable. L'accès aux toilettes propres demeure un luxe réservé à une petite fraction de la population.

Pour les calculs d'inégalité, nous considérons deux indicateurs:

- l'indice de concentration (pour mesurer le niveau moyen d'inégalité)
- et l'élasticité-revenu du Gini (inégalité « à la marge » quand le revenu d'un individu ou d'un groupe augmente d'un point de pourcentage).

Globalement, les pays d'ASS ont un niveau d'inégalité beaucoup plus élevé comme on s'y attendait par rapport au reste du monde.

Pour les tendances, nous remarquons que l'inégalité marginale s'accroît pour les services d'assainissement (eau, toilette et électricité), mais qu'elle diminue pour les soins de santé.

En ce qui concerne l'inégalité moyenne, elle indique une disproportion dans l'accès des classes riches par rapport à celles pauvres. Même si les groupes pauvres « rattrapent » ceux riches dans la provision de certains services, cela se fait de façon trop lente.

De fait, le haut niveau d'inégalité couplé à une recrudescence de cette inégalité à la marge pour certains services tendent à annihiler les effets positifs de la croissance économique et de la réduction de la pauvreté et maintiendraient la mortalité, la malnutrition et la morbidité des enfants en Afrique à des niveaux relativement élevés et plus particulièrement concentrés dans les groupes les plus pauvres.

Tout ceci appelle à des politiques économiques, sociales et sanitaires pour renverser fortement les tendances de la mortalité des enfants. En particulier, nos résultats suggèrent qu'il faudrait que les pays Africains puissent entre autres :

- accroître les services de soins de santé, notamment les soins préventifs comme les services essentiels à la santé de l'enfant dès sa naissance (vaccination, services prénataux et assistance à la naissance), les soins curatifs et les campagnes de sensibilisation.
- renverser la tendance baissière dans la provision des services sanitaires (eau, électricité, environnement et assainissement, prise en charge des déchets, etc.).
- améliorer la nutrition et l'environnement immédiat de ces enfants et les comportements des ménages (espacement des naissances, éducation des mères en matière de santé, etc.).

- plus généralement comme le montrent d'autres études, il faudrait aussi améliorer la performance globale de leur système de santé en empêchant la fuite des cerveaux, en allouant un budget suffisant à la santé, en organisant mieux les différents organes, de même que les ciblages des politiques de santé, en empêchant la corruption, en améliorant la qualité (accueil, propreté des centres de soins, etc.), en équipant les centres en médicaments, vaccins, moyens de transport et de communication, etc. Intégrer si possible les systèmes plus traditionnels de soins (comme les matrones et les guérisseurs) et le secteur privé, de même qu'une meilleure organisation du système pharmaceutique.

Ces politiques constituent un tout et doivent être mise en œuvre rapidement, ou renforcées le cas échéant. A cette seule condition les pays Africains pourraient espérer rattraper leur retard dans les Objectifs du Millénaire.

General Introduction to and Rationale for the Study

Introduction.

In this dissertation, we are mainly interested in the interactions between poverty and one of its greatest dimensions¹, namely health. More specifically, we will focus on their inequalities: does poverty inequality have more effect on poverty than health level? Does health inequality matter to poverty? Poverty and health are two related concepts that both express human deprivation.

Health is said to be one of the most important dimensions of poverty and vice-versa.

That is, poverty implies poor health because of a low investment in health, a bad environment and sanitation and other living conditions due to poverty, a poor nutrition (thus a greater risk of illness), a limited access to, and use of, health care, a lower health education and investment in health, etc².

Conversely, poor health leads inevitably to poverty due to high opportunity costs occasioned by ill-health such as unemployment or limited employability (thus a loss of income and revenues), a lower productivity (due to loss of strength, skills and ability), a loss of motivation and energy (which lengthen the duration of job search), high health care expenditures (or catastrophic expenditures), etc³.

But what are the degree of correlation and the direction of the causality between these two phenomena? Which causes which? This is a classic problem of simultaneity that has become a great challenge for economists. Worst, each of these phenomena (health and poverty) has many dimensions⁴.

¹ Aside the income-related material deprivation.

² Tenants of the “Absolute Income” hypothesis for instance show that absolute income level of individual has positive impact on their health status (Preston, 1975; Deaton, 2003). Conversely, lack of income (and the poverty state it implies) leads unambiguously to poor health. For other authors, it is not the absolute level per se, but the relative level (i.e. comparably to others in the society) that impacts most health outcomes. This is the “Relative Income” hypothesis (see van Doorslaer and Wagstaff, 2000, for a summary).

³ See Sen (1999) and more recently Marmot (2001) for more information.

⁴ Poverty could be seen as monetary poverty, human poverty, social poverty, etc. Identically, one talks of mental health, physical health, “positive” and “negative” health, etc. So a one-on-one causality could not possibly exist between the two, or will be hard to establish.

How to reconcile two multidimensional and simultaneous events?

We've chosen the first way of causality: that is, poverty (and inequality) causes poor health. As justification, we consider a life-cycle theory approach (Becker, 1962). An individual is born with a given stock of health. This stock is supposed to be adequate enough. During his life, this stock is submitted to depreciation due to health shocks and aging (Becker's theory, 1962). We could think that the poorer you are, the more difficult is your capacity to invest in your health⁵.

Empirically, many surveys (too numerous to be enumerated here) show that poor people⁶ do have worse health status (that is, high mortality and morbidity rates, poor access to health services, etc.). It has been established that poor children are less healthy worldwide, independently of the region or country considered.

It is generally agreed that the best way to improve the health of the poor is through pro-poor growth policies and redistribution.

Empirically, one of the major achievements of these last two decades in developing countries is the improvement in health status of populations (notably the drop in mortality rates and higher life expectations) following periods of (sustained) economic growth.

However, is this relation always true? In some countries as we will see later in this thesis, while observing an improvement in the population's welfare, the converse is observed in its health status, or vice versa.

If health and poverty are so closely related, they should theoretically move in the same direction. But the fact that in some countries we observe opposite trends suggests that some dimensions of health and poverty are not or may not be indeed so closely related, as postulated, and that they may depend of other factors.

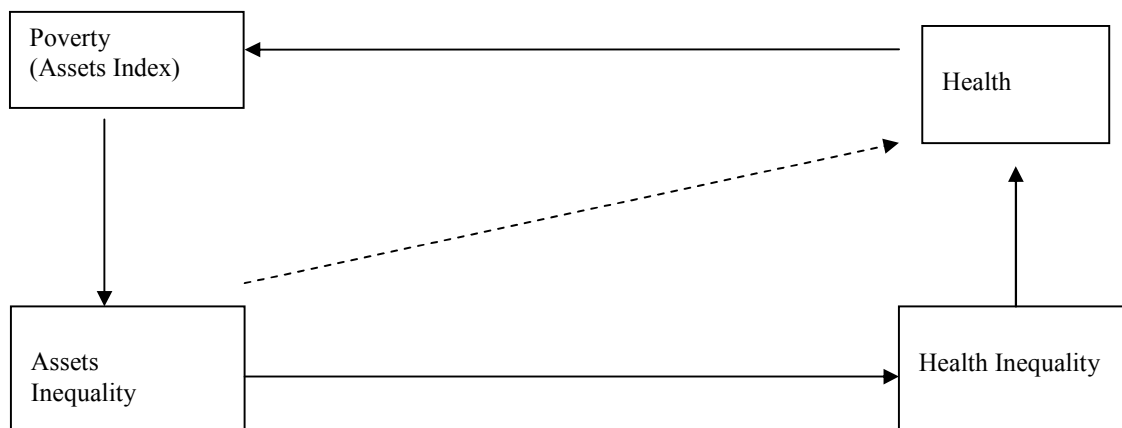
⁵ Another justification is that many authors have studied the problem the other way. Schultz and Tansel (1992, 1997) for instance showed that ill-health causes a loss of revenues in rural Cote d'Ivoire. Audibert, Mathonnat et al. (2003) also showed that malaria caused a loss of earnings of rural cotton producers in Cote d'Ivoire.

⁶ Usually defined from some income or expenditure-related metric or some assets-based metric.

1. The Purpose of the Study.

The ultimate goal of our dissertation in its essence is to measure inequality in health⁷ in developing countries using mainly Demographic and Health Surveys (DHS, henceforth)⁸. It deals with interactions between poverty and one of its greatest dimensions, putting aside the income-related material deprivation, namely health. It therefore measures inequality in health status and access to health and discusses which policies should be implemented to correct these inequalities.

That is, it aims to see how much rich people are better off and benefit from health interventions, as compared to the poor, and how to reduce such an inequality. The present dissertation contains four papers that are related to these questions. Our main hypothesis (that will be tested) is that poverty impacts health through inequality effects⁹. Graphically, we can lay these simple relationships as:



⁷ And corollary health sanitation (access to safe water, toilet and electricity). Though electricity is more a measure of economic development than health measure per se, we add it here as a control for sanitation and nutrition: for example women could read more carefully the drugs' notices, or warm more quickly foods; more generally, electricity often improves the mental and material wellbeing of households. It also conditions health facility's performance.

⁸ And potentially other surveys. In this case, we mention explicitly the survey(s).

⁹ The other important factor that could impact health is the performance of the health system. This is discussed in the Chapter 3.

The dashed line in the figure above suggests that income inequality could impact health directly. But we consider that this direct effect is rather small or negligible, as compared to the indirect effect through inequality in health. Therefore, inequality in health is central to our discussion.

To measure inequalities in health, we face three challenges:

- measuring welfare (income metric) and subsequently inequality in welfare,
- measuring health,
- and measuring inequality in health.

The measurements can be conducted using two approaches (Sahn, 2003):

- Directly by ranking the households or individuals vis-à-vis their performance in the health indicator; we thus have a direct measure of inequality in health. This is suitable when the health indicator is continuous (such as weight, height or body mass index). According to Prof. David E. Sahn, that approach “which has been referred to as the univariate approach to measuring pure health inequality, involves making comparisons of cardinal or scalar indicators of health inequality and distributions of health, regardless of whether health is correlated with welfare measured along other dimensions”.

- Indirectly by finding a scaling measure such as consumption or income or another indicator (assets index for instance)¹⁰ that would help ranking the households or individuals (from the poorest to the richest), and see what are their performance in the health variable of interest. We are therefore measuring an indirect health inequality. The indirect method is mostly suitable when the health indicator is dichotomous (for example whether the individual has got diarrhoea last 2 weeks, or “have the child been vaccinated”, or “place of delivery”) or is a rate (such as child mortality). Again, quoting Prof. Sahn, “making comparisons of health across populations with different social and economic characteristics is often referred to in the literature as following the so-called ‘gradient’ or ‘socioeconomic’ approach to health inequality. Much of the motivation for this work on the gradient approach to health inequality arises out of fundamental concerns over social and economic justice. The roots of the gradient will often arise from

¹⁰ Or more generally any other socioeconomic gradient such as education, gender or location.

various types of discrimination, prejudice, and other legal, social, and economic norms that may contribute to stratification and fragmentation, and subsequently inequality in access to material resources and various correlated welfare outcomes”.

While the first method would appear quickly limited for dummy or limited categorical health variables because of the small variability in the population, the second approach could also be impossible when no information is available to scale the units of observation in terms of welfare. We’ll be mostly focusing on the second approach, as did many health economists, and also due to the nature of the DHS datasets in hand and the indicators that we are investigating.

2. Strategy, Methods and Structure.

Measuring wealth-related inequality in health implies in the first stage defining and characterizing the poor. Who are indeed the poor?

Traditionally, monetary measures (income or consumption) have been used to distinguish households or people into “rich” and “poor” classes. Indeed, it is agreed that the “income-metric” approach is one of the best ways to measure welfare¹¹.

However, it sometimes, if not often, happens that we lack this essential information in household survey datasets. Especially in our case, the DHS datasets do not have income nor consumption information. Then, how to characterize the poor in this situation? For a long time, economists have eluded the question. But soon, it became evident that an alternative measure is needed to strengthen the “poverty debate”.

In the first part of our dissertation, we start by providing a theoretical framework to find a proxy for wellbeing, in the case where consumption or income-related data are missing, namely by

¹¹ There is a consensus in the economic literature that income is more suitable to measure wealth or welfare in developed countries while consumption is more adequate for developing ones due to various reasons such as irregularity of incomes for informal sector, seasonality, prices, recall periods, trustworthy, etc. (see Deaton 1998 for detail).

discussing the use of assets as such a proxy. The first part of this thesis is relatively long, as compared to the second. However, this is justified, due to its purpose.

The goal of the first part of the dissertation is to participate to the research agenda on poverty. It attempts to measure it in a “non traditional”¹² way.

The main rationale for this first part therefore is thus to find a new, non monetary measure to characterize in best, life conditions, welfare and then the poor. This measure is referred to as the “assets index”.

Indeed, as the majority of developing countries are engaged more and more in fighting poverty, inequality and deprivation, more and more information on the state of poverty¹³ is needed. If in almost all these countries, many household surveys have been implemented to collect information on socioeconomic indicators, the major indicator that is needed to analyze poverty (namely income or consumption data) is unfortunately not often collected due to various reasons (time, cost, periodicity, etc.). Even, if they were collected, the quality of the data is often poor. Therefore, economists tend to rely more on other indicators to compensate for the absence of monetary measures. One of the indicators often used are the assets owned by households.

The question arose then how to use these assets to characterize the poor in this context? How to weight each of them? In a first attempt, many economists built a simple linear index by assigning arbitrary weights to the assets¹⁴. In a seminal paper, Filmer and Pritchett (2001) propose to construct the so-called “assets index” which could be used as a proxy for consumption or income. It is commonly agreed that their methodology follows a “scientific” approach, thus is more credible. In their case, they use a Principal Component Analysis (PCA, henceforth) to build their assets index. Since, many other economists have followed in their footsteps which we label in our dissertation, the “material” poverty approach (as opposed to the

¹² i.e. a non monetary way.

¹³ And more generally welfare.

¹⁴ For example a television is given a weight of 100, a radio 50, and so on. But this is clearly not a ‘scientific’ way to proceed, as there is no rational ground in giving such weights.

monetary one) since it is based on materials (goods and assets) owned by the households or individuals.

Because of the importance of the subject (poverty) and because the method is pretty new and original, this first part of our thesis is as said quite long as compared to the second one and has two papers which focus mainly on poverty and inequality issues and their connections with economic growth. In this part, we start by presenting a methodology of measuring non monetary (material) poverty, when a consumption or income data is not available. We show how one can obtain robust results using assets or wealth variables. Once the method is clearly tested and validated, it is then confronted to real data. We show that the index shares basically the same properties with monetary metrics and roughly scales households in the same way as does the consumption or income variables. We discuss the advantages and also the limitations of using the assets index. The important thing to bear in mind is that, once it is obtained, it could be used to rank the observational units by wealth or welfare level.

- The first chapter defines in a first section poverty and how it is usually measured (by the income metric approach). We discuss the limitations of the use of income/expenditure and what could be alternative measures. We then propose in section 2 the assets metric as a proxy for poverty measurement and test the material poverty approach on international datasets collected by the DHS program. We explore the material poverty and inequality nexus in the world and how Sub-Saharan Africa (SSA)¹⁵ compares with other regions. We show, using that index and DHS data, that poverty, at least from an assets point of view, was also decreasing in SSA as well as in other regions of the world. This result contrasts with other findings such as Ravallion and Chen (2001) or Sala-i-Martin (2002) that show that, while other regions of the world are experiencing a decline in their (monetary) poverty rates, SSA is lagging behind, with rates starting to rise over the last decade. Therefore, two different measures of welfare could yield opposite results and messages in terms of policies to implement to combat poverty. Moreover,

¹⁵ SSA countries are Benin, Burkina Faso, Central African Republic, Cameroon, Chad, Comoros, Republic of Congo, Côte d'Ivoire, Ethiopia, Gabon, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

The "rest of the world" is represented by Armenia, Bangladesh, Bolivia, Brazil, Colombia, Dominican Republic, Egypt, Guatemala, Haiti, Honduras, India, Indonesia, Kazakhstan, Kyrgyz Republic, Moldova, Morocco, Nepal, Nicaragua, Pakistan, Paraguay, Peru, Philippines, Turkey, Uzbekistan, Vietnam and Yemen.

the method we use not only allows observing changes over time for each country, but also provides a *natural* ranking among countries (from the poorest to the richest).

In this chapter, aside the measure of welfare and poverty, we also discuss in a final section the impact of demographic transition on economic growth and therefore on poverty. Indeed, demographic transition is a new phenomenon that is occurring in developing countries, especially African ones. Its negligence could lead to underestimating poverty measures (both material and monetary) by underestimating real economic growth rates. We show that changes in the composition and the size of households put an extra-pressure on the development process. While traditional authors have not considered the impact of these changes, we show that taking this into account implies higher economic growth rates than those actually observed or forecasted.

- Once the assets index approach is established and tested on international data, the question arose how it performs as compared to the monetary metric. Indeed, if monetary measures remain the reference, then our assets index should share some common properties with them. The second chapter assesses the trends in material poverty in Ghana from the assets perspective using the Core Welfare Indicators Questionnaires Surveys (CWIQ). It then compared these trends with the monetary poverty over roughly the same period. We show that the assets index could be used and yields the same consistent results as using other welfare variable (such as income, consumption or expenditure). Therefore, using two consecutive CWIQ surveys, we find that material poverty in Ghana has decreased roughly by the same magnitude as monetary one, as found in other studies by other authors such as Coulombe and McKay (2007) using Ghanaian GLSS¹⁶ consumption data. Thus, this chapter could thus be viewed as providing the proof that the material and the monetary approaches could be equivalent.

The second part of our dissertation seeks how to define and measure health and inequality in health. While the definition of health is not obvious, we propose to measure it with child mortality rates. Our main rationale in doing so is that low child mortality generates, *ceteris*

¹⁶ Ghana Living Standard Surveys.

paribus, higher life expectancy¹⁷, thus is an adequate measure of a population's health. This may not be true in areas devastated by wars, famines, and HIV and other pandemics where child mortality could be high (in this case, the best measure should be life expectancy by age groups). Also, the reader should bear in mind that in fact, child mortality could be itself is a good indicator for measuring the (success of the) economic development level of a society as a whole (Sen, 1995), mainly because in developing countries, child mortality is highly correlated to factors linked to the level of development such as access to safe water, sanitation, vaccination coverage, access to health care, etc.

- In the third chapter, we focus on measuring overall population's health. For this, we estimate child mortality in SSA and compare it to the rest of the world. We explore the determinants of child mortality using mainly a Weibull model and DHS data with socioeconomic variables¹⁸ as one of our major covariates.

The use of the assets index information is to see how these quintiles behave in a multivariate regression framework of child mortality (i.e. how they affect child mortality). We find, among others, that mother's education and access to health care and sanitation are one of the strongest predictors for child survival. Controlling for education and other factors, family's wealth and the area of residency do not really matter for child survival in SSA, contrasting with results found elsewhere.

- The fourth and last chapter answers the ultimate goal of this dissertation, that is, the scope of health inequalities in the developing world, particularly in SSA.

It uses the factor analysis (FA) method of Chapter 1 to rank household according to their economic gradient status¹⁹ and then studies inequalities in various health indicators in relation with these groups. The intention is to analyze inequality rates between rich and poor for various health variables. In this chapter, we concentrate solely on inequality issues in health and health-related infrastructures and services.

¹⁷ By construction, life expectancy at birth is highly correlated and sensitive to child mortality (it is based on child mortality rates for various cohorts). Lower child mortality rates lead to higher life expectancy and vice versa.

¹⁸ Quintiles groups derived from an assets index.

¹⁹ By grouping usually households in 5 quintiles from poorer to richer ones.

Mainly, we analyze inequality in access to sanitation infrastructures (water and electricity²⁰) and various health status and access to health indicators (such as child death, child anthropometry, medically assisted delivery and vaccination coverage) using a Gini and Marginal Gini Income Elasticity approach (GIE and MGIE, henceforth) on one hand, and the Concentration Index (CI) approach on the other.

Results show that, while almost all countries have made great efforts in improving coverage in, and access to, these indicators, almost all the gains have been captured by the better-offs of the society, especially in SSA. We extend the analysis to compare GIE estimates to those of CI and find consistent results yielding quite similar messages.

3. Contribution of this Thesis.

This thesis seeks to analyze empirically the inequality in health and access to health in SSA and how this region compared to the rest of the world. To do so, it develops a new method to characterize poor households and to analyze assets-based poverty, when the monetary measure is unavailable. Such a method is indeed necessary as almost all developing countries have collected many surveys that lack the consumption or income information.

Once a poverty measure and a correct measure of health have been found, and their core determinants clearly established, we then proceed to the health inequality analysis, along with its determinants, using two methodologies: the traditional CI and the more recent GIE approaches. These approaches have been the mostly used to explore the inequality in health and access to health these last years.

Though already studied in the literature, and sometimes applied on DHS or some groups of DHS datasets, our dissertation differs in its purpose and scope and its large scale. No paper to our knowledge used the totally to-date freely available DHS datasets to study poverty and inequality topics and provide basic statistics. Our main contribution is to shed a new light on the welfare-

²⁰ On the rationale of using electricity, see footnote 7 above.

inequality-health nexus in Africa, how it evolves over time and how it compares to other regions around the world, using all available information.

It also put numbers on various important socioeconomic indicators such as poverty, inequality, child health and mortality, access to health-related infrastructures, etc., for developing countries, especially African ones.

As we sometimes lack these important information, this thesis proves finally to be a very useful exercise.

Part I:
ASSET-BASED POVERTY METHDOLOGY

“...no society can surely be flourishing and happy, of which the far greater part of the members are poor and miserable” (Smith 1776, Book I, chap. 8).

CHAPTER 1:

ASSETS-BASED POVERTY IN AFRICA AND THE REST OF THE WORLD

Introduction.

In studying poverty, one has to respond to the following questions. What is poverty? Why is it important to study it?

Very few subjects have been so intensively debated in the economic area than the one related to poverty and corollary inequality²¹ and how they are interrelated and related to economic growth and economic development. Yet, it is difficult to define and characterize these phenomena.

There is not yet a formal economic theory of poverty according to Prof. T.W. Schultz (1965). That is, despite great efforts and tremendous advances in development economics, economists have not yet been able to find an integrated model explaining satisfactorily poverty.

If such a model does not exist, we could nonetheless infer on poverty and ways to fight it.

Before attempting to answer why it is important to study poverty, it is important to understand what it is. There lays the first difficulty: in the definition of poverty itself.

I. Poverty: Concept, Definition, Measurement.

1.1. Concepts and Definitions.

Formally, we view poverty as the state in which a given person or group of persons has not enough, in regards to some defined norm or threshold. The problem occurs of course when one attempts to define what is that norm or threshold, supposedly socially admitted.

²¹ We focus merely on poverty because it is the major issue in developing countries such as Africa. But the concept is irremediably tied to the notion of inequality, which a more general concern. A state of poverty implies an unequal society, but the converse may not be always true.

From UNCTAD (2002, p. 39)'s point of view, poverty is defined as "a situation in which a major part of the population lives at or below income levels sufficient to meet their basic needs and in which the available resources in the economy, even when equally distributed, are barely sufficient to cater for the basic needs of the population on a sustainable basis".

According to the World Bank (2000), poverty could be defined as "a state of material deprivation in income or consumption accompanied by low educational and health status, high vulnerability and exposure to risks, voicelessness and powerlessness".

The reader engaged in poverty readings will quickly realize that even before attempting to define poverty, an effort to understand the broader notion of welfare, or more precisely socioeconomic welfare, is necessary. We'll come on this later in this section.

From the various approaches used in the economic literature to characterize poverty, general traits could be derived.

First, one could assert with certainty that poverty is a relative phenomenon. We compare one group, the "poor", to another one, the "rich"²². Second, poverty is a multidimensional poverty. We are deprived in terms of food (nutrition), health, money, education, clothes, happiness, etc. Third, poverty is not a static phenomenon. Instead, it is a dynamic one. For example, analyses on poverty dynamics using panel data from Uganda (Okidi and Mugambe, 2002) and Cote d'Ivoire (Grootaert and Kanbur, 1995) show that households in extreme poverty could move out of poverty although they have a lower likelihood of doing so compared to households with consumption expenditures nearer to the poverty line. This leads to distinguish transient poverty (in which individuals experienced poverty for a short period) and chronic poverty (where poverty could span over a long period of time, even an entire lifetime).

²² Allow us to tell this anecdote. We've once asked an uncle living in our native hometown, of whom he thought could be considered as poor. He answered thoroughly "the poor is your uncle Abou living in our village. He has no television, no car and can merely afford to eat rice every day." To the same question asked to Uncle Abou in our village, we get this straight answer: "the poor is certainly Ousmane, your uncle living in Niamey town. Look at him!. He has no land, no sheep or goat and no food". From this perspective, poverty is a highly subjective phenomenon, based on values or what the society considered as valuable goods or assets.

Nowadays, there is an emerging consensus on defining poverty. It is agreed that beyond the purely monetary dimension, poverty is also characterized by the lack of good health, adequate nutrition, access to education, and even subtle characteristics such as voice and empowerment. It encompasses the individual's physical conditions as captured by consumption expenditure or income metric. Low levels of income and/or consumption expenditure impact, and are in turn impacted by, low levels of educational attainment and low health status. Poverty also encompasses the individual's social interactions and state of mental wellbeing. It also encompasses economic, social, governance perspectives, low achievements in education and health, vulnerability and exposure to risk, voicelessness and powerlessness, etc. (World Development Report, World Bank, 2000).

Poverty and inequality are, as said, multidimensional phenomena that encompass the individual's physical conditions as measured by consumption expenditure or income. Economically, the poor are not only deprived of income and resources, but also of opportunities. Markets and jobs are often difficult to access for them, because of low capabilities and geographical and social exclusion. Limited education affects their ability to get jobs and to access information that could improve the quality of their lives. Poor health, due to inadequate nutrition and health services, further limits their prospects for work and from realizing their mental and physical potential. This fragile position is exacerbated by insecurity. Living in marginal conditions with no resources to fall back on, shocks become hard or impossible to offset. The situation is worsened by the structure of societies and institutions that tend to exclude the poor from participating in decision-making over the direction of social and economic development.

All this multidimensionality is captured in participatory poverty assessments where the surveyed communities present their perceptions of what is poverty, how it impacts on their lives and what solutions can be implemented for its eradication.

These participatory assessments reveal that the low levels of health status, education attainment and assets, and limited access to basic utilities and sense of exclusion from the main stream of society can lead to a vicious circle of destitution and poverty that is difficult to emerge from (World Bank, 2000).

That is why it is not only difficult to define them (the multi-dimensionalities), but also to measure them. However, they could be approached at any level, may it be individual, household, community, region or country.

1.2. Schools of Thought.

Today, two major schools broadly exist with antagonist visions of poverty: the welfarist (or utilitarian) school, and the non-welfarist (or functionings and capabilities) school.

Defining poverty and policy implications differ whether one adopts a Welfarist and a non Welfarist angle. Both have strengths and weaknesses. Araar and Duclos (2005) provide a detailed discussion on this subject, and the two paragraphs below draw heavily on their book.

The Welfare approach to poverty is the oldest. It is tied to individuals' utility or preferences and finds its roots in classical microeconomics. Simply put, Welfarists view individuals as the best judges of the life they want to live and acting accordingly to maximize their utility and happiness, given the conditions (prices, production function, constraints, etc.) that prevail at that moment. Therefore, their actual state of welfare (poor or non poor) is the result of, and reflects those choices²³. In this approach, a person could be deemed poor in the consumption or income approach. But that person could have chosen to work and consume little. This is why he is judged poor. Nonetheless, he might have the capacity to work more and therefore be non poor. Why should we deem him poor if he is content of his actual state? Everything is thus a question of perspective. Another example is that if poverty is assessed in a happiness perspective, a rich but grumbling banker could be judged poorer than a poor but contented peasant.

The Welfarist approach of poverty is difficult to implement in practice, as it requires substantive information on revealed preferences and because it is difficult to assess utility or happiness. Preferences are heterogeneous and therefore avoid making inter-personal comparisons²⁴. These

²³ Note that the maximization process must occur in a neoclassical sense (i.e. perfect competition, free information, no externality) to make these choices pareto-efficient. These conditions are rather restrictive in the real World.

²⁴ Most economics believe that making interpersonal comparisons of economic wellbeing do not indeed make much sense.

difficulties lead Welfarists to use imperfect but objectively observable proxies for utility such as income or consumption. The working definition of poverty from the Welfarist view is thus a lack of command over income or consumption. This inadequate command is indeed one of the most important dimensions of poverty. But it is not the only one. Welfarists argue that this determines the other aspects of welfare (health, education, life expectancy, happiness, etc.).

The non Welfarist approach is more recent. It came as a criticism of characterizing welfare solely through the lens of the rather restrictive monetary metric, and precisely because utility is difficult to assess. Rather, welfare may depend on many other factors. No attempt is made in to compressing these many dimensions of welfare into a single one such as utility or happiness. Non Welfarist tenants consist mainly of two sub-schools, both derived from the influential works by Prof. Amartya K. Sen (1992): - the functionings or basic needs school and - the capabilities school.

Functionings can be understood to be the constitutive elements of wellbeing, the beings and doings each person has the right to have access to²⁵. They are in this sense slightly different of basic needs, which are the minimum physical inputs individuals need to achieve functionings. Whereas functionings are universal by definition (e.g.: to be literate, going to vacation, “appearing in public without a shame” (Adam Smith), etc.), basic needs depend on individual characteristics (Streeten et al., 1981; Richards and Leonor, 1982). In this approach, a person is judged poor if these minimal requirements are not met.

The capability approach is defined by Sen as the capacity to achieve functionings. It relays on the philosophical notion that humans are born equal and each human being has the right to enjoy substantial freedoms, notably the right to live well and in good health. A great role is given to the freedom of choice. Capabilities are in this sense the substantive freedoms a person enjoys to live the kind of life he/she values²⁶.

²⁵ They are “such elementary things as being adequately nourished, being in good health, avoiding escapable morbidity and premature mortality, etc., to more complex achievements such as being happy, having self-respect, taking part in the life of the community, and so on” (Sen, 1992, p.39).

²⁶ What is most important is the capacity of the individual to function well in the society, not the functionings actually achieved by that person per se. A person can be deemed not poor, even if he chooses not to enact some basic functionings. It is not important to know what a person has (radio, bicycle or other), nor what he actually does

The non Welfarist approach faces the same kind of criticisms as the Welfarist one. Basic needs rely on individuals' characteristics which, as utility in the welfarist approach, are heterogeneous. Likewise, on which logical grounds can we judge an individual's freedom of choice? Freedom, as utility, is an elusive quest for the economist. In fact, if Welfarists restrict welfare to the sole metric-dimension, the multidimensionality of welfare considered by the non-Welfarists is also difficult to capture in practice. What these multidimensions are? How to measure them in practice? How to combine them? What are the appropriate weights?

Welfarist and non Welfarist approaches to poverty are somewhat equivalent in the sense that, in practice, a threshold is (arbitrarily) drawn and people or groups of people that fail to attain this minimal level are deemed poor²⁷. Nowadays, the basic needs approach has gained increased popularity. Thus, a person, or a household or a country would be considered poor if it lacks a minimum level of income, education, or health status, etc. A person is poor, if he could not afford those minimum requirements.

What are the policy implications from these two views of welfare and poverty?

Imagine that a Government wants to set up a public policy. Welfarists would plea for example for providing the poor with income-generating activities or cash transfers and let them decide what to make of it (i.e. whether they want to use it to escape poverty or not). Non Welfarists would argue that this may not be sufficient, because poor individuals are not the best judges of what is good for them. They are blinded by short-run preoccupations that harm their long-term interests. Because they are poor, they won't know (i.e. they lack the basic skills on) how to use the money received. Thus, the Government must also provide them with other programs such as

with it. The most important thing in the capability theory is what he can do or achieve with it. The person can choose for instance to go to the marketplace by foot or bicycle. It is this (freedom of) choice that is most valuable in Sen's view. Only the potential matters.

²⁷ Many institutions such as the World Bank are taking middle-road approach. Welfare is approximated by income or expenditure (Welfarist vision) but the threshold is set using basic needs (non Welfarist vision) approach (for example by the cost of a representative food basket required to meet a minimum daily calories intake or by the food energy intake method).

education, trainings, publicly provided health services, sanitation, etc. In this view, the non-welfarist approach is highly paternalistic²⁸ and possibly very costly, at least in the short term²⁹.

1.3. The Importance of Poverty.

The most formal answer to the quite nagging question (that is, why to study poverty) is to be found deeply in the roots of the theory of justice³⁰. This is evident in the new found World Bank's motto "Poverty is bad for our hearts".

Is poverty a major issue in poor and rich countries alike? The answer is yes, but the situation is more dramatic in the former group. Deaton (2000) stresses out in his famous book that poverty is really more a matter of concerns in developing countries. Poverty is seen as a mark of underdevelopment and its elimination as the top development priority for governments and donor agencies³¹. Earlier, we indicate that poverty has a negative impact on some defined social or economic welfare³². Deaton, however, warns against just focusing on poverty to design development policies, but instead to focus on the broader notion of welfare³³.

²⁸ And therefore could hurt the poor's self interests.

²⁹ See Araar and Duclos (2005) for a complete discussion on the subject.

³⁰ A more general answer is that we are, first of all, human beings who care about other human beings. By definition, we are also development economists. As a person made of flesh and blood and an economist, we are entitled to study human society and how to ease its misery and improve its living conditions. Sen (1984) has a detailed discussion on the notion of "living standards". It is also a question of morale. As Professor Sen put it so rightly, economics is a "moral" science. Beyond that, we should add that it is also, more than a "human" science, a "humanist" science. It is indeed the development economist in us who lambasted so vigorously the so wide inequality in this World. How could it be that the 3 most fortunate men in the World be richer than the 47 poorest countries considered altogether? How could it be that 3% of the World population owns 60% of its resources? Investigating living conditions in developing countries, assessing the impacts of policies, seeking a solution to ease pain and sufferance in this World, these are the goals that we so passionately assigned to ourselves. On the theories of justice, we refer the reader to the chapter 4.

³¹ The World Bank's slogan "Our dream is a World free of poverty" states its top priority. The UN on its own has set the so-called MDGs which are a set of quantified objectives to be reached before 2015 and which have been quickly adopted by almost all developing countries as well as donors. The UK Department for International Development has made its goal "to eliminate poverty in poorer countries" and the German Development Agency GTZ wants "to improve the living conditions and perspectives of people in developing and transition countries" (White, 2003).

³² As welfare is multidimensional, so is poverty. These multiple aspects interact and reinforce each other.

³³ From his point of view, "poverty measures are designed to count the poor and to diagnose the extent and distribution, while social welfare functions are guides to policy. Just as the measurement of social welfare can be an inadequate guide to poverty, so are poverty measures likely to be an inadequate guide to policy" (Deaton, 2000, p. 141.)

Practically, promoting social welfare is equivalent to promoting economic welfare. The goal to promote economic welfare is intimately tied to sustained economic development. Sustained economic development itself is conditioned by sustained economic growth and a sound redistributive policy.

From the historical point of view, developed countries were those that also enjoyed the highest level of wellbeing (highest per capita income, highest education, highest health status, democracy, political freedom, etc.). Failure to provide greater wellbeing to the population could thus be viewed as an economic failure (Sen, 1981, 1984).

Conversely, an economic decline or failure would undoubtedly lead to a decline in wellbeing. This is a why each society should try its best possible to achieve the ultimate goal of welfare, and thus promote economic development and fight all the obstacles that impede it.

The focus on welfare is not new...

The Britain economist Sir Arthur Cecil Pigou (1952) stated, “the greatest economic goal of human society should be to achieve the highest level of economic wellbeing for its members. Economic wellbeing or welfare is itself part of overall welfare”³⁴. And Sen emphasized: “a concrete way to raise economic wellbeing is to raise living standards of the society” (Sen, 1984). By raising living standards, he meant providing enough (abundance or opulence view of the economic development) and equal (equity or fairness view) capabilities to the members of the society to leave a decent life.

Raising the living standards is more often seen as a right for the member of the society. This right itself is tied to the universal rights of each human being. From this point of view, a person has the right to live well, in good health, with the highest education, and free to make decisions that seem logical to him. This is a long traditional philosophical view of the ultimate goal of all human society that goes back to Adam Smith or earlier, if we consider more philosophical, non-

³⁴ On the immense literature of the social welfare function, see Bentham, Sen, Pigou, Walras, Arrow and Rawls among others.

economic point of view³⁵. An idealistic or ideological one also, since if enough could seem been hardly attainable since its based on a common agreement in the society of what it is or should be, equal seems to be even more difficult to fulfil.

Poverty, as well as its dimensions taken alone, harms these basic rights of human beings.

Its different aspects interact and reinforce one another in important ways. It prevents people to be free and reduces their wellbeing. In the new neoclassical view, summarized by the 2000 World Bank's report, this means that policies do more than simply add up. For example, increasing education not only improves wellbeing but it also leads to better health outcomes and to higher incomes. Improving health outcomes will not only improves wellbeing but also increases income and the earning potentials (World Bank's WDR, 2000).

For a long time, lack of equity and inequality has seemed to characterize human societies. Poor people, households, regions or countries have less than their richest counterparts. Worse, the degree of inequality and inequity tends to increase as the country is poorer. Indeed, developed countries have achieved through ages a remarkable reduction of inequality in their society^{36,37}.

If welfare is the key, then why focus on poverty and inequality? The reason is that poverty and inequality are one of strongest obstacles to achieve wellbeing. That justifies the greater interest they generate among economists and policy makers.

Aside the welfare and equity or justice concerns, there is also a concern for social peace³⁸.

³⁵ Aristotle's "Nation" and Plato's "Republic" deal extensively with this.

³⁶ Inequality and inequity are often seen from the income view. Sen in his paper "Income inequality and economic inequality" (1997) shows that indeed, once one considers a broader approach than income, "poor" countries or regions could do better in terms of human indicators than "rich" ones. One of the famous examples proposed in the literature has been to oppose Sri Lanka (poor) to Pakistan (rich). In our dissertation, we will discuss of inequality in terms of assets index, unless further notifications.

³⁷ But the between countries inequality seems to rise.

³⁸ Indeed, exacerbated poverty and inequality or iniquity can lead to social unrest and instability in a given society. Indeed, as the fathers of economics wrote in the eighteen century and afterwards, the King should provide for food and bread to the miserable to ensure peace and quiet in the kingdom. This is evident from French economists, who wrote tons of books to warn the King against pauperization in France. See for example M. le Bon de Gérando (1839), Marbeau (1847), SAS le Prince de Monaco (1840), M. le Baron de Morogues (1834), Fodéré (1825), Marchand (1845), Rémusat (1840), Walras (1877), etc.

For various reasons listed above, poverty eradication has become the overriding objective for the international development community since the United Nation's 1995 World Summit for Social Development. In 2000, the U.N. Millennium Assembly re-affirmed this commitment through the Millennium Development Goals (MDGs). Among its eight major goals, it endorsed the target of halving by 2015 extreme income poverty and hunger³⁹. Many development international institutions such as the World Bank also endorsed this renewed commitment. This is also perceptible at the national level, especially in developing countries. Poverty has become nowadays *the* major priority for many countries and this found its concretization with the Poverty Reduction Strategies (PRSs) that each country is producing. These PRS papers (PRSPs) diagnosed local poverty conditions in a country and solutions to combat it.

On practical grounds, it is important to have a quantitative assessment of the poverty (and inequality, and health) situation in a country and if possible over time. This would help countries and donors agencies designing effective policies for attacking poverty (World Bank, WDR 2004)⁴⁰. Policies are ineffective unless Government knows who the poor are and how they will likely respond to the policy intervention geared specifically toward helping them (Prescott and Pradham, 1997). The long-standing inattention of economists, donor institutions and governments in developing countries (particularly Africa) to poverty and to inequality in the distribution of assets (particularly the human capital ones) and income, has been costly (Birdsall and Londono, 1997)⁴¹.

³⁹ Indeed, this particular goal and the others could be criticized. Why only focus on a half portion? What about the other half? On what economic rules should we choose individuals? True, it is a first step. But meanwhile, it generates discrimination against the other half left behind. Nothing guarantees that another portion of the population won't also become poor during the process. We think the most efficient way to fight poverty is a holistic approach.

⁴⁰ The 2006 WDR came under critics in its earlier versions, because of the lack of information in the inequality situation in welfare in Africa. Data from a mimeo paper from Diallo and Wodon (2005), on which our last chapter is built upon, have been therefore used in the WDR 2006 to help filling these gaps.

⁴¹ From our opinion, inequality is inherent to the Human society. There will always be inequality. We all differ in terms of endowments and characteristics. Another source of inequality is the limited resources available to mankind. What matters the most is that inequality not being too pronounced and that its negative effects been mitigated.

It is now a fact: most economists agreed that poverty is one of the greatest challenges of our time and has become the most important goal for development and human achievement and a noble goal worth fighting for. So be it.

1.4. The Renewed Interest on “Poverty” in Economic Analysis.

For a long time, development economists, as said, have paid little attention to the problem of poverty. What were the reasons?

Early in the fifties and thereafter, the dominant, neoliberal, thought was that market-driven economic growth was the sole engine to promote development, as the expansion of the (economic) pie and opulence will improve with no doubt the living standards of people (Rosenstein-Rodan, 1943; Singer, 1952; Nurkse, 1953; Lewis, 1955, 1988; Dasgupta, 1954; Baran, 1957; Hirschman, 1958)⁴². Thus, efforts have been concentrated only on ways to achieve economic growth, and attention shifted away from socioeconomic concerns.

In the seventies and eighties, especially after the oil shock and the debt crisis, most developing countries agreed with international institutions and the Paris Club to implement tight measures aimed at promoting economic growth. These countries had to concentrate their efforts on macroeconomic policies that are believed to promote growth (including currency devaluation, budget deficit reduction, increasing fiscal taxes, opening the economy to international trade by eliminating barriers, accelerating privatization and decentralization, etc.)⁴³. While these measures have had some positive impacts, their main negative impact was to suppress the provision of many social services that are basic needs of the poor (education, health, access to safe water, sanitation, energy, etc.). This had had strong negative effects on poverty. The suppression of subsidy policy in agricultural sector that guaranteed farmers fixed prices (for instance the Caistab in Cote d’Ivoire) directly reduced the revenues of farmers (through greater

⁴² For additional references, see Sen (2005) who provided a complete discussion on the topic.

⁴³ These policies were supposed to go hand-in-hand with some “mesures d’accompagnement” that were aimed at mitigating their negative effects. But such measures have been rarely implemented. If they did, it was often long after the policy’s negative shocks have passed.

prices volatility and vulnerability effects), increasing poverty and deprivation in the developing world.

The problem with the economic growth approach to development economics is first to shift attention from other of-equal-importance dimensions such as redistribution.

Another problem consists of the choice of the tool to measure economic growth. Usually, GNP⁴⁴ (per capita)'s growth is the traditional variable used. But, as Sen (2005) emphasized, "Even though an expansion of GNP, given other things, should enhance the living conditions of people, and will typically expand the life expectancy figures of that country, there are many other variables that also influence the living conditions, and the concept of development cannot ignore the role of these other variables" (Sen, 2005).

The present thesis sought to explore these "other variables" that are hampering poverty eradication efforts, especially in SSA.

1.5. Anti-Poverty Strategies at the National and International Levels.

If poverty reduction is just about reducing the number of people under the poverty line, why this could some countries and regions, especially SSA, still face so high poverty rates?⁴⁵ Why policymakers do not take actions (such as taxes and subsidies) to reduce the number of poor? The truth is that unfortunately poverty reduction is not always a prior objective of government policies. At least, for long, it has not been. Governments make policies keeping in view a multiplicity of objectives, including personal ones. In many countries, governments knowingly

⁴⁴ Gross National Product.

⁴⁵ Despite nearly a decade of reforms in many African countries, economic growth remains fragile, and there has been little progress in reducing absolute poverty. Poverty is a matter of all countries in the World, even the developed ones (as illustrated by the recent strikes against la "vie chère" in France). However, it is a more serious problem in the developing world. Poverty in Africa is widespread and severe. In Sub-Saharan Africa 52% of people live on less than \$1 a day (in 1995 dollars adjusted for purchasing price parity). Many empirical studies show that poverty is rising in some parts of the developing world, especially Sub-Saharan Africa despite paradoxically major improvement in health, education and sanitation (Birdsall and Londono, 1997). Today, more than 1.3 billion people in developing countries are living in poverty, with less than 1 dollar per day to subsist (World Bank, 1996). The situation is particularly dramatic in SSA. Quick measures need to be taken in face of such a staggering crisis.

or unknowingly adopt policies that are biased in favour of the rich. Consequently, there is slower reduction in poverty (Kakwani and Son, 2001). Simply put, there exists a fight between classes. Richer classes that hold power, wealth and assets are not always willing to share them with others.

At a national level, poverty measurement plays an important role in public policy. It brings new insights to the policy debate by first identifying and counting the poor and assesses the effectiveness and the equity of poverty alleviation policies (if any). Defining poverty, understanding its causes, informing policy, that is the new motto of development economists. More broadly, poverty analysis can help assess (ex ante and ex post) the economic performance of a country. Has the observed economic growth been pro-poor (i.e. does it lead to a decrease in the number of poor in the country)? How did relative prices changes and taxation policies affect the poor? Are the poor suffering from trade and openness? From a social spending point of view, are the public services reaching the poor? Are they using these services? Do they benefit from Government subsidies? Will they be hurt if the Government retrenches from providing a service? How will they react if a private party takes over the Government in providing a service?

Poverty study also helps designing optimal targeting schemes (e.g.: safety nets, cash transfers, etc.) by helping to narrow errors of exclusion (type I) and inclusion (type II) through, say, a “poverty profile”. What should the target groups be for socially-improving Government interventions? How should transfers be allocated and how much impact these transfers will have on poverty? Is the poorest of the poor benefiting most from public policy?

At an international level, poverty has also become a central theme in the policy debate. This is due to two major facts. The first is the renewed attention of international donors on poverty. A sign of this could be viewed in the shift of recommendation policies of the World Bank which abandoned the long-time advocated but controversial “Structural Adjustment” for a more convenient and consensual “Poverty Reduction Strategy” (PRS). The shift is partly caused by the lack of results of the SA in developing countries that have been forced to implement it. Over decades, these countries have witnessed the withdrawal of Governments from key domains vital for the poor (such as the provision of water, electricity, and even health and education), for more

macroeconomic and liberal policies (with the assumption that market forces will correct for all the imperfections in the economy, will eliminate underemployment and foster growth). Government in many places has been replaced by private actors through a wide series of privatization. The result has been catastrophic in some countries, with a dramatic increase in the number of poor. Nowadays, the PRS process received much consensus and the majority of developing countries are in the process of implementing a PRS process.

The first step of the PRS is for each country to elaborate a PRSP, a document which is country-owned, and which will present a complete scope of poverty in the countries, along with suggestions on how to eradicate it. These PRSP have different stages (initial, interim, full), corresponding to different levels of the PRS process. Once the country reaches the completion point of the PRS, then it benefits from debt forgiveness and various interest-free aid, with the obligation to reinvest the money in domains benefiting to the poor. The second fact is the engagement of these developing countries to fulfil the MDGs, a set of target policies initiated by the United Nations (UN) that are to be met by the year 2015. As of today, as low as 190 countries have adhered to the MDGs charts.

1.6. Measuring Poverty: The Income-Metric Approach.

Since poverty is such a multidimensional phenomenon, the question arises how to adequately measure it. Two questions stand up here:

- On what economic bases or rules should we judge that person A “has more” than person B? If one bases only analysis on utility theory, a person A with low endowments than B could judge himself happier or more favoured than B. Thus, our poverty and inequality measures will be based only on quantitative measures, not utility or happiness.

- What should be the minimum level of capability acceptable for a society to judge it has attained its goals?

The most common approach consists of finding a suitable measure of living standards that captures the highest portion of the various dimensions. This is labelled the income-based metric. Amongst the most used candidates, we have income and consumption (or equivalently expenditure)⁴⁶.

We begin by focusing our attention on the income-based metric. In this metric, poverty can be approached on either a cardinal basis⁴⁷ which relies on poverty lines or an ordinal basis⁴⁸ which relies on stochastic dominance. In the first, one can say for example that poverty in region A is x% higher than in region B. In the second view, it is enough to say that poverty is higher in region A than B. As economists and policymakers usually tend to prefer seeing hard numbers put on assumptions, we follow mainly the cardinal view in our dissertation.

Once the cardinal approach has been decided, then the economist must decide whether he chooses an absolute or a relative line. The absolute line does not vary across time and space. The relative one is generally set at some proportion of income (say the mean, or the median) in each group or across time. Thus, lines may vary. Defining and constructing absolute poverty lines is the trickiest part. There is an extensive literature on poverty lines, on which we won't come back. Instead, we refer the reader to Ravallion (1998) for a survey⁴⁹.

Once one agrees on the measure of living standards, Sen (1976) provides the guidelines for assessing poverty:

- identify the poor among the population (using the line or another rule),
- construct an index of poverty using information available on the poor (this is the so-called aggregation problem).

⁴⁶ Other non-income metric candidates such as nutritional status indicators are however possible (see for example Sahn and Younger, 2004).

⁴⁷ Based on quantitative assessments.

⁴⁸ One compares the distributions of poverty for various groups.

⁴⁹ There is clear evidence that it is impossible to define a correct poverty line for any population at any time. All methods entail a significant level of arbitrariness and choices.

The first guideline involves the definition of the so-called and controversial “poverty line”, while the second involves, as well as controversial, poverty indices.

To deal with the second, Sen (1976) has proposed, among others, two major axioms:

Monotonicity Axiom: *Ceteris paribus*, a reduction in income of a person below the poverty line must increase the poverty measure.

Transfer Axiom: *Ceteris paribus*, a pure transfer of income from a person below the poverty line to anyone who is richer must increase the poverty measure.

The first axiom states that the poverty index should be sensitive to the average income among the poor. The second is often referred to as the “Dalton’s principle”. It states merely in essence that the poverty index should be sensible to the distribution of income among the poor⁵⁰.

Various other axioms have been proposed⁵¹, as well as several measures of poverty. But we’ll limit ourselves to the two above mentioned axioms, which are believed the most important.

In developing countries, consumption is conventionally viewed as the preferred welfare and poverty indicator, for practical reasons of reliability and because consumption is thought to capture better long-run welfare levels than current income. Where survey data were available on income but not on consumption, consumption was estimated by multiplying all incomes by the share of aggregate private consumption in national income, based on national accounts data. This procedure, unchanged from past exercises, scales back income to obtain consumption from past exercises but leaves the distribution unchanged⁵².

Most of the modern concepts of measuring poverty (and inequality) arise from the pioneering work of Atkinson (1970) and Sen (1976). Today, two major approaches exist to compute

⁵⁰ There is a third, less important axiom (the “Focus” Axiom) that states that the poverty index should be based solely on poor incomes.

⁵¹ Such as the Symmetry Principle, the Replication Invariance Principle, etc.

⁵² See part III of this chapter.

poverty indices: - the equally-distributed-equivalent (EDE) approach and - the poverty gap (PG) approach. We focus on the second, as it is the most widely used.

There exist many poverty (gap) indices⁵³. We've chosen in this thesis to limit ourselves to the well-known Foster-Greer-Thorbecke (FGT, 1984) class of poverty measures.

Borrowing terminology from Araar and Duclos (2005), it is better to use a quantile function to derive FGT poverty measures.

Let $p = F(y)$ be the proportion of individuals in the population who enjoy a level of income that is less than or equal to y , where $F(y)$ is the cumulative density function $F(y) \geq 0, y \in [0, \infty]$.

The quantile distribution is simply the income level below which we find a certain proportion p of the population that is poor: $Q(p) = F^{-1}(y)$. Therefore, the normalized⁵⁴ FGT indices can be written as:

$$P(y, z, \alpha) = \int_0^1 \left(\frac{g(p, y, z)}{z} \right)^\alpha dp \quad (1)$$

with $g(p, y, z) = z - Q^*(p, y, z)$ being the poverty gap and $Q^*(\bullet)$ the quantile function censored at poverty line z ⁵⁵. α could be viewed as the population's aversion to poverty.

⁵³ Such as the Head-Count index, the Normalized Deficit index, the Watts index, the Sen's index, the Clark et al. index, the Foster et al. index, the Atkinson index, the Pyatt index, the Hagenaars index, the Chakravarty index, the Shorrocks index, etc.

⁵⁴ To obtain the un-normalized indices, simply do not divide the gap by the poverty line z .

⁵⁵ We can now see the difference between the EDE and the PG approaches. In the EDE approach, the quantile function $Q^*(\bullet)$ is replaced by the EDE income $\xi^*(\bullet)$. The EDE income imposes strict conditions for the various poverty axioms, especially the Pigou-Dalton's transfer principle not to be violated and is less intuitive. Thus, most economists prefer the PG approach which is simpler, both conceptually and empirically.

For $\alpha = 0$, we have the headcount ratio H . It is simply the share of the population (the number of poor people) below the line. This measures the incidence of poverty. The formula simplifies to $\frac{M}{N}$ where M is the number of poor and N is the size sample.

$\alpha = 1$ is the poverty gap I (or deficit) (Atkinson, 1987). It gives the average distance separating the poor from the poverty line as a proportion of that line, with the non-poor being assigned a zero distance. It tells how far each poor is from the line and measures the depth of poverty, or the average shortfall of income from the line.

$\alpha = 2$ is the squared poverty gap, and is sensitive to inequality among the poor, that is, how unequal is the distribution of income amongst the poor. It is sometimes referred to as the poverty severity. It is a bit difficult-to-grasp concept⁵⁶.

The two most used indicators are H and I . The headcount H does not satisfy the two axioms above. The poverty gap I violates the transfer axiom⁵⁷. They are however accepted because they are easily understood and easy to compute.

1.7. Poverty Trends and Comparisons using the Income-Metric Approach.

Poverty analysis is part of a broader concern dealing with the analysis of living standards, which is a common measure of development analysis. The term “poverty” indeed relates to the fact that some people are “poor” in terms of some living standard measure (i.e. either they lack it or do not have enough of it, in regard of a certain socially admitted threshold). Thus studying poverty is also investigating why the development process is leaving a certain portion of the population out of its path.

⁵⁶ Higher orders of poverty exist, but are more mental constructs than of any practical utility.

⁵⁷ Sen (1976) argued that the two measures H and I capture all relevant aspects of poverty in the special case when all poor persons have the same income - that is when there is absolutely no inequality in the distribution of income amongst the poor.

As stated, it is known that the best way to design effective poverty eradication policies is to measure and analyze the characteristics and causes of poverty in a country or a region.

Beyond, it has quickly become necessary to conduct between countries (or regions) poverty comparisons across regions and over time to capture its dynamics. Comparing poverty or inequality rates across regions or countries and over time is regaining strong popularity in the context of the current globalization of the world economy.

Assessing poverty dynamics is related to whether poor people are getting “better” or “worse” over time and is relevant for policymakers, not only to assess the effectiveness of their policies, to compare them with other policies in other countries, but more importantly, to provide guidance on how to influence these tendencies.

Also important is the question whether poverty in one region of the country or the world is lower or higher than poverty in another. Thus, a redistribution policy could take place to reallocate public funds toward the most deprived regions. All these are qualitative aspects of poverty comparisons. Also important is the quantitative aspect, which deals for example with how much poverty exists, how much it has decreased between two periods, after a specific policy, etc.

Poverty comparisons aim also at providing a poverty mapping, and show evidence of “success stories” if any and how they could be adapted elsewhere where a particular socioeconomic policy has failed, taking into account local conditions⁵⁸.

It is a common belief that monetary poverty is decreasing all over the world but in Africa since the early 1980s. Using historical data, Chen and Ravallion (2001) provided new estimates (below 1 and 2 dollars per day at the 1993 PPP) and showed that monetary poverty has increased in Africa from 40% in 1980 to nearly 47% in 2001, in the one dollar a day figure, while it has

⁵⁸ There is an important literature on developed countries, such as the US (Betson and Warlick, 1998), Canada and US (Osberg 2000), European and North American countries (Osberg and Xu 2000). A major reference for the developing World is Ravallion and Chen (2001). On inequality, Milanovic (2005) showed an increase in World inequality between 1988 and 1993. The World Development Report 1990 (World Bank, 1990) in its chapter 2 offers also a poverty comparison for 22 countries using a poverty line set at \$US 370 per capita at purchasing parity power in 1985 (see Ravallion, van de Walle and Datt, 1991). While the latter studies use poverty line, Grimm et al. (2006) and Duclos and Makdissi (2004) offer the alternative approach based on stochastic dominance.

decreased in the rest of the world. These results have been confirmed by Bhalla (2002), Chen and Ravallion (2004), Berry and Serieux (2004) and Sala-i-Martin (2006)⁵⁹.

Why monetary poverty has grown in SSA? Several reasons could explain this. First, it is related as said above to policies implemented in the past decades and the lack of good governance, corruption, high fiscal evasion, high debt, low trade and economic integration which are truly part of the puzzle. The last two decades have also witnessed an increase in civil wars and unrests, and the resurgence of epidemics, especially tuberculosis and HIV/AIDS. Malaria is also still a major preoccupation that gained renewed interest these last years. Other exogenous factors such as climate could also be advanced.

At the international level, the macroeconomic context in Africa has failed to attract aid and foreign investments. The reliance on primary goods and agricultural products exposed SSA countries to price shocks and high volatility on international markets. Particularly for agricultural which provided jobs for about 80% of Africans, the continent has been the victim of price and revenue instabilities, unfair market rules and heavy subsidy of farmers in the developed countries, and the national level, poor and ineffective agricultural policies.

1.8. Limits of the Income-Metric Approach.

In theory, as said, the income or monetary metric in its essence is the best tool to assess welfare and socioeconomic status. But in practice, their usage is not free of serious shortcomings.

Indeed, many problems often arise when comparing monetary poverty measures derived from budget or consumption surveys. In studying inter-temporal comparisons of poverty and inequality, one is inevitably confronted to the problem of comparability of the surveys. Do international surveys use the same methodology (questionnaires, sampling technique, coverage and nationally representative, wellbeing and intra-household inequality indicators, variability and time period)? How to capture equivalent scales? How to measure and to aggregate preferences?

⁵⁹ Reddy and Minoiu (2007) using the same dataset and lines but under alternative assumptions found that there is an uncertainty in Chen-Ravallion and Bhalla findings. They found that poverty has in fact remained unchanged and called for deeper work to reduce uncertainties in poverty measurements.

As we can see, the income-metric has many shortcomings calling for caution in its usage. One of the greatest weaknesses in our sense is the problem of weighting individuals. More serious is the problem of prices. Indeed, prices are rarely collected, leading to the use of implicit or shadow prices (e.g.: expenditure divided by the quantity consumed) and if they were collected, the quality is often low. In developing countries, there is also a great deal of measurement errors in collecting information. Even if the quality is good, inter-spatial variations are often observed, leading to construct aggregate indicators such as the Fisher or the Paasche indexes, or the World Bank's international dollar using purchase parity powers (PPP). Different countries with different levels of development have different consumption patterns (especially the non-food component). Constructing a common poverty line to make a poverty comparison (using a common basket of goods and appropriate price index) is therefore a tremendous and hazardous adventure⁶⁰.

Even if price and budget information were available and if we solved all aforementioned problems (which is unlikely), consumption surveys are quite expensive to implement. In developing countries with severe budget constraints and limited technical capabilities, it is more advantageous to conduct quick and short surveys which simply ignore the monetary dimension but collect other useful socioeconomic information.

Indeed in using assets index as we will see in the next section, we avoid many problems such as the preferences and the heterogeneity of individuals surveyed and also the debate between "Welfarists" and "non Welfarists" tenants of wellbeing analysis. In our opinion, assets do not also face the problem of equivalent scale because they are shared by all household members (unless ones assumes for example that the TV is kept in the father's bedroom for his private use or that he is the only one allowed to ride the bicycle in the household).

With the assets index, we are defining another notion of poverty: *material* poverty.

⁶⁰ The World Bank's Purchase Parity Power (PPP) is an attempt to overcome all these difficulties, by defining an international dollar based on a common food basket to all countries in the World. But the method has come under harsh criticism by many authors. For full detail, see Islam (2005).

Truly, material poverty is an important aspect of the multidimensionality of poverty that cannot be ignored for all the reasons stated above. It is defined here as the lack of assets and amenities (sanitation and infrastructures) necessary to live a descent life. We viewed material wealth as a proxy for a long-term wealth (a form of savings), as assets are less liquid than income or consumption. In this, it might be sometimes preferable to use it in welfare studies, instead of the traditional tools used (income or consumption) which are more short-term related measures of wellbeing. The methodology is fully described in the next section.

II. Assets-Based Poverty: Application to DHS Data.

In this part of the chapter, we present the assets-based methodology of conducting a (material) poverty comparison.

2.1. The Assets Methodology.

This section attempts to investigate whether we observe the same trends as Chen and Ravallion for Africa and other regions in the world using non monetary approaches, in particular assets (or material) measures. The chapter analyzes comparable poverty and inequality measures for 56 countries in the world, based on an alternative measure of welfare, namely the assets-based metric. We follow a two-step methodology.

First, we compute a composite indicator which is a proxy for households' wellbeing. Then we compute poverty and inequality rates using standard approaches in a second step. The data come from comparable DHS surveys that lack information on expenditures or income, but allowed assets-based measures using a factor analysis (FA), a data reduction technique well described by Filmer and Pritchett (1998). We present the mathematical framework of FA in appendix A1.

Our methodology consists of pooling all the 124 surveys available for the 56 countries, and to use a common list of assets owned by households and appropriate population weights to construct an assets-based measure of wellbeing and then compute the poverty and inequality

rates, i.e. the portion of the population leaving below a certain threshold. That is, we want to have 60% of poor below the poverty line z which is set at .81 in this paper)⁶¹. The 60% poverty line is set to delimit arguably the portion of people in SSA who lack sufficient assets and means to meet their basic needs. We choose 60% because taking the average poverty rates in SSA using World Bank's data, we found that it is close to 60%.

This threshold is an absolute poverty line and is set to obtain the quantile of the distribution corresponding to a desired level of poverty. It is useful in the sense that we are trying to capture trends and more importantly, the amount of inequality in our sample. Generally, these levels come from consumption survey sources and, in this context, are meaningless on their own. Only the trends are important. They serve as reference point to compare surveys across time. The choice of the line is arbitrary and fixed a priori for one country and for only one time or period. Again, it is important to understand that it is not absolute levels per se that are important, but the dynamics or trends over time.

This method, though not widely used, is not new and is detailed for example in Asselin (2002). To make comparability across countries and time, we use exactly the same information for all countries. This way, the assets index's weights would be constructed using the same information and would therefore allow comparability. The second step is to use the obtained index from FA or PCA to calculate poverty and inequality rates and trends, as well as the dynamics of these trends.

The assets-based poverty methodology⁶² is gaining increasing popularity. It has been pioneered by a few authors.

Filmer and Pritchett (1998) are among the firsts to analyze poverty in India states using the PCA methodology. Sahn and Stifel (2000) use the method on DHS data for nine African countries through a FA. The difference with our current work is that they compute assets index separately

⁶¹ Formally, we seek whether: $P_{i,t2}(y, z) - P_{i,t1}(y, z) \gtrless P_{j,t2}(y, z) - P_{j,t1}(y, z)$ at a given line z for two groups i and j and two periods in time $t1, t2$. In this paper, the poverty line $z = .81$.

⁶² Once again, we remind that it is principally based on Principal Component Analysis (PCA) and/or Factor Analysis (FA).

for each dataset and consider country-specific lines for each. Doing so do not however allow for country comparison in our opinion. Booyesen et al. (2005) do the same study for seven African DHS countries using MCA (Multiple Components Analysis, a generalization of PCA), though they are not interested in poverty trends, but rather on its spatial distribution. A major weakness to the latter study is to apply equal weights to all datasets. Diallo and Wodon (2005) use the assets index approach in a PCA framework to assess multidimensional poverty in Ghana using two CWIQ datasets. They find that this methodology provides roughly the same results than monetary measures⁶³. The difference in Diallo and Wodon (2005) as compared to previous studies is that we are assessing poverty trends, and also we compare the assets poverty results to the monetary ones.

The current study follows in the footprints of the above studies but seeks to go fully beyond.

- First, the scope of the analysis. The study covers the complete set of freely available DHS data at the time of the thesis (124 surveys for 56 countries). In doing so, we allow for more variability in the data as some countries now possess up to 5 waves of survey. Not only we assess the trends, but we also provide a natural ranking of the countries in our sample. The challenge lays in the harmonization of the data because the variables, though sharing the same names, differ in their modalities from a survey to another and using common assets impose recoding all the variables to a uniform structure⁶⁴. Our goal is, by increasing the coverage, to see whether we would obtain the same kind of result on a larger sample as those studies that have only focused on small or single datasets⁶⁵.

- Second, we do not confine ourselves to the sole poverty analysis per se, but also to inequality and broadly to welfare analysis. We provide a profile for poverty, inequality and welfare. This allows us to assess the inter-temporal and the spatial distribution of these important social indicators. Not only we give the differences in each country and for each survey, but we've also provided poverty and inequality rates at more aggregate levels.

⁶³ See chapter 2, this thesis.

⁶⁴ Indeed, harmonization of all surveys has been of the most difficult tasks in conducting our study.

⁶⁵ One could wonder about pooling together countries with different levels of development. Assets could have different usage in each country, depending on users' set of preferences and living standard. However, if such effect existed, it should be very minor, as "developed" countries represent a very small proportion of our sample.

The second issue is why using assets index instead of consumption in our international comparison?

Primarily, DHS do not collect consumption or income information. Secondly, as said in the previous paragraph, income and consumption, though they are broader concept than assets index, have many shortcomings. Furthermore new studies questioned the economists' focus on consumption survey data and it is worth scrutinizing other dimensions of welfare and poverty such as assets ownership or access to services⁶⁶. Indeed, many countries in Africa and other developing regions have collected a wide range of surveys, sometimes repeated in the time such as WFS, DHS, MICS or CWIQ⁶⁷ that cannot be ignored in poverty analysis. It will be indeed a great waste and lost if these surveys are not used in economic research. Even though they lack information on income, expenditures and prices, they provide useful insights on other dimension of welfare and standards of living.

DHS data in general have this nice feature to avoid many of the aforementioned shortcomings⁶⁸.

The study of other dimensions of poverty would complete, we believe, the picture and our knowledge of poverty and inequality in developing countries. Finally, assets have their own utility. They mean economic security. They mean opportunity and mobility and they allow the assessment of households' vulnerability.

⁶⁶ Indeed, there is an ongoing controversy between Martin Ravallion (and more generally World Bank's economists on one side) and critics such as Bhalla and Sala-i-Martin on how to measure poverty, in assessing World poverty trends. For example, Bhalla (2003) suggests that poverty decreases on the period considered in Ravallion and Chen (2001) are higher when using national accounts. Ravallion (2003) rejects the criticism, arguing that national accounts are prone to errors. We remind the reader that Ravallion and Chen used household consumption surveys for their study. Using for our dissertation DHS datasets and the assets index approach henceforth allows us to dodge this polemical and unresolved debate.

⁶⁷ MICS (Multiple Indicators Core Surveys) are implemented by UNICEF. CWIQ (Core Welfare Indicators Questionnaires) surveys are collected by the World Bank. WFS are the World Fertility Surveys, the ancestors of DHS.

⁶⁸ Some authors such as Bocquier (1991) have pointed out strange features in DHS putting some countries data quality in question. But there is a general agreement that DHS survey is of very good quality (Sahn and Stifel, 2000).

To make comparability of the analysis of trends in poverty and inequality, we have pooled all the DHS datasets and only common assets that appear in all our datasets are used. These assets have been reformatted (recoded) so that their modalities are the same across surveys⁶⁹. In doing so, one would inevitably obtain a very few numbers of common assets. However, the obtained assets index is still robust enough to pursue the study.

Why construct a pooled assets index?

We did so because the weights of assets variables derived in individual surveys may differ over time and surveys. Consider a country with two surveys. If in the first an asset is owned by a small percent of households while it is held by a higher fraction in the second, thus, a factor analysis will put relatively more weights on the ownership of the assets in the first survey, the converse being true for the second. When factor analysis is performed on the pooled data⁷⁰, the weights reflect variation across the two surveys.

Since we do not know the assets poverty line, the only way to measure poverty trend is to arbitrarily choose a poverty line in a reference period⁷¹. This arbitrariness is inevitable. As said above, we decide to set the line at 60% for the first SSA country in our sample (Benin, 1996).

This has the advantage of avoiding the hard exercise of constructing a poverty line for each survey in our sample. The threshold chosen is consistent with the headcount rates provided by the World Bank for these countries for the study periods.

Since assets ownership is so scarce in some regions, choosing a high threshold made indeed sense (van der Berg et al., 2004, 2006). Having set an *a priori* poverty rate, we observe how

⁶⁹ For example, if access to water in dwelling is coded 11 in one survey and 12 in another, and 13 in another, the second and third surveys will be recoded 11, etc. Thus, water in dwelling will have only one code (11) for all the surveys in our sample.

⁷⁰ In pooling all country-year observations, we are making the assumption all our sample are homogenous. We follow in this many authors because of the comparability of the DHS data and thus take homogeneity as granted. We do not thus test for the homogeneity of the relationships across countries and acknowledge this potential shortcoming.

⁷¹ If possible one should choose a line to match the results of other studies (expenditure surveys) in the country at approximately the same period.

much they varied in each country over time. Rates are again comparable since the assets index has been computed on the pooled sample using common variables and weights.

2.2. Limits of the Assets Index.

Using assets is however not free of problems.

One limitation to our study is that we lack preferences in using assets instead of other monetary measures. We also lack assets prices (depreciation rates) that in principle allow discriminating among the assets and assessing their current values. This also implies that we do not observe the depreciation rate of these assets.

In ignoring preferences and more importantly price effects, we are in fact implicitly supposing that a colour TV had the same value or importance than a white and black TV. These are data limitations that cannot be dealt with in the current situation. In the future, the DHS team should try to account for these problems.

The problem of prices, which cannot be addressed here in the context of the DHS data, can be even more serious and invalidate our findings.

Suppose that the price of an item such as radio has declined so much that its ownership has increased. This would give a relatively lower weight of radio in our pooled assets index and thus reverse the direction of poverty trends, especially if the costs of many assets have decreased and their ownership increased.

However, this is difficult to test in the reality since the majority of consumption surveys does not collect assets prices. Even if assets prices are observed, and if many items' prices have declined, nothing really guaranties that assets poverty will fall since we do not *a priori* know what the relative weights will be, so that poverty could vary both ways.

We also seriously doubt that assets prices have declined much over the period under study since, as said, there have been many economic and financial crises that could have raised prices from time to time (food and non-food alike) and thus leading to a great variability in prices. Indeed, some rare surveys incorporating assets prices show that their prices have not declined much over time.

But in the reality, the truth is that we know nothing about assets prices over time. They have probably decreased but by how much? That, we do not know, even though we think the decreased is not very impressive.

2.3. Does the Choice of the Assets Index as a Measure of Living Standards Matter?

Are assets the “best” tool for measuring poverty? As we’ve seen, first we are limited by data constraints and, secondly, consumption data also have their own problems. We also highlight above some shortcomings of using assets.

Of course, since we only have the assets index as our socioeconomic status (SES) indicator, there is no great issue on the choice of the SES choice. However, when both indicators are available, which is the best tool to be considered by the researcher? Indeed, both assets and consumption carry some notion of long-term command over resources (Wagstaff et al., 2007). But the problem is that most studies find that the correlation between the two indicators is often low.

Consumption data are mostly preferred by economists because rooted in economics science. When available, it is often given priority. But as we’ve already discussed, they are difficult and expensive to collect and prone to measurement errors (see above). Assets on the contrary are cheaper, easier to collect and it is generally agreed that they are less prone to errors (Filmer and Pritchett 2001; Sahn and Stifel 2003). They are handy when consumption is unavailable.

The important question is whether assets index can yield basically the same results as consumption in analysing health inequality? If for instance assets index unveils higher

inequality rate for the health indicator under study than consumption, this can have an impact on the policy recommendations and public spending.

That is, the usage of the wrong indicator can have huge impact in terms of policy and spending.

If both SES indicators yield different results, on what ground the researcher should choose? Unfortunately, there is no theoretical ground to decide about the robustness of one indicator versus the other.

Many studies respond affirmatively to the question (of whether they carry the same message), particularly when we have enough data (Montgomery et al., 2000; Bollen et al., 2001; Sahn and Stifel, 2003; McKenzie, 2005; Wagstaff and Watanabe, 2003). That is, there is no sharp difference between the results yielded by both socioeconomic indicators. This comforts us in using that indicator. However, some studies point to the other direction (Houweling et al., 2003; Lindelow, 2006). Lindelow (2006) for example find in the case of Mozambique less inequality when using consumption rather than assets index in analysing the access to health care. Therefore, when both indicators are available, the reader should check both results to assess the sensibility of his findings to the choice of the SES indicator. Both are handy when assessing multidimensional poverty, especially a massive one.

Wagstaff et al. (2007) discuss this issue more in detail.

2.4. The Data.

We use DHS data to conduct our analysis. The DHS is a multi-country multi-year program conducted by Macro International Inc. and financed by the USAID. Its primary purpose is to analyze health, nutrition, fertility as well as population issues to assist donors and governments in these areas (Sahn and Stifel 2000). More than seventy nationally representative surveys have been implemented so far, in more than fifty countries. Each year, a new survey is added as follow-up or new survey. The coverage is expanding by the addition each year of new countries to the list, such as recently Lesotho or the Republic of Congo (Brazzaville). Some other

countries, Cambodia, Angola or the Democratic Republic of Congo are expected to be added shortly.

Effort has been made to standardize these surveys so that in most cases they are comparable. Standardization (in terms of sampling design, national coverage, etc.) is indeed one of the greatest strengths of the DHS program. In addition to the sampling design, key information are recorded using exactly the same names or codes and, in some cases, the same modalities⁷². Most sections of the survey questionnaires are indeed identical across countries, with additional sections referred to as “country-specific” modules. Thus, comparability between surveys inside and between countries becomes possible.

However, one problem of the DHS data is that they are biased toward low and middle income countries where USAID focuses its development efforts (UNFPA, 2002). We compensate this with the geographical distribution of the countries in our sample that allowed making inference for the whole world or specific regions.

The DHS program is designed for typically self-weighted national samples of 5,000 to 6,000 households. In some cases the sample sizes are considerably larger (up to 12,000 or more), and some areas are over/under sampled. Household sampling weights are used to account for over- and under-sampling in various regions within surveys. For virtually all of the countries in this study, the surveys are nationally representative. In addition to the standard set of survey instruments, country-specific questions are asked. Globally, survey errors are reported to be less than 5%, which is truly acceptable from a statistical point of view.

Countries for which we conduct the analysis are presented in the Table A1 in Annex, along with the year and the number of observations. These are all countries to which we have free access to survey data. Pooling together all the data, we obtain finally a sample of 124 observations, where each observation is country-year specific. We’ve chosen not only to take countries with two or more surveys, but also those with one survey, for two reasons.

⁷² Actually, only often the variable names are identical, but rarely their modalities. Thus, we have undertaken the painful exercise to recode these modalities for all countries to match them.

- First, to expand our sample.
- Second to obtain a full ranking of all countries in terms of assets poverty and inequality⁷³. We restrict our sample to the surveys collected after 1990 because those collected before are not of good quality.

The assets variables available in DHS surveys to conduct our analysis are: the source of drinking and non-drinking water, the time to get to water source, the type of toilet facility, whether household has electricity, radio, television, refrigerator, bicycle, motorcycle/scooter, car/truck and telephone, the main floor material, the main wall material, the main roof material, the number of rooms for sleeping, the type of cooking fuel and finally if household has a bednet for sleeping.

2.5. Poverty Trends and Comparisons using the Assets-Based Approach.

We present results in the Table A1. For comparison purposes, we also provide in this Table results for the 50% poverty line, the Sen's poverty measures with line at 60% and the median poverty rates (50% of the distribution). The following discussion is based on the headcount values. But as said, the same general tendencies apply to all other measures.

Assets poverty rates vary considerably between countries from 0% in Armenia and Turkey to 92% in Chad based on the 60% poverty line figure.

- Countries below 10% poverty rates are all either lower-middle or high-middle income ones, as expected. The only exceptions are South Africa that belongs to the high-middle class, in 1998, but this could be imputed to the apartheid effects, and Gabon (high-middle) but this could plausibly be due to high inequality in the income redistribution.

- Between 10% and 60%, we have many low-middle income countries (Philippines, Morocco, Indonesia, etc.) and some low income ones (Cote d'Ivoire, Ghana, Senegal, etc.). Some

⁷³ The implication of including a country with only one observation is to increase sample size, though obviously its observation may be less reliable. This could be contestable but we acknowledge this aspect.

classified low income countries such as Vietnam (with 15%) are performing better than many low-middle income ones (such as Indonesia with 30% or more astonishingly Namibia with a distressing 60%).

- Above 60%, all countries are low income countries.

Over the period 1990-2005, average assets poverty rate in the world is 42%, 18 points below the quantile chosen as poverty threshold. In countries which have more than one survey, there is also great variability in the rate of decrease, with some experiencing faster decrease than others. Based on the full sample, on average, the eastern part of SSA is the poorest region in the world in terms of assets possession (75%)⁷⁴, followed by South Asia (64%), the Southern part of SSA (61%), Central Africa (57%), West Africa (55%), West Asia (40%), Southeast Asia (19%), Latin America (18%), Caribbean region (17%), North Africa (6%), Central Asia (2%) and Eastern Europe (1%)⁷⁵.

There is a huge gap between African countries and South Asia (poverty around 60% or more) on one side and the rest of the world (poverty around 20% or less). Looking at development levels, we could see that low-income countries have three to four times higher poverty rates than low-middle or high-middle income countries. On the graph below, richer countries have even had a greater decrease over the last two periods than poorer ones.

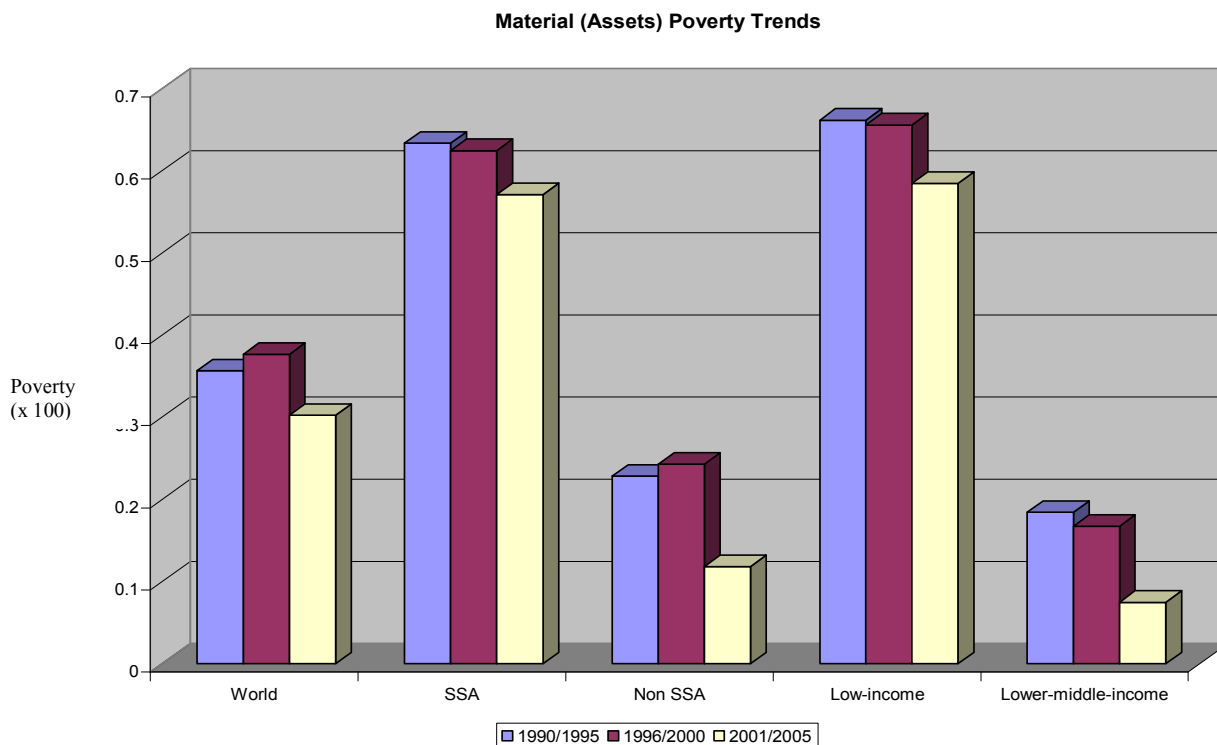
To assess the trends across world regions and make reliable comparisons, we've only considered a sub sample of those countries that have at least a survey in each of our three periods (1990-1995, 1996-2000 and 2001-2005)⁷⁶. Results are displayed in the Figure 1 below. Strong cautious is required because in doing so, we restrict our sample, and some world regions may not be adequately represented. But this was necessary to avoid biased results.

⁷⁴ That region is characterized by a very low urbanized population, and amongst the urban dwellers, a sizable proportion of informal settlements in cities.

⁷⁵ Because some regions may be under-represented, these numbers must strongly be taken with caution, unless more DHS surveys become available in each country of the World.

⁷⁶ Rates are based on a sub sample of countries that have at least one survey in each period. These countries are Burkina Faso, Cameroon, Ghana, Kenya, Madagascar, Malawi, Nigeria, Rwanda, Senegal, Tanzania and Zambia for SSA, and Bangladesh, Bolivia, Colombia, Dominican Republic, Egypt, Indonesia, Peru and Philippines for the rest of the world.

Figure 1: Assets Poverty Trends in Various Parts of the World.



Source: Author’s calculations based on DHS data.

From this sub-sample, overall, there has been a decrease in material poverty in the world (35.6% in the first period followed by a jump to 38% over the period 1996-2000, and a decrease in the last period to 30%). The same trend is observed for Africa but the sub-continent is still lagging behind the other regions, both in terms of level and decrease.

When separating the subcontinent from the rest of the world, we can see that poverty has also decreased in SSA but at a slower pace. The rates drop from 63% in the first period, to 62% in the second and 58% in the third.

For the rest of the world, figures are 23%, 24% and 12% respectively.

Comparing these trends, SSA has performed well between the first and the second period while other regions were experiencing an increase⁷⁷. In SSA, only the southern part has experienced a drawback, with Zambia facing poverty resurgence. When looking at the last period, all regions are performing well in increasing the living standards of their populations. Thus, SSA has gained 4.5 of percentage points, while the rest of the world gained 12.5 points. This is about three times the SSA performance.

Comparing these numbers with GDP per capita growth yields surprising results.

In the first period, on average the 11 SSA countries used for comparison have had a negative growth rate (-.8) while the other 8 countries representing the rest of the world have had 2.4. In the second period, numbers were 1.3 against 2.7 and in the third period, 3.5 against 2.5. One possible conclusion could be that in the period of crisis in the 1990s, African households seem to have responded to economic shocks by accumulating assets (i.e. by saving or investing their money into buying assets)⁷⁸.

Of course, one natural argument against our hypothesis is that in period of crisis, poor people usually sell their assets. But in the context of SSA, this presupposed that these households have accumulated enough assets to be able to de-save and sell them. Another possible explanation could be that people are so poor that one could not easily sell his assets (absence of market for them).

Another possible explanation could be that social networks might have played a strong role to mitigate the impact of the economic downturn, leaving assets accumulation virtually unchanged. If our “accumulation” hypothesis is true, therefore as a general rule, assets have served as strong determinants of the capacity of households to absorb unexpected shocks to income. In periods of economic growth, African households continued to accumulate assets, but at a slower pace.

⁷⁷ In fact, refining our results, we see that only Latin American countries were facing a poverty recrudescence over these two periods, this being not the case in the rest of the World. Many of them have experienced financial crises in these two periods.

⁷⁸ Even though Africa gained some points on economic growth, its poor performance over the first periods could explain its poor performance in terms of poverty reduction and health improvement.

Focusing on SSA, material poverty has decreased overtime in most of countries, but in Zambia. Thus, out of 30 countries, only one has been unsuccessful in achieving the goal of reducing material poverty. Madagascar has been the sole country to achieve the greatest absolute reduction in poverty, passing from as high as 78% in 1992 to 57% in 2004. That was a 21 percentage point reduction over 12 years (1.8 points reduction on average per year).

Let's concentrate one second on various parts of the world to see how poverty has evolved. This would provide a finer picture of the poverty situation. We provide in the following lines, several graphs (Figures 2 to 6 below) showing the trends in material poverty in each country, with poverty rates on abscises axe and years on ordinates.

In Central Africa, we only observe two countries.

Cameroon is the top leader in poverty reduction. This is not really surprising as the county serves as a model of stability and economic prosperity in the region.

On the converse, the Central African Republic is lagging far behind, due certainly to political instability and chronic rebellion, as well as decades of economic setbacks.

Overall, the region's performance is poor, but once again, we urge strong caution on such an interpretation as this could not be true, due to the under-representativeness of the sample.

In Eastern Africa, the situation is mixed.

Though under the period considered (1990-2005), poverty has on average decreased in all countries, some of them have experienced a reverse trend over the last two periods (2000-2005) where poverty rates have slightly increased.

It is worth emphasizing how our results are closed to those of van der Berg et al. (2006), for the 60% line, though they were using multiple component analysis. For example, in their paper, Tanzania's poverty rate dropped from 73% in 1992 to 70% in 1996 and to 68% in 2003. In our case, poverty in that country drops from 76% to 72% and 65% for the same years. We thus have roughly the same magnitudes of decreases, both in levels and trends.

Poor countries like Ethiopia and Uganda have done better in fighting poverty, the latter due to an impressive economic performance over the period. For Ethiopia, despite the war with Eritrea, one could argue that the country has been economically well-managed, putting aside the famine

in the East. For Uganda also, the last two decades have been an economic success, after the political instability that characterized the country in the 80s. Poverty has also decreased in the richest country, Kenya, but at a slower pace over the last period.

In Northern Africa, Egypt and Morocco have highly decreased their poverty rates. As noted in the case of the Eastern part of the continent above, poorest countries have done better.

This could be explained by the fact that poverty is already low in richer countries, so that at the margin, the gains are lower than in poor countries. By the end of 2005, Egypt has almost eradicated assets poverty, comparatively to Morocco.

In the Southern part of Africa, as expected, Madagascar, Namibia and surprisingly Zimbabwe appear to be the top performers, in terms of assets ownership. Madagascar especially has almost halved its assets poverty, passing from 78% in 1992 of poor to 69% in 1999 and to 57% in 2004. This is a 21 percentage points of gain over 12 years (1.75% of reduction per year on average).

Among poorer performers, Zambia, and to a lesser extent, Malawi, are on the top list. The situation is particularly preoccupying with poverty increasing over time in Zambia.

For the Western part of Africa as shown in the Figure 6 below, all countries have decreased poverty rates, following the general trend. Benin is among the top performers, followed by Mali and to a lesser extent Senegal and Cote d'Ivoire.

However, Niger, Guinea and Burkina Faso remain stagnant. The latter particularly is reversing the trend over the first two periods before starting a decrease, despite sound economic growth rates in the country.

Elsewhere in the world, we face the same general tendency (see Figure A1 in Annex).

In the Caribbean region, poverty is reduced, but at a slow pace, both in Dominican Republic and in the much poorer Haiti (before the recent social and economic crises along natural disasters).

In Latin America, Brazil has made an impressive progress, re-joining Colombia in the list of top performers of the zone. Guatemala and Nicaragua are also doing well, although they had high

absolute levels, as compared to others. The situation is slowing in Peru and Bolivia, the first having increased its level (due certainly to the big economic crisis in the country in earlier 1990s when private aggregate consumption declined by around 25% in real terms), before starting a decrease in the last period.

In South Asia, India is the champion, with a decrease over time, while much poorer Bangladesh and Nepal are following the same path. The situation in India is particularly interesting, as an intense debate is taking place among economists to determine whether poverty (monetary or other) has indeed decreased in this country. From our part, it is definitely a “yes”.

In Southeast Asia, Indonesia and Vietnam have made tremendous efforts to improve the living standards of their populations. The economically advanced Philippines, though witnessing also a decrease, is much slower.

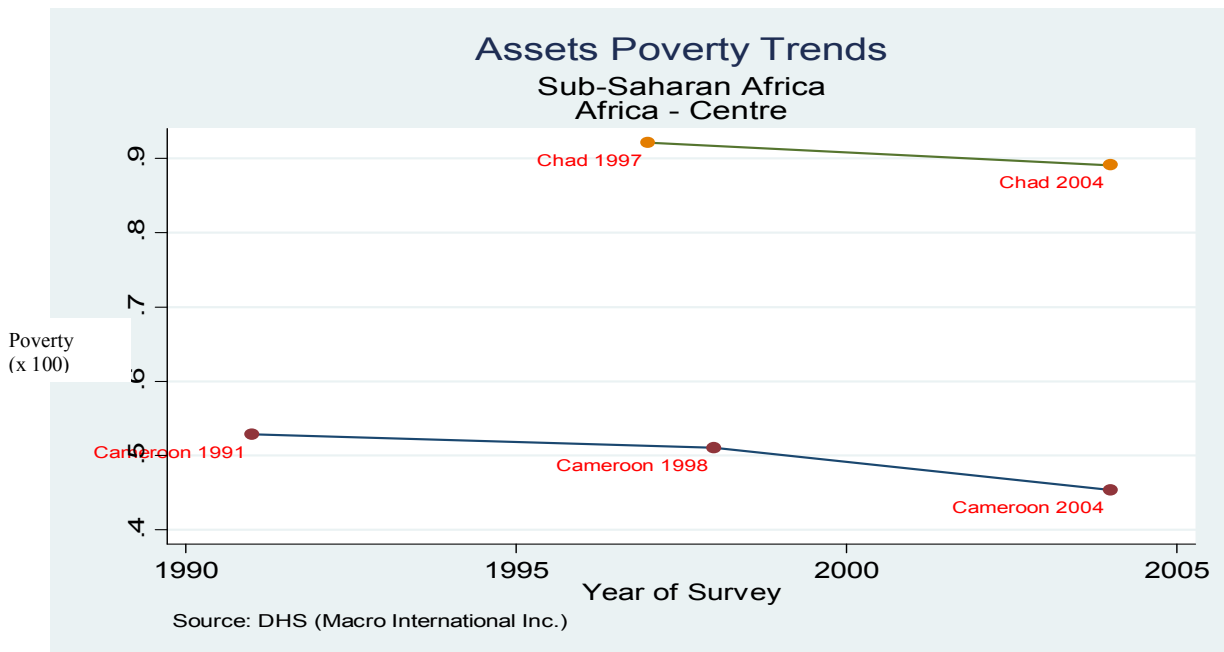
Finally, Central Asia and Europe are not well represented. Kazakhstan in the first is doing badly, while Turkey in the second is a champion.

Considering, in each country, the average annual decrease, we could see that Vietnam is the country that has achieved the highest decrease per year (3.42%) followed by Brazil (3.23%), Zimbabwe (2.31%) and Benin (2.23%). On average, assets poverty has been reduced by .95% throughout the world, almost one percent percentage point over 15 years.

Looking at other poverty measures, we had globally the same general trends (Table A1 in Annex).

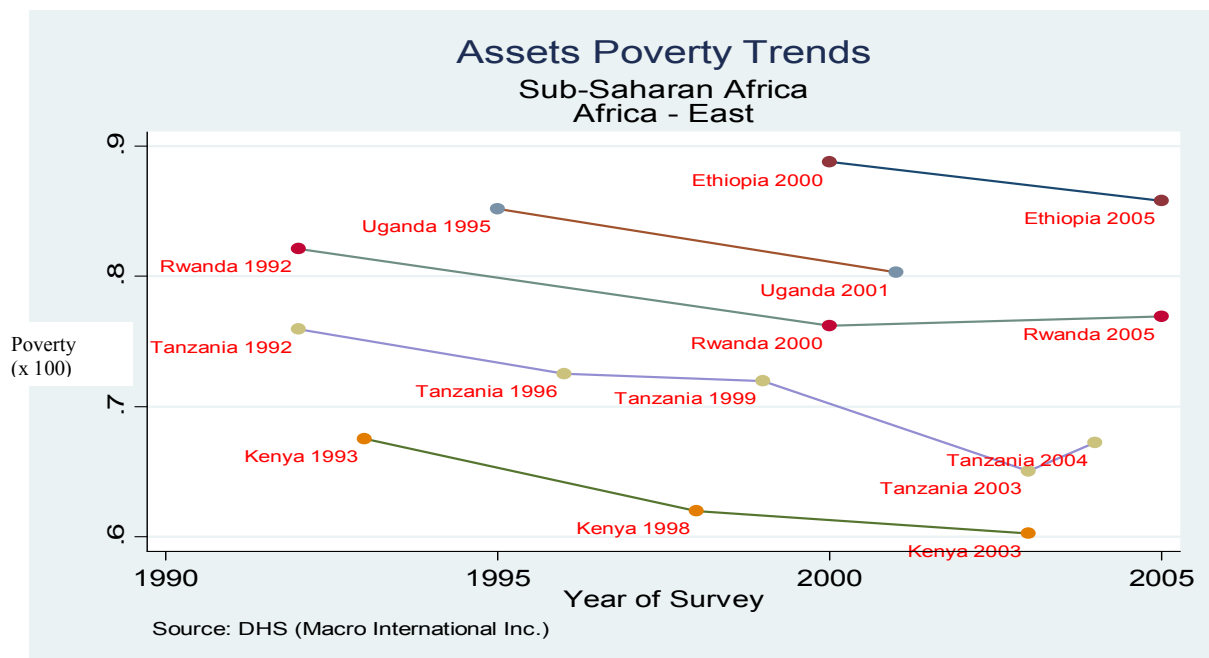
In conclusion to this section, Africa region has made remarkable efforts in fighting (assets) poverty and increasing its population's welfare. But its performance in the last period (2000-2005) remains tern when set against that of other world regions.

Figure 2: Assets Poverty Trends in Central Africa.



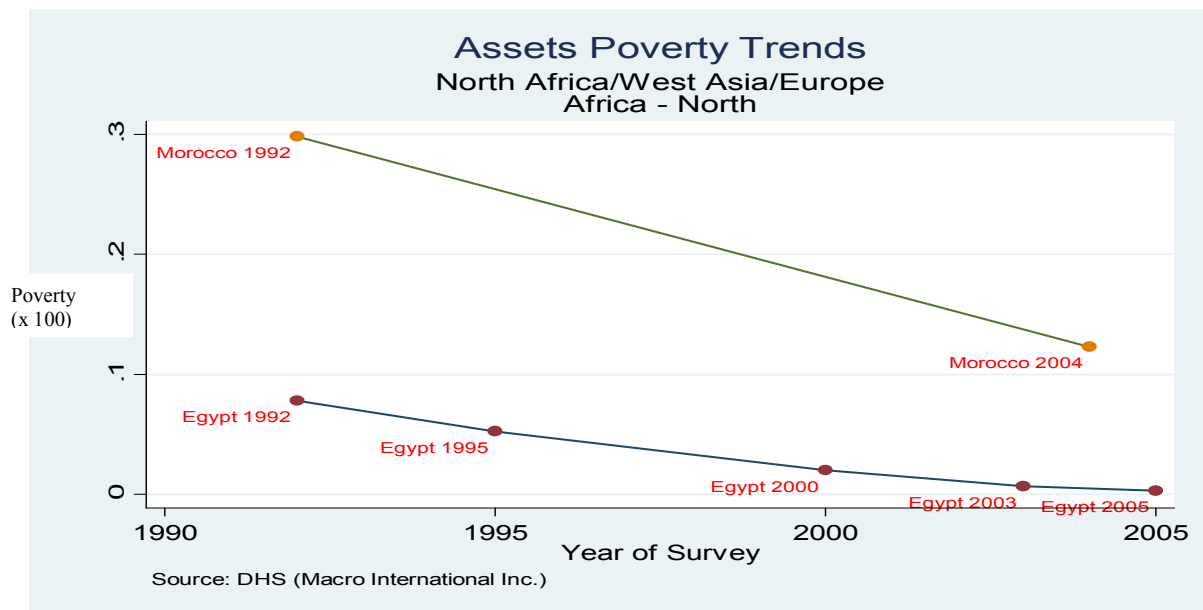
Source: Author's calculations based on DHS data.

Figure 3: Assets Poverty Trends in Eastern Africa.



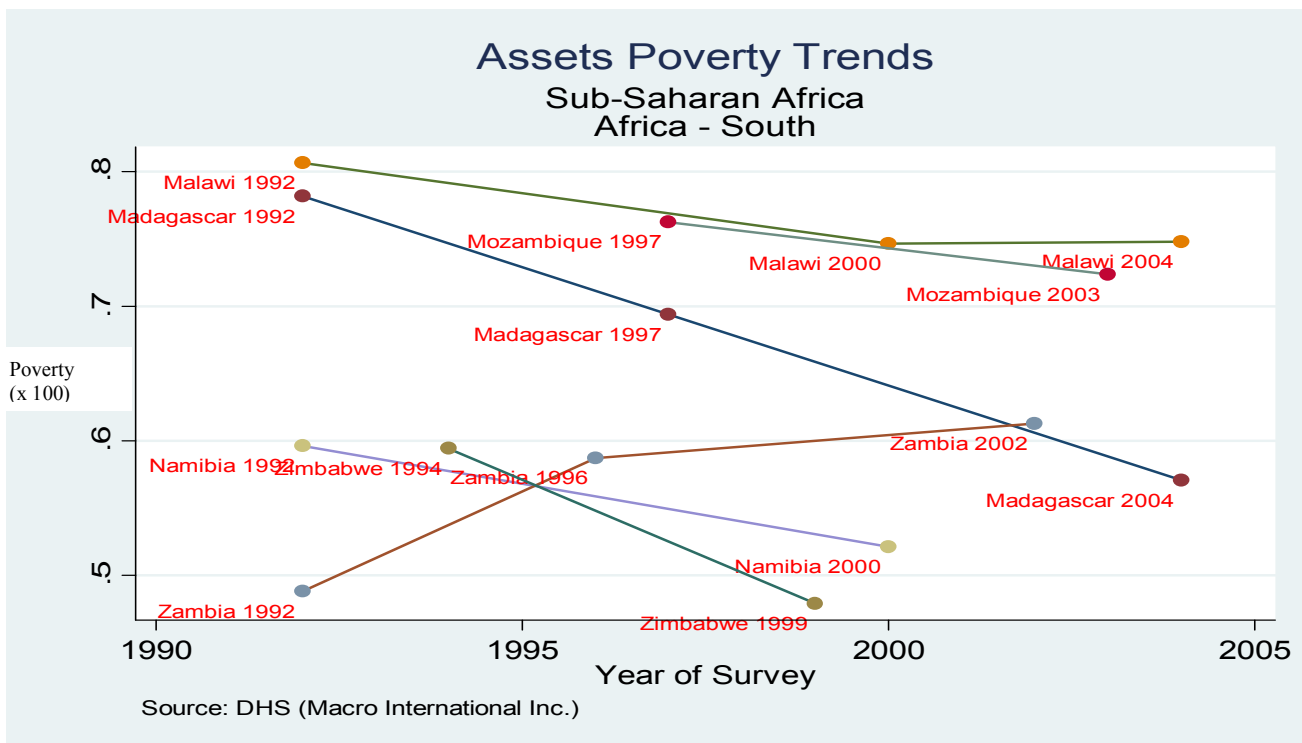
Source: Author's calculations based on DHS data.

Figure 4: Assets Poverty Trends in Northern Africa.



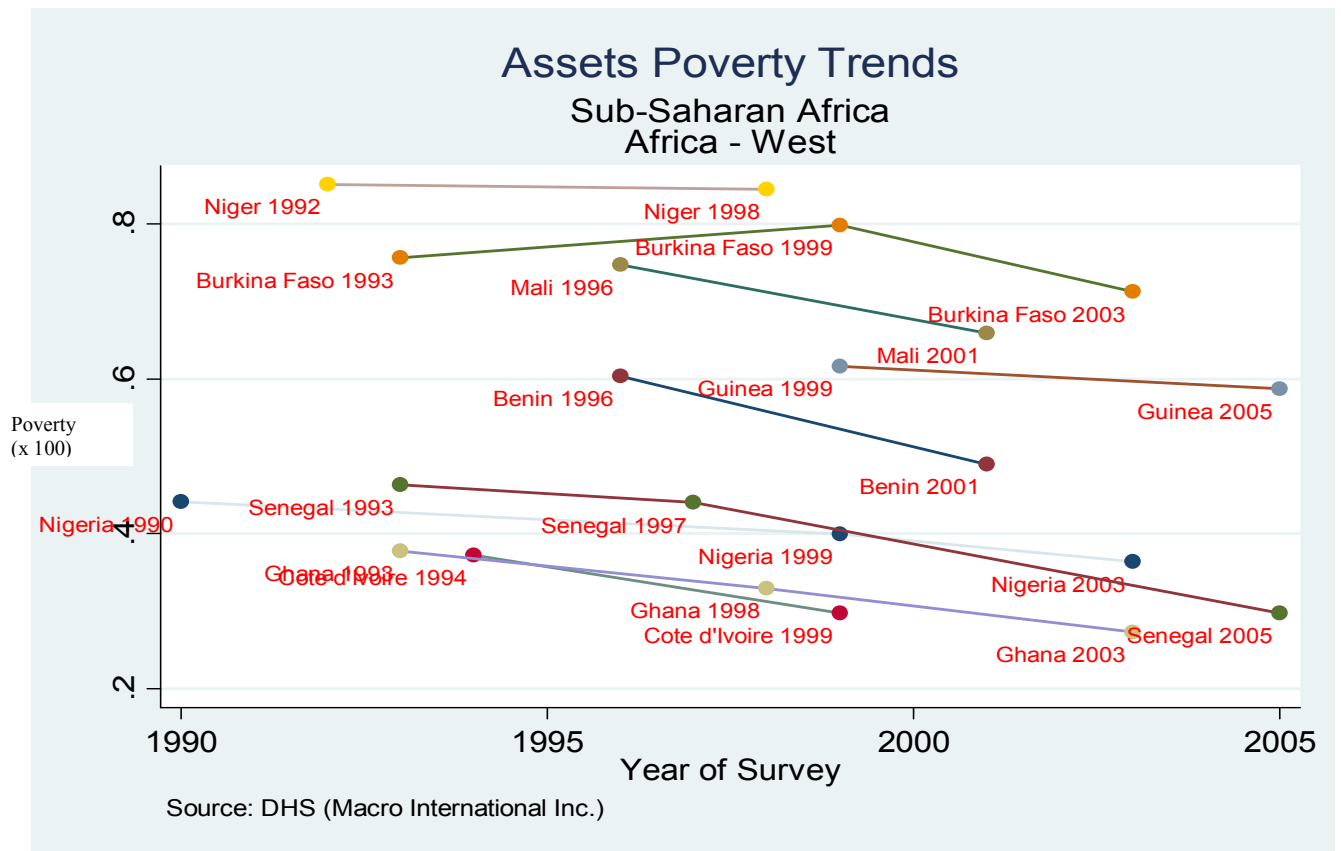
Source: Author's calculations based on DHS data.

Figure 5: Assets Poverty Trends in Southern Africa.



Source: Author's calculations based on DHS data.

Figure 6: Assets Poverty Trends in Western Africa.



Source: Author's calculations based on DHS data.

2.6. Comparing What is Comparable: Confronting our Results to Those of Chen and Ravallion.

As we stated earlier, there is one fundamental difference between our findings in the trends of material poverty in SSA region and the findings of Ravallion and Chen (2001) for the same region. We find that assets poverty is decreasing in the Sub Saharan Africa region, following worldwide trends. Ravallion and Chen (2001)⁷⁹ find on the contrary that while other regions of the world are reducing significantly monetary poverty rates, SSA is far lagging behind, with rates

⁷⁹ In fact, Chen and Ravallion started this project in 1985 with 22 countries. Since, they have tried to improve their methods. The last work to date is 2007. It is striking to note that their poverty rates varies a lot from one paper to another, casting serious doubt on the consistency of comparing so very different survey data.

increasing or at least unchanged, passing from 46% on the period 1980-1990 to 48% over 1990-1995 and 47% over 1995 and 1998⁸⁰.

To understand this apparent contradiction, the reader should realize that we are not measuring the same thing. While Chen and Ravallion are measuring consumption or expenditures, we are in fact analyzing assets ownership. The differences are highlighted in the Figure 7 below.

Let us explain very briefly the process followed by both authors. They start by examining consumption or budget survey data and construct consumption aggregates (sum of expenditures) whenever needed. Then they estimate national poverty lines, first by calculating food poverty lines and then deriving non-food poverty lines (usually based on the food poverty line). The food poverty line is often based on a representative basket to attain a daily calorie intake (usually 2400 calories/day/person) and requires observing market food prices. The surveys usually do not collect non-food prices (especially durable goods) because of their scarcity and potential errors such as recall problems. Thus non food poverty line is always assumed to be a given percentage of the food poverty line. These national poverty lines are then reweighted so that we observe the percentage of people living below 1.08 dollar a day (the 1993 PPP line).

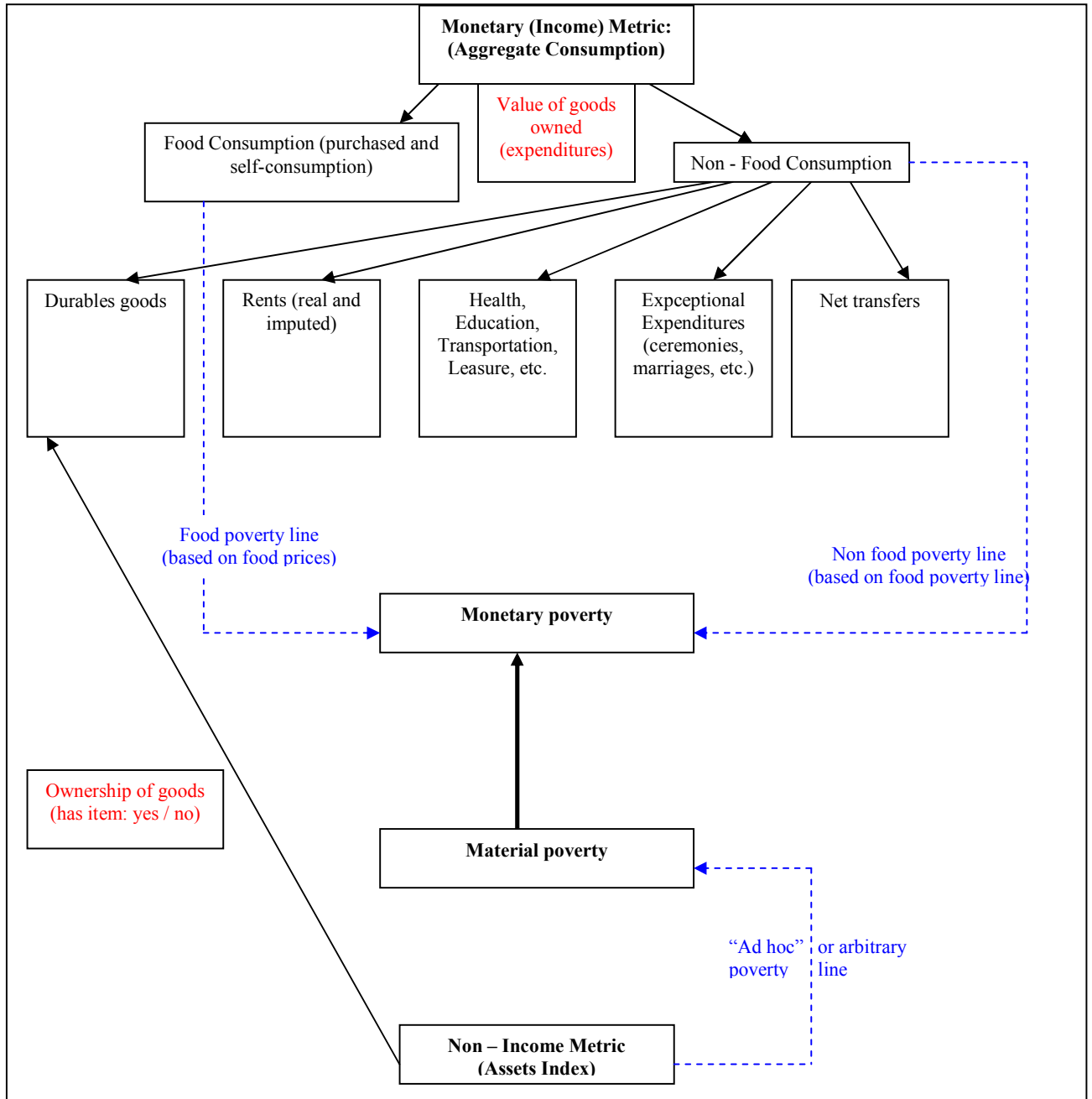
Our method is different and is extensively already described in sections above. The main difference is that we base our analysis on the assets (durable goods). In this, the monetary poverty is a much broader concept than our material poverty and it is possible to observe opposite trends in the two indicators (especially if the various components of the aggregate consumption do not vary in the same direction). The other difference is that we observe ownership of durable goods rather than expenditures on these goods.

Ravallion and Chen acknowledge in their various papers the problems with their approach: mixing consumption and income, varying calories threshold by countries, differences in recall periods, differences in survey methodology, unobserved intra-household inequality, differences

⁸⁰ According to other versions, we have a continuous increase, due to “adjustments” in their calculus. This is the sign that such an exercise is not easy task.

in food prices (sometimes collected by the survey, sometimes implicitly computed when prices are not available or sometimes provided by statistical offices), etc.

Figure 7: Monetary versus Material Poverty.



Source: Author.

Also, they are mixing long term investments such as the purchase of un-fungible or durable goods with short-term current expenditures. Finally, comparing surveys so distant in time supposes that households have not much changed their consumption behaviours; that hypothesis can be wrong and misleading. Notice finally that the PPP computation is not free of problems.

Some may argue that, as we aforementioned above, the major problem with our method is the lack of prices and preferences so that we cannot estimate depreciation rates and the true value of our assets. However, we invite the reader to remark also that assets, beyond their value, have an utility on their own (a solid but 5 years old cart will provide basically the same services to the peasant and improve his welfare than a brand new one). So we take the usage into account, rather than the actual value. On the other hand, the positive aspect is that we have truly comparable surveys.

So how to explain the apparent paradox?

- The first explication is the prices of non durable goods. Since 1990, African countries have participated more and more to the international trade. Many products, especially Chinese ones, are available on the markets at affordable prices⁸¹. Since the prices of the durables goods are not properly taken into account in computing the national poverty lines, this can lead to opposite and contradictory results.

To illustrate, let's take the example of a motorbike (with two brands: a high quality Japanese Honda and a much lower quality Dayun from China). Suppose a household bought a Honda in 1990 at one million FCFA and two Dayun in 2000 at 300000 FCFA each⁸².

In the monetary-metric, if price effects are not properly taken into account, the household will be said to be poorer (he expended 1 million FCFA in 1990 and now only 600000 FCFA in 2000)

⁸¹ We said above that we do not believe assets prices have decreased. But we believe that salaries have increased allowing households to buy more items.

⁸² We are not describing a reduction in prices but the fact that we have two different brands for the same item (motorcycle).

while in the assets-based metric, he is richer (he owned one motorbike in 1990 and now owns two motorbikes in 2000). So the first explanation is a price-effect.

- Even if prices are properly taken into account, households could increase the purchase of durables goods and lower those on other items such as marriages, health and education (if freely provided by the Government for instance), so that globally, we observe a decrease of the level of total consumption, but and increase of their durables.

- Finally, transfers from abroad are not often properly accounted for in household surveys. Many African households (even some poor ones) have sent migrants in rich countries. They receive more and more transfers (monetary usually but also more and more materials such as cars, phones, etc.) from them. Material transfers are usually not considered or registered in surveys.

Nonetheless, many recent surveys, including Ravallion and Chen (2007) recognize that welfare has improved in Africa. Their latest findings show that monetary poverty varies from 45% in 1990-1995 to 46% in 1995-2000 and 44% in 2000-2004. That is, a *little* progress.

2.7. Trends in Assets-Based Inequality.

Along with poverty rates, we also provide inequality measures. Indeed, if poverty is our main concern, it has become a tradition to accompany its analysis with some inference on inequality. This would help to further understand the extent to which inequality contributes directly to (the variations in) poverty rates. As inequality is a matter of concerns for the whole population, its fight is far more complicated than the sole poverty reduction which concerns only the poor.

Following Deaton (1997), we estimate the Theil's (1967) generalized entropy measures GE , the Atkinson measures as well as the Gini inequality coefficient G ⁸³. According to all these

⁸³ These measures have been recently applied to the analysis of the DHS datasets for 7 countries by van der Berg et al. (2006).

- The Generalized Entropy formula is:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha} \left[\frac{1}{N} \sum_{i=1}^N \left(\frac{I_i}{\bar{I}} \right)^\alpha - 1 \right]$$

$$0 \leq GE < \infty$$

where N is the sample size, I is the welfare indicator (our assets index) for each person or household i , α is the weight given to distance between I at different parts of its distribution ($\alpha \geq 0$). A value of GE equals to zero means no inequality (equal distribution of wealth). GE is sensitive to values of α . For small values of α , GE is more sensitive to changes that affect the lower tail of the distribution (i.e. the poor) and vice versa. Hence, a value of $\alpha = 0$ gives more weight to distances between assets ownership in the lower tail of the distribution, while $\alpha = 1$ assigns equal weight all across the distribution of the assets index. A value of $\alpha = 2$ put more weight to gaps for rich households in the upper tail. We discussed mainly three measures of GE measures: $GE(0)$, $GE(1)$, and $GE(2)$, respectively the mean log deviance, the Theil index and the squared coefficient of variation. Applying the values of α and Michel de l'Hopital's rule yields:

$$GE(0) = \frac{1}{N} \sum_{i=1}^N \log \frac{\mu}{I_i}$$

$$GE(1) = \frac{1}{N} \sum_{i=1}^N \frac{I_i}{\bar{I}} \log \frac{I_i}{\mu}$$

$$GE(2) = \frac{1}{2} \frac{1}{\mu} \left[\frac{1}{N} \sum_{i=1}^N (I_i - \mu)^2 \right]^{1/2}$$

$GE(0)$ is called the mean logarithm deviation and $GE(1)$ is the Theil's index. Twice $GE(2)$ yields the squared coefficient of variation CV.

- The Atkinson measures are special cases of GE indices. In this particular setting, $\alpha = 1 - \varepsilon$, $\alpha < 1$. Thus:

$$A_\alpha = 1 - \left\{ \frac{1}{n} \sum_{i=1}^n \left[\frac{y_i}{y} \right]^{1-\varepsilon} \right\}^{1/1-\varepsilon}$$

$$0 \leq A \leq 1$$

where ε is an inequality aversion parameter, $0 < \varepsilon < \infty$. The higher the value of ε the more society is concerned about inequality (Atkinson, 1970). The Atkinson measures range from 0 to 1, with zero representing no inequality and one, full inequality (one person captures all wealth).

- The Gini Index (Gini, 1912) is the second most popular after the Lorenz curve, on which it relies. It is twice the area between the Lorenz curve and the hypothetical line of perfect equality. It could be written as:

$$G = 2 \int_0^1 (p - L(p)) dp$$

$$= \frac{\text{cov}(Q(p), p)}{\mu}$$

$$0 \leq G \leq 1$$

where $L(p)$ and $Q(p)$ are respectively the Lorenz curve and the quantile values associated to a proportion p of the population. μ is the welfare variable (assets index)'s sample mean. In the discrete case, the formula simplifies to:

measures, inequality is more pronounced in SSA than in the rest of the world. Using assets index's distribution, the SSA's Lorenz curve⁸⁴ lays below that of the other regions (Figure 8).

As for the trends, results show that assets inequality is also decreasing in almost all countries, following the fall in poverty⁸⁵. The exceptions are Kazakhstan, Rwanda, Tanzania and Uganda. In these cases, the rise in inequality is probably associated with either an increase in poverty or a mild reduction in it. For Tanzania and Uganda nonetheless, there has been a marked decrease in poverty, so the explanation must be found elsewhere, perhaps in the redistribution and taxation policies in these countries.

$$G = \frac{1}{2N^2\mu} \sum_{i=1}^N \sum_{\substack{j=1 \\ i>j}}^N |I_i - I_j|$$

$$0 \leq G \leq 1$$

As for the interpretation, a value of zero means no inequality while a value of 1 means full inequality (on person holds all the pie). An increasing value of Gini thus means increasing inequality. Though relatively easy to compute and to interpret, the Gini coefficient suffers many shortcomings. Among these deficiencies, it is scale-sensitive violating (thus the second principle) and in some case it can yield the same result for very different distributions (making thus interpretation uneasy). It is more sensitive to incomes around the mean than around the tails. It also fails to satisfy the decomposability principle in the case the sub-groups vectors of income overlap (Pyatt, 1976; Fei et al., 1978; Lerman and Yitzhaki, 1991). For all these reasons, the Gini coefficient is not a GE class.

⁸⁴ The Lorenz Curve is one of the most popular inequality measures. It is a graphical tool for assessing inequality. Using the quantile function approach defined in Part I's introduction, one can write the Lorenz curve as (Araar and Duclos, 2005):

$$L(p) = \frac{\int_0^p Q(q) dq}{\int_0^1 Q(q) dq} = \frac{1}{\mu} \int_0^p Q(q) dq$$

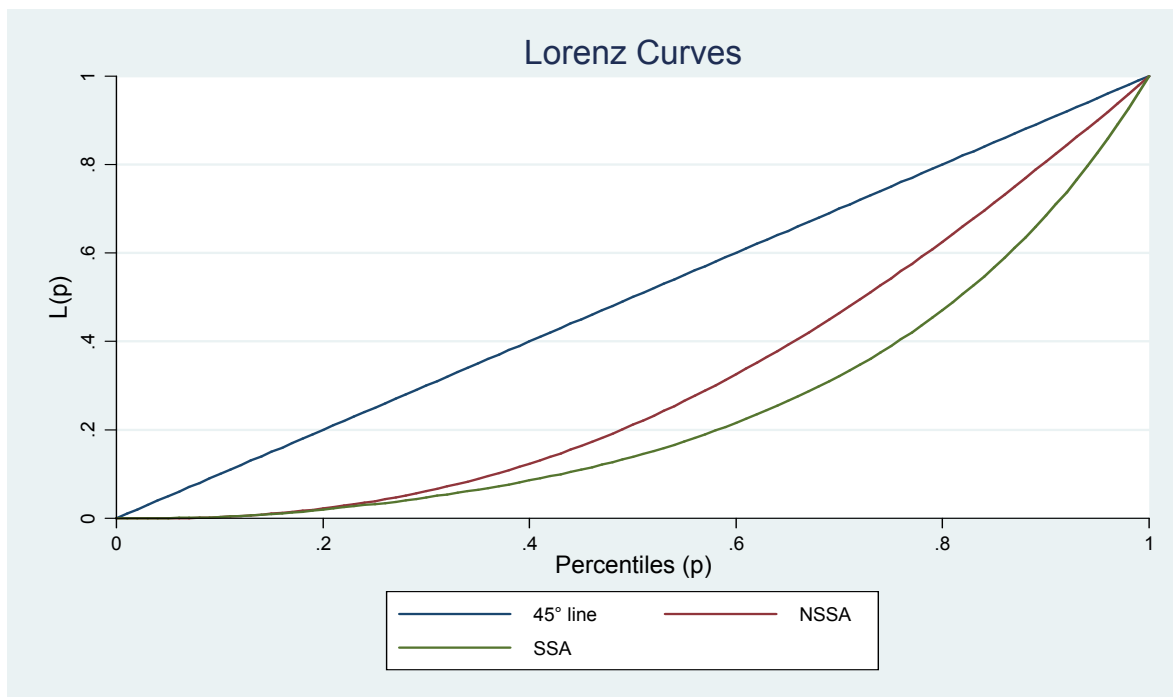
$$\frac{\partial L(p)}{\partial p} = \frac{Q(p)}{\mu} > 0$$

$$\frac{\partial^2 L(p)}{\partial p^2} = \frac{1}{\mu} \frac{\partial Q(p)}{\partial p} \geq 0$$

where $Q(p)$ is the level of the socioeconomic status indicator y below which we find an exact proportion p of the population. It is a convex function of p ⁸⁴. The numerator $\int_0^p Q(q) dq$ is the total income of the poorest p % of the population, while the denominator is the aggregate income of the total population. The Lorenz curve thus tells us which fraction of the total income is held by a fraction p of the population. If $L(.8) = .4$, then 80% of the population holds 40% of total income. If the axis is ranked from the poorest to the richest, the greater p and the smaller $L(p)$, the more unequal is the society.

⁸⁵ See Table A1 in Annex for Gini. Results for other measures are available upon request.

Figure 8: Lorenz Curve for the Assets Index.



Source: Author's calculations based on DHS data.

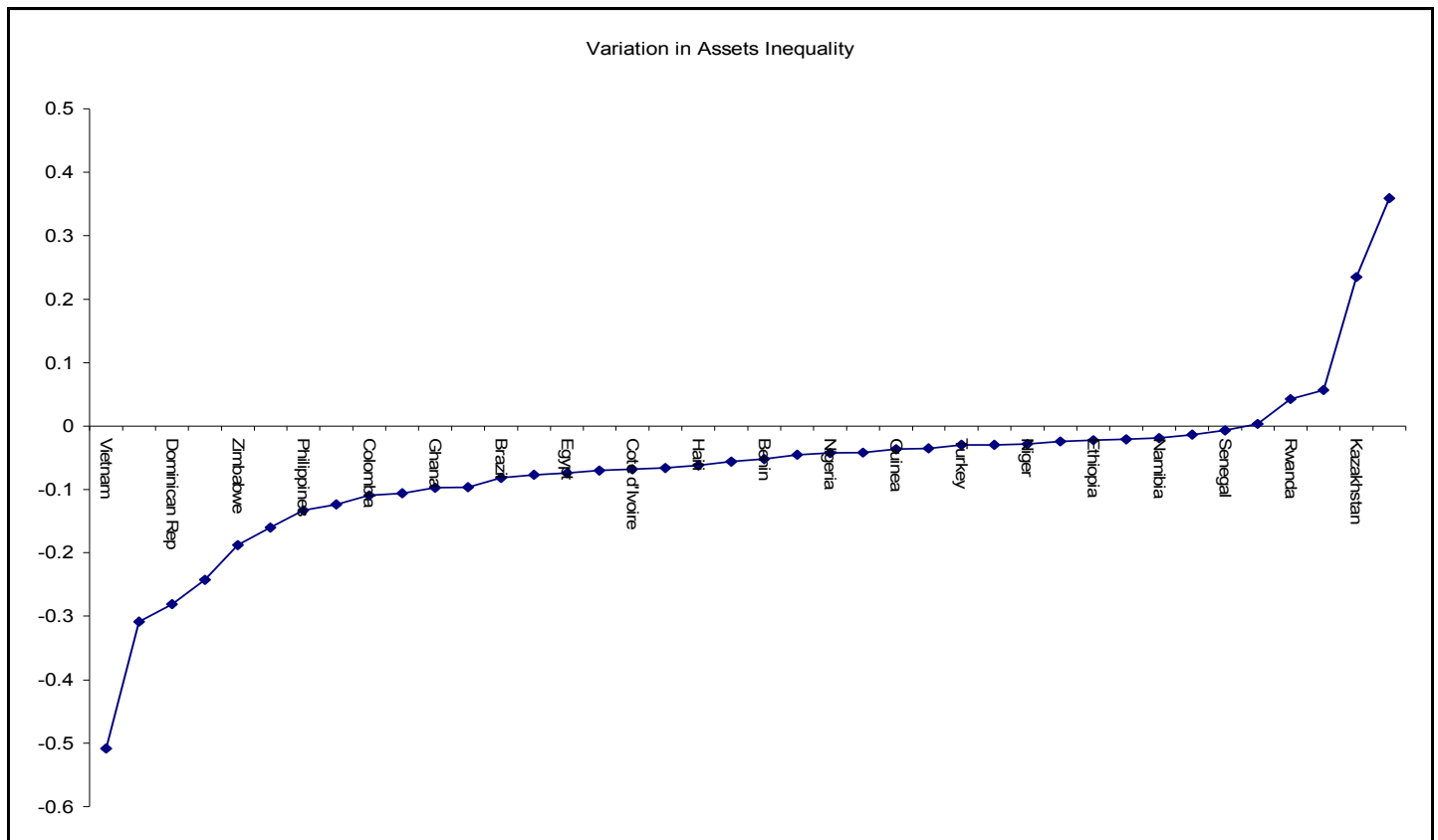
Armenia and Bangladesh are the countries with exceptionally low inequality (less than 10). Between 10 and 40 of inequality levels, we have countries that differ in terms of development level (e.g. Benin and Burkina Faso in SSA, Colombia in Latin America, Egypt in the MENA⁸⁶ region and Indonesia in South Asia). Above 40, inequality is considered high. Extremes are found in Vietnam, Yemen, Zambia and Zimbabwe, well far above 60.

When looking at annual average decrease, Vietnam is once again the country that has achieved the highest drop in assets inequality (as it did for poverty rates), followed surprisingly by Chad, the Dominican Republic and Bangladesh. Kazakhstan and Zambia are among the most unequal countries, according to Figure 9 below. Thus, this chapter confirms the overall decrease in (assets-based) inequality worldwide as found in other papers (Milanovic, 2002; van der Berg et al., 2006; Chen et al., 1994).

Again, due to under-representativeness issues, we urge strong cautious in comparing results.

⁸⁶ Middle-East and North Africa.

Figure 9: Trends in Assets Inequality (Gini) in the World: 1990-2005.



Source: Author's calculations based on DHS data.

There is also at this point a fact that could invalidate the decrease in assets inequality. It is the price-effect already discussed above in the case of material poverty. If the heterogeneity of the prices of an asset has decreased over time, inequality might have risen in reality even though it seems to have declined in the assets data. We acknowledge this possibility and invite the reader to bear this in mind.

As usual, we perform also between and within group decomposition for inequality, assuming no migration or sharing effects.

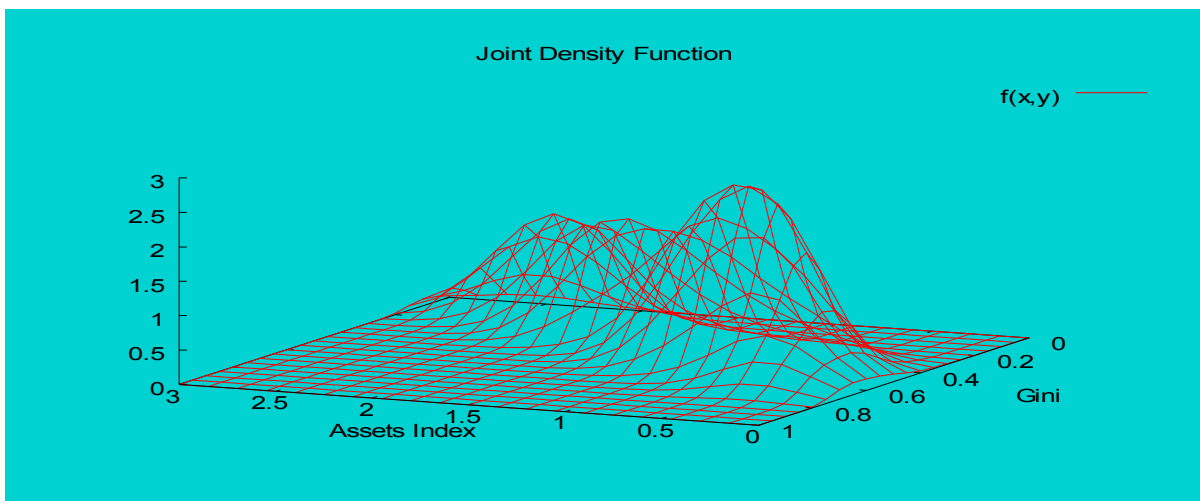
Between groups inequality is the inequality calculated on the total population when each household's assets index in a group is replaced by its mean in that group. It reflects therefore the mean differences across the groups, when inequality has been eliminated in each group.

Within group inequality is a population weighted sum of the inequalities calculated for each of the groups. Inequality is computed for each subgroup, then, it is multiplied by the group's population share, and thus aggregated over all groups. It thus reflects the inequality that exists on top mean difference across groups. In essence, it tells us what inequality would be, if there were no difference in the mean assets index between groups.

When decomposing Gini and other inequality measures, it seems that the variation in inequality is due more to within group inequality than between group one (Table 1 below). In fact, depending on the inequality indicator, the within or between groups effects are taking over. For Theil's measures, the within effect is higher, while for Atkinson and Gini measures, the between effects dominate, so that no clear conclusion could be derived.

It also seems to us worth looking at the joint distribution of poverty and inequality. We analyze this using the STATA software to compute the kernel densities and the GNUPLOT program to plot the 3-D graph (Figure 10). Looking closely, we can see that high inequality is associated with the lower tail of the assets index's distribution. Thus, the lower the assets index level, the higher the poverty and the higher the inequality.

Figure 10: Joint Density Estimation for Poverty and Welfare.



Source: Author's calculations based on DHS data.

Table 1: Decomposing Inequality Trends.

	GE(-1)	GE(0)	GE(1)	GE(2)	A(0.5)	A(1)	A(2)	Gini
Within-Group								
Country	17.30	0.52	0.21	0.18	0.12	0.27	0.70	0.015
Country-Year	17.29	0.52	0.21	0.17	0.12	0.26	0.66	0.006
Language	17.40	0.60	0.27	0.23	0.16	0.37	0.86	0.103
Zone	17.39	0.58	0.26	0.22	0.15	0.36	0.84	0.102
Sub-Zone	17.35	0.55	0.24	0.20	0.13	0.30	0.78	0.044
Time Period	17.46	0.65	0.33	0.30	0.19	0.47	0.97	0.174
Area of residency	17.34	0.54	0.22	0.17	0.12	0.28	0.85	0.147
Development Level	17.36	0.56	0.25	0.21	0.14	0.32	0.82	0.170
Between-Group								
Country	0.16	0.14	0.12	0.12	0.09	0.29	0.91	0.278
Country-Year	0.17	0.14	0.13	0.13	0.09	0.30	0.92	0.282
Language	0.06	0.06	0.06	0.07	0.05	0.17	0.80	0.178
Zone	0.07	0.07	0.07	0.08	0.05	0.19	0.82	0.206
Sub-Zone	0.11	0.10	0.10	0.10	0.07	0.26	0.88	0.248
Time Period	0.00	0.00	0.00	0.00	0.00	0.02	0.12	0.211
Area of residency	0.12	0.12	0.12	0.12	0.09	0.27	0.81	0.040
Development Level	0.09	0.09	0.09	0.09	0.07	0.24	0.85	0.240

Source: Author's calculations based on DHS data. Note: Gini decomposition is based on Pyatt's decomposition (Pyatt, 1976).

Overlaps effects for the Gini decomposition not shown. GE () General Entropy measures. A() Atkinson measure.

III. The Impact of Demographic Transition on Growth and Poverty⁸⁷.

3.1. The Importance of Demographic Transition in Economic Development and Poverty Reduction Strategies.

In this section, we discuss how demographic transition could undermine economic growth and therefore the fight against poverty.

Most economists believe in the existence of economies of scale in household consumption, as demonstrated by the widespread use of equivalence scales when measuring consumption or income per equivalent adult. In fact, there is a lively debate on the magnitude of these

⁸⁷ This section is based on a paper with Quentin Wodon submitted to Demographic Research. An applied version to infrastructures' investments needs has been published in Economics Bulletin.

economies of scales, on the way to measure them, and on how to use them in empirical work (see among many others, Deaton and Mullbeauer, 1980; Deaton, 1986; Buhmann et al., 1987; Gronau 1988; Coulter et al., 1992a, 1992b; Jenkins and Lambert, 1993; Dagum and Ferrari, 2004).

Yet in the indicators used by many developing countries to measure their progress toward development, as well as in the official benchmarks used for monitoring development at a global level, the use of GDP, income or consumption data per capita as opposed to per equivalent adult remains the norm. This is the case for example with the Human Development Index (HDI), which includes as one of its components an index based on GDP per capita. It is also the case of global poverty monitoring under the MDGs framework, where poverty measurement remains based on the estimation of measures of consumption or income per capita.

The use of income or consumption per capita data to track welfare or poverty is problematic at a time when many developing countries are experiencing a demographic transition to smaller household sizes. This demographic transition is itself due to a range factors, including lower rates of fertility, urbanization, the adoption of nuclear as opposed to extended family structures, and the impact of HIV/AIDS. A number of consequences from the demographic transition have been identified, some positive (such as better quality due to more investment in each child, an improvement of overall population's health, etc.), others negative (example, population aging). See Lee (2003) for a full survey.

Yet the link between the demographic transition and the higher needs of household members due to the loss in economies of scale does not appear to have been discussed much. If there are economies of scale in consumption, and if developing countries are going through a demographic transition reducing household sizes, then using measures of wellbeing based on consumption or income per capita lead to an over-estimation of the gains in wellbeing from growth, as well as an over-estimation of poverty reduction from past growth or future assumed rates of growth^{88, 89}.

⁸⁸ The use of the sole GDP per equivalent adult to characterize welfare may seem too restrictive. Also, there may be other factors associated with welfare, such as the quality of children resulting from the demographic transition. If quality is preferred to quantity, thus households experiencing small size may see their utility increasing rather than decreasing, if economies of scale are not important. Our hypothesis here is that quality effects are rather low in early stages of economic development where children are desired mostly for their contribution to household's income and/or served as replacement for the deceased ones. Even if a child quality bias may exist, it will be very

Consider for example the fact that in many developing countries preparing and implementing PRS, projections of GDP growth rates are routinely used to estimate how poverty could change over time under alternative macroeconomic scenarios.

In large part due to limitations in the data available, this is often done in a rather *ad hoc* fashion by relying on a number of strong assumptions. Estimates of the growth in GDP per capita are obtained by subtracting the rate of growth of the population from the rate of growth in real GDP. Then, it is assumed that growth in GDP per capita translates into an identical level of growth in consumption per person, the indicator used for poverty measurement. Next, in the absence of data on the distributional impact of alternative policies and scenarios, it is often assumed that inequality measures will remain unchanged over time. In addition it is assumed that alternative macroeconomic scenarios do not affect the relative prices of various goods, so that the composition of the poverty line is not affected.

These many assumptions enable the analyst to simply scale up the vector of household consumption per person (or per equivalent adult) from the latest household survey available by the cumulative growth rate in real per capita GDP in order to what estimate future social welfare will be, and how poverty will increase or decrease, using the same baseline poverty line. Inequality remains unchanged in these simulations since all household consumption levels have been raised proportionately.

While the above methodology is crude, it is fairly widely used because it is transparent, simple to implement and it is believed that it does provide a rough an idea of what can reasonably be expected for in terms of improvements in social welfare and poverty reduction under alternative growth rates. In this simple approach, the population growth rate is basically the only parameter affecting social welfare and poverty over time once growth and the distribution of income or consumption in the base period are known and accounted for.

hard to measure it without an adequate survey. GDP per capita or per equivalent adult is just a simple and convenient tool and is most often used as a measure of welfare.

⁸⁹ The growth it will be question about in this section is the predicted or forecasted growth, not the realized one. As the two tend to be usually close, demographic transition is also of equal importance for the later.

For any given rate of real GDP growth, a lower population growth rate leads to a higher growth in GDP per capita, and thereby to a higher assumed growth rate in the consumption level of households. This in turns leads to a higher level of social welfare, and a lower level of poverty. And vice versa.

Because of this simple relationship, it is often argued that a lower rate of population growth would help to increase welfare and reduce poverty, particularly in SSA countries that have high rates of fertility and face serious food security issues.

The issue with which we are concerned here relates to the relationship between the demographic transitions that many countries are experiencing, and the impact of GDP growth on the level of wellbeing in these countries. Under returns to scale in consumption, the demographic transition leads not only to smaller fertility and population growth rates, but also to smaller household sizes.

This in turn implies that the needs of a typical person in the country are increasing over time (because the benefits from large household sizes are being reduced).

Thus, a positive level of real GDP growth is required to simply keep social welfare and poverty measures unchanged if there are economies of scale in consumption and a reduction in household size, *ceteris paribus*. We show in this paper that the required rate of growth to offset the demographic transition in household size is non-trivial, simply because in many countries the reduction in household size is large.

3.2. Growth and Equivalent Income: a Hypothetical Example.

Returns to scale have implication for the impact of GDP growth on mean income, social welfare and poverty among populations undergoing a demographic transition with a decrease in household size.

Consider a society with a number of households of different sizes. Following standard practice in the literature on economies of scale, the number of equivalent adults $e(n)$ in each household depends on household size n , with $e(n) \leq n$ for all n , except for $n = 1$ where $e(1) = 1$. We also assume that $0 < e'(n) < 1$ and $e''(n) > 0$, where e' and e'' are the first and second derivatives. This implies that $e(n)/n$ is a decreasing function of n .

One of the frequently used functional forms for equivalence scales is (Atkinson et al., 1995; Buhmann et al., 1987):

$$e(n) = n^\beta, \text{ with } 0 \leq \beta \leq 1. \quad (2)$$

where β is the elasticity of income w.r.t. family size. It is sometimes termed the scale relativity parameter and expresses the economies of scale in the household (Jenkins et al., 1992). It takes into account the age structure in the family and the costs associated to each individual in the household. It is thus the relative weight of each individual in the household.

The equivalent income thus is expressed in terms of per equivalent adult:

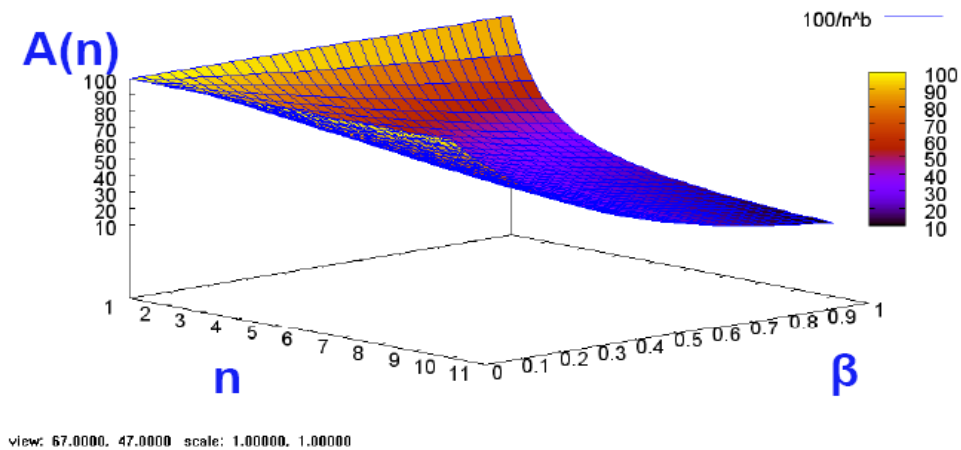
$$A(n) = Y / e(n) = Y / n^\beta \quad (3)$$

Assuming a nominal household income of 100, Table 2 below provides the equivalent consumption or income of households of different size under alternative values for β ⁹⁰. A smaller value of β implies smaller economies of scale, and thereby a lower level of income per equivalent adult among households with several members. For example, with $\beta = 0.5$, a household of size 5 has a level of income per equivalent adult of 44.7 ($=100/5^{0.5}$), versus 40.8 ($=100/6^{0.5}$) for a household of size 6. Alternatively, if a household of size 6 has a nominal income of 100 and an income per equivalent adult of 40.8, a household of size 5 would need to

⁹⁰ A more rigorous work should be to estimate β for each country, but this requires extensive budget-based household surveys information that were not available to us.

have a nominal income of 91.3 in order to be at the same level of welfare since $91.3 = (40.8/44.7) * 100$.

A graphical plot using the MAXIMA program shows that the higher the household size and the economies of scale, the lower the equivalent welfare level associated.



Now, assume that in a given country, the mean household size has been reduced from 6 to 5 over time. In order to keep things simple, also assume that all households are of the same size, and that the total population in the two periods has remained constant, at 30 people overall. Then, in period one, we have 5 households with 6 members each in the country, while in period two, we have 6 households with 5 members each.

In period one, total income in the country is 500 (five households with 6 members each and a nominal income of 100, and an income per equivalent adult of 40.8). In period two, each household of size 5 needs a nominal income of 91.3 in order to have the same welfare level as in period one. But there are now six households of size 5, so that the total required income to keep welfare constant is 547.7. The required real growth required to keep welfare constant under this demographic transition is 9.54 percent. This is the value provided in the second panel of Table 2 for this demographic transition under $\beta = 0.5$. A smaller value of β implies a larger required

growth rate, and similarly, the further advanced the demographic transition (the smaller the household size), the larger the required growth rate.

If apart from undergoing a demographic transition, a country also has a growing population, then the required growth rate is even larger. For example, with a 15 percent cumulative population growth rate between periods one and two, the required growth rate of GDP per capita required to keep welfare constant due to the decrease in household size will be 15 percent higher than the required growth rate provided in the Table 2 under a constant population. With a transition from households of size 6 to households of size 5 and with $\beta = 0.5$, this means that the cumulative required growth rate per capita will be 10.98 percent (=9.54 percent times 1.15) if the country's population has increased by 15 percent between the two periods under review.

Given that in many developing countries, especially in SSA, real GDP growth is rather weak and the demographic transition is well underway, the required growth rates needed to offset the potential negative impact on welfare through the loss in economies of scale due to smaller household sizes may not be trivial.

3.3. Change in Household Size and Implication for Economic Growth.

Table 3 provides the average household sizes observed for 40 countries between the mid 1990s and the early 2000s. The estimates are based on the unit level data DHS.

The DHS data come from countries for which access is freely granted by Macro International Inc. and for which we have at least two surveys over time (when we have more than two surveys, we use the earliest and latest surveys for the estimation). In most countries, household sizes have decreased between surveys, as expected. Consider for example the first two countries. In Burkina Faso, the average household size has decreased from 6.65 in 1993 to 6.47 in 2003. The decrease in Benin is larger, from 5.99 in 1996 to 5.18 in 2001. The per capita GDP is provided for information only. The cumulative population growth index is obtained from the World Bank's WDI. Over ten years separating the two surveys in Burkina Faso the country's population increased by 34 percent. For Benin, over five years, the increase was at 16 percent.

The last column in the Table 3 provides the annual population growth rate for each country between the two surveys. In Table 3, there has been an increase in household size for a few countries (this could happen for example if a country experiences hard times, so that households have to combine forces to cope with a degradation in their living conditions; other reasons may also lead to larger household sizes over time, even if fertility is decreasing), but these are rather exceptions.

The detailed Table A3 in the Appendix provides the required GDP growth needed to offset the impact of change in household size over time, in order to keep welfare constant. For simplicity, we estimated the required growth rates using average household sizes, rather than reporting the changes in the share of the population with different household sizes over time, and using a weighted average of these shares and changes in order to estimate the required growth rate.

Consider again the case of the first two countries in the Table A3 with estimates obtained under a value of $\beta = 0.5$. In Burkina Faso, taking into account the increase in the population observed between the two surveys, the cumulative growth rate needed in order to offset the impact of a smaller household size over time is 1.89 percent, which implies that on an annual basis, a growth rate of 0.19 percent was needed in order to offset the impact of smaller household sizes over time. This is considerable if one knows how difficult it is for a Government to boost growth rate by a tiny percentage. For Benin, the corresponding value is a required annual rate of real GDP growth of 1.69 percent, which is very large, and due to the fact that household sizes according to the DHS data available were reduced rapidly in a short period of time (Benin had indeed apparently one of the largest decreases in household sizes in the sample).

Table 2: Growth and Income per Equivalent Adult: a Hypothetical Example.

	$\beta = 0$	$\beta = 0.1$	$\beta = 0.2$	$\beta = 0.3$	$\beta = 0.4$	$\beta = 0.5$	$\beta = 0.6$	$\beta = 0.7$	$\beta = 0.8$	$\beta = 0.9$	$\beta = 1$
Level of wellbeing for a household of size N with a nominal income of 100											
Household size 1	100	100	100	100	100	100	100	100	100	100	100
Household size 2	100	93.303	87.055	81.225	75.786	70.711	65.975	61.557	57.435	53.589	50
Household size 3	100	89.596	80.274	71.922	64.439	57.735	51.728	46.346	41.524	37.204	33.333
Household size 4	100	87.055	75.786	65.975	57.435	50	43.528	37.893	32.988	28.717	25
Household size 5	100	85.134	72.478	61.703	52.531	44.721	38.073	32.413	27.595	23.492	20
Household size 6	100	83.596	69.883	58.419	48.836	40.825	34.128	28.530	23.849	19.937	16.667
Household size 7	100	82.317	67.761	55.779	45.916	37.796	31.113	25.611	21.082	17.354	14.286
Household size 8	100	81.225	65.975	53.589	43.528	35.355	28.717	23.326	18.946	15.389	12.5
Household size 9	100	80.274	64.439	51.728	41.524	33.333	26.758	21.480	17.243	13.841	11.111
Household size 10	100	79.433	63.096	50.119	39.811	31.623	25.119	19.953	15.849	12.589	10
Equivalent household nominal income											
Household size 1	100	93.303	87.055	81.225	75.786	70.711	65.975	61.557	57.435	53.589	50
Household size 2	100	96.026	92.211	88.547	85.028	81.650	78.405	75.290	72.298	69.425	66.667
Household size 3	100	97.164	94.409	91.731	89.13	86.603	84.147	81.760	79.442	77.189	75
Household size 4	100	97.793	95.635	93.525	91.461	89.443	87.469	85.539	83.651	81.805	80
Household size 5	100	98.193	96.419	94.677	92.967	91.287	89.638	88.018	86.428	84.867	83.333
Household size 6	100	98.470	96.964	95.481	94.02	92.582	91.166	89.771	88.398	87.046	85.714
Household size 7	100	98.674	97.365	96.073	94.799	93.541	92.301	91.076	89.868	88.676	87.5
Household size 8	100	98.829	97.672	96.528	95.398	94.281	93.177	92.086	91.008	89.942	88.889
Household size 9	100	98.952	97.915	96.889	95.873	94.868	93.874	92.890	91.917	90.953	90
Required growth rate to keep mean consumption constant without population growth											
Size 2 to 1	100	86.607	74.110	62.45	51.572	41.421	31.951	23.114	14.870	7.177	0
Size 3 to 2	50	44.040	38.316	32.82	27.542	22.474	17.608	12.935	8.447	4.138	0
Size 4 to 3	33.333	29.552	25.878	22.309	18.84	15.470	12.196	9.014	5.922	2.919	0

Size 5 to 4	25	22.242	19.544	16.906	14.326	11.803	9.336	6.923	4.564	2.257	0
Size 6 to 5	20	17.832	15.703	13.613	11.56	9.545	7.565	5.622	3.714	1.840	0
Size 7 to 6	16.667	14.882	13.125	11.394	9.69	8.012	6.360	4.733	3.131	1.553	0
Size 8 to 7	14.286	12.770	11.274	9.798	8.342	6.904	5.486	4.087	2.707	1.344	0
Size 9 to 8	12.5	11.183	9.881	8.594	7.323	6.066	4.824	3.597	2.384	1.185	0
Size 10 to 9	11.111	9.947	8.794	7.654	6.526	5.409	4.304	3.211	2.130	1.059	0
Required growth rate to keep mean consumption constant with 15 percent population growth											
Size 2 to 1	115	99.598	85.227	71.818	59.307	47.635	36.743	26.582	17.100	8.254	0
Size 3 to 2	57.5	50.646	44.064	37.743	31.674	25.846	20.249	14.875	9.714	4.759	0
Size 4 to 3	38.333	33.985	29.760	25.655	21.666	17.791	14.025	10.366	6.811	3.356	0
Size 5 to 4	28.750	25.578	22.476	19.442	16.475	13.574	10.737	7.962	5.249	2.595	0
Size 6 to 5	23	20.507	18.059	15.655	13.294	10.976	8.700	6.465	4.271	2.116	0
Size 7 to 6	19.167	17.114	15.093	13.103	11.144	9.214	7.314	5.443	3.601	1.786	0
Size 8 to 7	16.429	14.685	12.965	11.268	9.593	7.940	6.309	4.700	3.113	1.546	0
Size 9 to 8	14.375	12.860	11.363	9.883	8.421	6.976	5.548	4.136	2.741	1.363	0
Size 10 to 9	12.778	11.439	10.113	8.802	7.505	6.221	4.950	3.693	2.449	1.218	0

Source: Authors' calculations.

Table 3: Population Growth and Average Household Size.

Country	DHS survey year	Population	Average household size	GDP per capita (constant 2000 US\$)	Cumulative population growth index (base = 1.00)	Annual population growth (%)
Burkina Faso	1993	9299056	6.65	214.59		
	2003	12417649	6.47	246.60	1.34	2.93%
Benin	1996	6398470	5.99	286.70		
	2001	7425465	5.18	318.85	1.16	3.02%
Cote d'Ivoire	1994	14338732	6.21	579.42		
	1999	16382824	6.17	658.40	1.14	2.70%
Cameroon	1991	11982233	5.59	705.86		
	2004	16037746	4.76	736.71	1.34	2.27%
Ethiopia	2000	64298000	4.82	122.01		
	2005	71256000	5.03	140.59	1.11	2.08%
Ghana	1993	16826814	3.76	222.62		
	2003	21211860	4.03	268.81	1.26	2.34%
Guinea	1999	8260931	6.62	369.73		
	2005	9402098	6.09	384.02	1.14	2.18%
Kenya	1993	25737392	4.79	414.22		
	2003	32733766	4.35	418.00	1.27	2.43%
Madagascar	1992	12763361	5.17	242.56		
	2004	18112724	4.62	229.06	1.42	2.96%
Mali	1996	10423839	5.60	186.38		
	2001	11993751	5.32	226.42	1.15	2.85%
Malawi	1992	9819300	4.46	127.55		
	2004	12608271	4.38	153.58	1.28	2.11%
Mozambique	1997	16747151	4.62	182.68		
	2003	19052198	4.85	261.72	1.14	2.17%
Nigeria	1990	90557312	6.28	357.51		
	2003	125912256	4.97	387.30	1.39	2.57%
Niger	1992	9017953	6.27	160.13		
	1998	10997018	5.93	166.82	1.22	3.36%
Namibia	1992	1503056	6.00	1745.43		
	2000	1894436	5.05	1801.88	1.26	2.94%
Rwanda	1992	6391335	4.97	287.70		
	2005	9037690	4.57	257.79	1.41	2.70%
Senegal	1993	8656856	8.83	377.32		
	2005	11658172	8.69	478.41	1.35	2.51%
Chad	1997	7469206	5.33	175.06		

	2004	9447944	5.35	260.67	1.26	3.41%
Tanzania	1992	28106800	5.31	248.44		
	2004	37626916	4.87	314.20	1.34	2.46%
Uganda	1995	20892272	4.75	206.65		
	2001	25110890	4.80	247.68	1.20	3.11%
Zambia	1992	8856117	5.61	335.82		
	2002	11101816	5.24	316.02	1.25	2.29%
Zimbabwe	1994	11608500	4.67	614.80		
	1999	12475708	4.19	643.96	1.07	1.45%
Egypt	1992	57915908	5.63	1197.97		
	2005	74032880	4.88	1661.95	1.28	1.91%
Morocco	1992	24929848	6.02	1099.42		
	2004	29823706	5.35	1348.59	1.20	1.50%
Indonesia	1991	181320352	4.63	655.72		
	2003	214674160	4.32	872.36	1.18	1.42%
Philippines	1993	65450296	5.33	869.26		
	2003	80166344	4.81	1044.65	1.22	2.05%
Vietnam	1997	75460000	4.72	349.10		
	2002	80423992	4.40	443.66	1.07	1.28%
Bolivia	1994	7315414	4.50	926.04		
	2003	8835246	4.22	1019.69	1.21	2.12%
Brazil	1991	151857600	4.75	3079.66		
	1996	163819248	4.08	3376.81	1.08	1.53%
Colombia	1990	34969640	4.62	1869.41		
	2005	45600244	4.11	2173.88	1.30	1.79%
Dominican Republic	1991	7209699	4.60	1548.30		
	2002	8513900	3.92	2511.81	1.18	1.52%
Guatemala	1995	9970367	5.25	1593.93		
	1999	10910275	5.27	1706.52	1.09	2.28%
Haiti	1995	7391265	5.01	446.19		
	2000	7938791	4.69	468.06	1.07	1.44%
Nicaragua	1998	4765647	5.52	741.28		
	2001	5059290	5.29	801.08	1.06	2.01%
Peru	1992	22597344	5.25	1620.81		
	2004	27562392	4.33	2206.33	1.22	1.67%
Kazakhstan	1995	15815626	3.81	1022.93		
	1999	14928426	3.60	1115.95	0.94	-1.43%
Turkey	1993	59491000	4.51	2723.61		
	1998	65157000	4.31	2989.40	1.10	1.84%
Bangladesh	1994	113945872	5.44	294.86		
	2004	139214528	4.96	401.35	1.22	2.02%

Nepal	1996	22226052	5.51	205.55		
	2001	24975144	5.29	232.14	1.12	2.36%
India	1993	899329024	5.66	334.73		
	1999	999016000	5.38	444.08	1.11	1.77%

Source: Authors' estimation using DHS data. Population data are from the World Bank's database.

To summarize these results, it appears that the more household size is reduced, the more this has a cost in terms of additional growth rate.

In countries where household size has increased (or have mildly increased), the net effect is to come into subtraction, instead of additional, to the growth rate, because the households numbers have decreased and thus less is needed to satisfy them.

The average value across the whole sample of countries for the annual rate of real GDP growth required in order to offset the impact on welfare of the reduction in household size is given in the Table 4 for various values of β .

For example, the required growth rate is 0.53 percent per year if $\beta = 0.5$. Clearly, if economies of scale within household are substantial, the growth required to offset the decrease in household size is thus far from trivial.

Table 4: Average Value of Required GDP Growth Needed to Offset Changes in Household Size.

	Beta values										
	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Annual growth needed without pop. growth	0.90	0.81	0.72	0.63	0.54	0.45	0.36	0.27	0.18	0.09	0.00
Annual growth needed with pop. growth	1.06	0.95	0.85	0.74	0.64	0.53	0.42	0.32	0.21	0.11	0.00

Source: Authors' estimation using DHS data. Population data are from the World Bank's database.

Conclusion.

Using DHS data and pooled factor analysis, we showed in this paper that SSA, at least from assets-based metric point of view, is not lagging behind other regions, in terms of material poverty or inequality. Indeed, following worldwide trends, poverty and inequality rates are falling in the Sub-Continent. This contrasts with the findings of other

authors who empirically demonstrated that poverty and inequality (in its monetary form) are increasing in Africa, while dropping elsewhere. Africa region has made tremendous efforts in fighting poverty and increase its population's welfare. But its performance in the period 2000-2005 remains gloom when compared to that of other world regions.

This paper has provided further evidence that the assets index is a good proxy for welfare. Indeed, as welfare is multidimensional, and as income-based metric faces too problems and shortcomings, studies using this new metric could provide good and consistent results of welfare analysis.

Assets seem to serve as a replacement for savings, especially in SSA. To be coherent with the results found in the monetary metric cases such as in Ravallion and Chen, assets poverty should also rise during periods of economic crisis. Indeed, in these times, poor households should normally sell their assets, thus de-saving. But our results tended to imply the converse, that is, assets poverty decreases while monetary one increases. Does it mean that African households absorb economic shocks by saving their revenues in the purchase of durable goods? It is tempting to answer yes to that question. Do they have other strategies that forbid them to sell their goods, say through social solidarity? What are these alternate strategies? Truly, there is a paradox here that calls for deeper investigation. To validate such an assertion (that is, African households buy more assets during crisis), one needs a panel datasets containing both monetary measures of welfare (expenditures, consumption and/or income) and assets, notably productive ones. More specifically, a clear connection must be established between non productive and productive assets (such as tractors, hoes, carts, etc.) on one hand⁹¹, and on the other, between assets and monetary measures. Unfortunately, we do not have productive assets in our DHS datasets such as agricultural tools or land. A future study on other surveys could try to see if we obtain robust results with this kind of goods, and if they are related to the assets used in this paper. If such is the case, then an economic policy geared at providing greater access to assets (especially the productive ones) and durable goods

⁹¹ More generally, the user should care about goods that are truly owned and goods that are borrowed or subject to debts.

(through taxes, redistribution and investments in infrastructures) could enhance the welfare of people.

After demonstrating that assets matter for poverty evaluation, we then turn to another phenomenon that could potentially hamper economic development: demographic transition.

Indeed, despite widespread belief in economies of scale in household consumption, the assessment of trends in wellbeing and household purchasing power in developing countries are often based on trends in real GDP or consumption per capita rather than per equivalent adult. Yet under economies of scale and a demographic transition toward smaller household sizes, some level of real GDP growth per capita is required to simply keep mean income or consumption per equivalent adult constant. Said differently, wellbeing is likely to decrease over time with smaller household sizes if real GDP per capita remains constant. The importance of a decrease in household size is also overlooked when assessing the potential impact of growth on poverty, leading to an overestimation of the reduction in poverty obtained from growth.

This paper has provided estimates of the reduction in household size that is taking place in developing countries and of the level of GDP growth that is required to offset the impact of this reduction on welfare under various assumptions regarding economies of scale in household consumption. The empirical results suggest that the magnitude of the effect of the decline in household size on household welfare is far from being trivial.

We have focused only on the negative effects of the economies of scale of the demographic transition. We did not consider possible positive effects such as better quality of children due to small household size. Indeed, such positive effects can be substantial, and even counter-balance the negative ones that are described in this paper. For instance, one could complicate equation (2) above by imposing an explicit household demographic structure and take into account preferences for child quality. Another

simplification was to assume average household sizes instead of real values. The same applies for the betas which are arbitrary. This is left for future research.

CHAPTER 2: CONFRONTING ASSETS AND MONETARY POVERTY RATES IN GHANA⁹².

Introduction.

In Chapter 1, we developed the assets-based methodology and tested it on the world using all available DHS data. Results show that material poverty is decreasing on average in all world regions.

In this chapter, we redo the analysis on another set of data (Ghanaian CWIQ surveys) and compare the results with the monetary metric to test the robustness of our assets method.

Ghana has long been considered a star performer in SSA. Beginning with the presidency of Rawlings and aided by external support, Ghana embarked on a series of economic reforms in 1983. The focus of the reform package was initially on macroeconomic stabilization through fiscal, monetary and foreign exchange liberalization in the initial phase of reforms (see among others Roe et al., 1992; Kraus, 1991; IMF, 1991; Ahiakpor, 1991). Following a successful macroeconomic stabilization, the focus of reforms shifted toward structural adjustment measures to accelerate growth with sustained poverty reduction. Ghana during much of the 1990s had one of the strongest growth rates amongst Sub-Saharan countries, and poverty was reduced accordingly (Coulombe and McKay, 2007). However, GDP growth rates receded slightly in the late 1990s, before rebounding after 2002. But despite the positive growth rates, the country remains poor according to a range of social indicators. A large share of the adult population remains illiterate, and infant and child mortality remain high, as does the maternal mortality rate which is one of the highest in the world (WHO, 2004; UNICEF, 2004). The threat of

⁹² This chapter is based on a previous paper with Quentin Wodon that serves as a basis for a book by editors Coulombe and Wodon on Poverty and Growth in Ghana (reference in bibliography).

AIDS epidemic remains endemic. In 2003, 30,000 are reported to have died from the disease (UNAIDS, 2005).

The last consumption-based poverty measures for Ghana are based on the 1997-1999 Ghana Living Standards Survey (GLSS 4). A new survey with data on consumption has been implemented in 2008, but is not accessible to us at the time of the study.

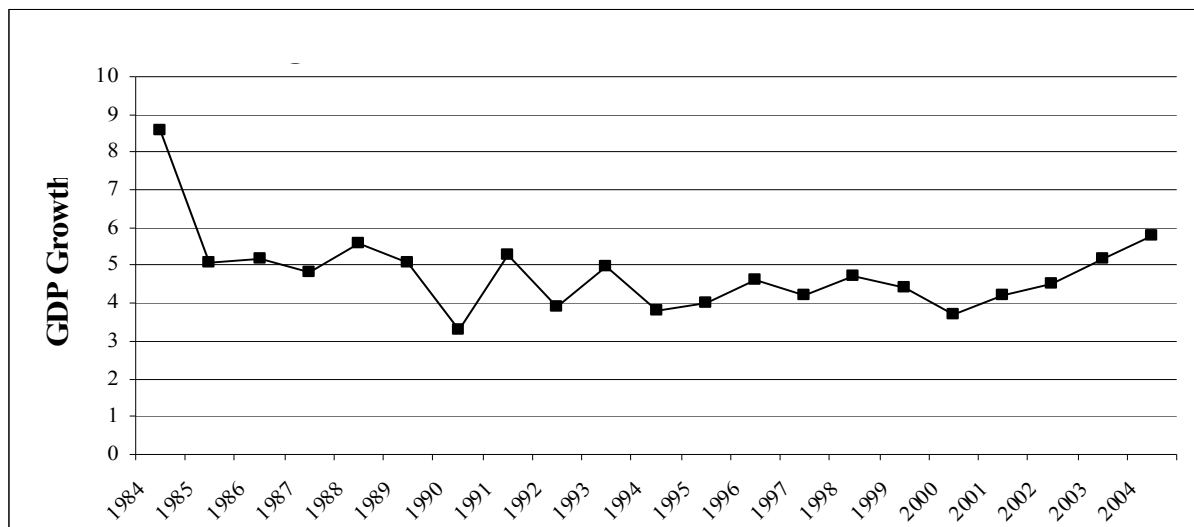
In order to analyze trends in wellbeing since 1997, it is however feasible to use data on assets from the 1997 and 2003 Core Welfare Indicators Questionnaires surveys (CWIQ). The CWIQ surveys lack information on consumption. However, assets information has been collected. Indeed, many of the same techniques that are used for standard poverty analysis can also be used for the analysis of assets-based poverty. As shown by Filmer and Pritchett (1998; see also among others World Bank, 2000/1; and Sahn and Stifel., 2000, 2003), assets indices can be good proxies for household equivalent income or consumption, so that analyzing the trends in, and determinants of, assets-based poverty can provide useful insights. This would also help assessing the performance of the index in poverty analysis, compared to consumption or income.

The objective of this paper is to measure the trend in, and determinants of, assets-based wellbeing in Ghana on the basis of the 1997 and 2003 CWIQ surveys. As shown in the Figure 11 below, GDP growth in the period between 1997 and 2003 continued to be strong, at more than 4 percent per year in all but one year. The total increase in per capita GDP over the six years was close to 15 percent, so that a reduction in poverty was to be expected, and has indeed been observed.

In section 2, we provide estimates of the trends in assets-based poverty and inequality, as well as an analysis of the changes over time using standard decomposition techniques as well as growth incidence curves (Ravallion and Chen, 1997). We find that assets poverty was reduced by about 7 percentage points, suggesting an elasticity of poverty to growth of about minus one, a level well in line with the experience of other countries.

In section 3, we provide a profile of the assets poverty, and an analysis of the determinants of the assets indicator of wellbeing. Education, employment, and geographic location appear to have the strongest impacts on the level of wealth of households. A brief conclusion follows.

Figure 11: Trend in GDP Growth (%) in Ghana (1984-2004).



Source: Government of Ghana (2006).

I. Trends in Asset-Based Poverty and Inequality.

This section provides an analysis of the trends in, and determinants of, assets-based poverty in Ghana for the period 1997 to 2003.

The conventional approach to measuring poverty is based on consumption data (Deaton, 1995) as said repeatedly in sections above. Consumption per capita or per equivalent adult is compared to a poverty line based on the estimation of the cost of basic needs. Households whose consumption is below the poverty line are considered as poor, and different poverty measures are computed to reflect not only the share of the population in poverty, but also the distance (or a function thereof) that separates the consumption level of the poor from the poverty line.

Let us recall briefly some formulas.

Denoting by z the poverty line, by I_i the index of wellbeing of the household, by n the population size, and by $i = 1, \dots, q$ the poor, and using appropriate weights in estimations, most studies report poverty measures of the FGT class:

$$P_\alpha = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - I_i}{z} \right)^\alpha \quad (1)$$

Because Ghana's CWIQ surveys for 1997 and 2003 do not have consumption data, we rely instead on an assets index to estimate poverty. Indeed, when consumption data exist, there is arguably no need to use assets, other than perhaps to compare these two measures of wellbeing. However, when only assets information are available in a survey, then one needs to find the best way to still analyze poverty and make use of the survey⁹³. This is the objective of this paper. Usually, authors use various methods to derive common information (called the index) from the assets owned by the households. The assets index derived in this paper is defined through a Principal Components Analysis (PCA)⁹⁴ (see among others Filmer and Pritchett, 1998; Habing, 2003; van der Berg et al., 2004, 2006). We provide in the Appendix its dominance curve, which provides estimates of poverty rates for each year at various welfare levels^{95,96}. The reliance on a PCA in this chapter

⁹³ Indeed, many surveys collected in developing countries are full of information but lack data on consumption. These surveys are “cheap” and are collected quickly. Ignoring them may lead to missing important findings, along with waste of time and money to implement them.

⁹⁴ Loosely speaking, the PCA method could be defined as: $I_i = \sum \frac{(X_{ij} - \bar{X}_j)}{S_j} * W_j$, where I_i is the composite assets index arising from PCA, i is a household, j the asset, X_{ij} the ownership (the response) of i to j , \bar{X}_j and S_j , respectively, the mean and standard deviation of j and W_j the weight applied to category j .

⁹⁵ These dominance curves are helpful to infer poverty for various poverty levels.

⁹⁶ The variables used to conduct the PCA are available upon request, with their values for both years provided at the national level, for urban and rural areas, by region, and by quintile of wealth (those quintiles of wealth depend themselves on the variables used for constructing the index).

instead of FA as in the Chapter 1, is just to show that both methods are quite equivalent in essence and suitable for the assets-based poverty comparison.

The assets have been mostly chosen because of their availability in both surveys. They consist in the equipment owned by the households (phone, television, radio, etc), the availability and access to utility services (water and electricity for example), access to sanitation (toilets) as well as the characteristics of the building materials (type of roof, of floor, etc.). These assets are arguably representative of some dimensions of the wellbeing of a household. For instance, access to water or sanitation is representative of basic needs of the household, to the same extent that for example access to education or health. The PCA will give the relative weight of each asset in the index, i.e. for example what is the relative weight of a phone vis-à-vis a television.

In order to base comparisons of standards of living on a consistent indicator, the same assets and the same weights are used in both years by pooling as in the Chapter 1 the data together when implementing the PCA. Also, since we are dealing with assets owned by households (or used by them, as is the case for dwellings that may be rented), we do not need to adapt the poverty threshold over time for inflation or other factors insofar as we are interested in absolute as opposed to relative standards of living comparisons.

Our PCA results are shown in the Table A4. Kaiser-Meyer-Olkin (KMO)'s tests of sampling adequacy, as well as Bartlett's test of sphericity are satisfactory. As 57 variables are considered, up to 57 underlying factors (or components) are extracted to explain the total variance. The first five components account for 29% of the total variability. The last ten components account for 0%, that is, they do not vary a lot, as many people tend to possess virtually the same goods. The loadings on them do not seem associated with measurement errors. As for the weights (last two columns), the variables that contribute the most to higher living standards have positive and increasing values. For example, owning an iron or having cement walls have a weight of .25, while having no toilet is weighted -.14. The more people possess an item, the smaller its weight in the index.

As for the choice of the poverty threshold, it is as said somewhat arbitrary since it is not clear which combination of assets would lift a household out of assets-based poverty. In order to anchor our poverty estimates in realistic assumptions for Ghana, we defined the assets-based poverty line in order to reproduce the consumption-based poverty headcounts obtained by Coulombe and McKay (2007) using the 1997-98 GLS survey, namely roughly 25% of the urban population living in poverty, versus 55% in rural areas. This yields a national poverty headcount of 42% in 1997 using the CWIQ-based urban and rural population shares. Thus, our assets-based poverty lines are defined separately in urban and rural areas so as to reproduce using the 1997 CWIQ existing estimates of consumption-based poverty.

The rationale for not using the same assets-based poverty line in urban and rural areas, despite the fact that the wealth index in both types of areas is based on the same underlying variables, is that doing so would lead to very low measures of poverty in urban areas, and very high measures in rural areas, since there is a “bias” in the choice of assets in favour of goods that are available more in urban areas. This choice of using different assets poverty threshold for urban and rural areas is arbitrary, but the results reflect better the standards of living in various parts of the country. To ensure consistency and comparability between national, urban and rural poverty rates, we choose the urban poverty line as reference and rescaled (weighted) the rural line up by that factor. This has become a standard technique used in many studies at the World Bank and elsewhere (see for instance Gunewardena, 2005 for Sri-Lanka).

The estimates in the Table 5 suggest that the national assets-based headcount of poverty decreased from 46% in 1997 to 39% in 2003. This decrease of 7 percentage points is smaller than (but still comparable to) the 10 percentage points reduction in consumption poverty reported by Coulombe and McKay (2007) for 1993-1998, but it is still very large and roughly in line with the growth in GDP per capita observed over the seven years between the two surveys. From 1998 to 2003, if one assumes a growth rate of the

population of 2 percent per year, the cumulative growth rate in per capita GDP over the period is 15 percent.

Table 5: Asset-Based Poverty, Inequality and Growth, Ghana 1997-2003 (%).

	Rural	Urban	National
Inequality measures			
Gini index in 1997	41.355	24.681	36.718
Gini index in 2003	40.675	24.087	34.495
GE (0) in 1997	34.872	13.090	28.487
GE (0) in 2003	31.538	11.969	23.780
GE(1) in 1997	28.767	10.179	22.547
GE(1) in 2003	27.672	9.600	19.665
GE (2) in 1997	33.602	9.289	24.384
GE (2) in 2003	32.744	8.793	20.994
Headcount index			
Poverty in 1997	55.207	25.002	45.711
Poverty in 2003	51.831	21.072	38.880
Change in poverty	-3.376	-3.930	-6.831
Growth component	-5.183	-4.237	-6.249
Redistribution component	1.807	0.307	-0.581
Poverty gap			
Poverty in 1997	24.520	8.966	19.630
Poverty in 2003	20.696	7.088	14.966
Change in poverty	-3.825	-1.878	-4.664
Growth component	-3.007	-1.367	-2.913
Redistribution component	-0.818	-0.510	-1.751
Squared poverty gap			
Poverty in 1997	14.931	4.705	11.716
Poverty in 2003	11.834	3.494	8.323
Change in poverty	-3.097	-1.210	-3.393
Growth component	-1.814	-0.717	-1.709
Redistribution component	-1.283	-0.494	-1.684
Growth incidence curves			
Growth rate in mean	10.280	9.520	12.410
Growth rate at median	5.750	9.800	14.330
Mean percentile growth rate	15.190	10.610	18.650
Corresponding percentile	55.000	25.000	45.500
Rate of pro-poor growth	20.370	14.570	26.970

Source: Authors' estimations based on 1997 and 2003 CWIQ surveys.

The decrease in assets-based poverty, at 7 percentage points between 1997 and 2003, represents 15% of the initial level of poverty (46%). In other words, the magnitude of the decrease in assets poverty suggests an elasticity of assets poverty to growth of 0.99, which is a fairly reasonable value (this elasticity factors in the fact that assets inequality decreased slightly over the period in review, hence the net observed elasticity of assets poverty to growth is actually slightly lower). Within urban areas, the headcount was reduced from 25% to 21%. In rural areas, the headcount dropped from 55% to 52%. Similar results in terms of broad trends are obtained for the poverty gap and squared poverty gap.

The larger drop in the national poverty than in both urban and rural poverty is due to the fact that a larger share of the population lived in urban areas in 2003 than in 1997, so that loosely speaking, one can say that rural-to-urban migration contributed to the reduction in poverty.

1.1. Migration Effects.

It is difficult to derive the migration effect of the poverty reduction since we did not observe those who have migrated. However, one might assume that wealth has increased in the group of the migrants as well as in that of the host urban (pre-migration) population.

In Table 6 below, we build some counterfactuals to try to capture such migration effect. A more rigorous methodology will, however, be needed to obtain more accurate results. If no migration took place, we know that urban settlers would have experienced a drop of 14 percentage points in poverty rate. If migration took place but the migrants did not benefit from their migration, the overall situation in the urban area would have been an increase in poverty of 3 points (the migrants become a burden for the urban population). If on the contrary, we have the highly unlikely situation where the migrants captured most of the decrease, then the host urban settlers would have only experienced a drop of 1.6 points. Therefore, either the situation of migrants has worsened (unlikely) or has improved. In any case, the situation of settlers might have improved with a fall between 10 and 20 percentage points.

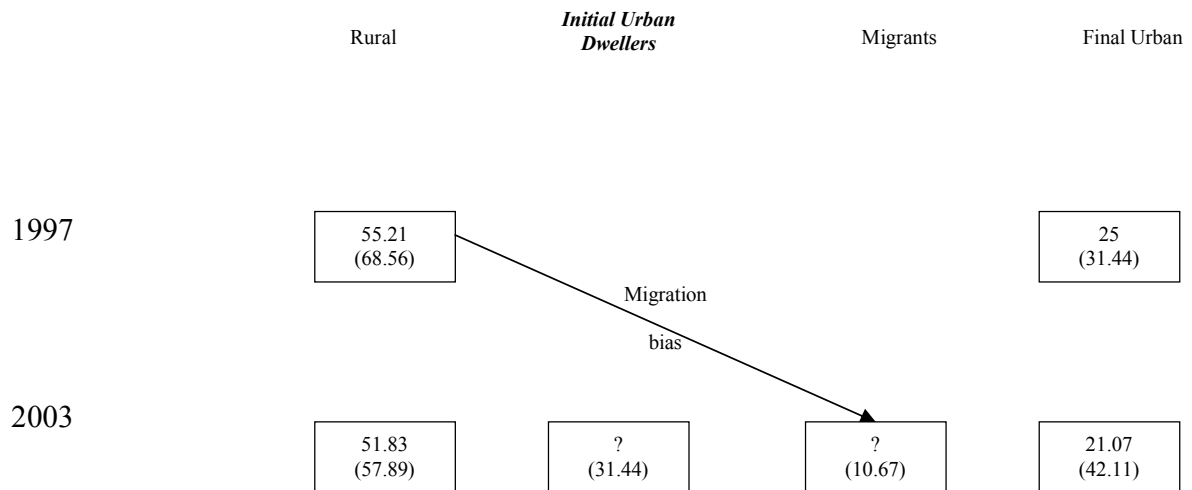
Table 6: Estimates of Some Counterfactuals of Poverty Trends for Urban Area, Ghana (1997-2003).

	1997	2003	Gain	Total national in 2003
Shares				
N	100.00%	100.00%	0.00%	
R	68.56%	57.89%	-10.67%	
U	31.44%	42.11%	10.67%	
Migrants	0.00%	10.67%	10.67%	
Observed P0				
N	45.71%	38.88%	-6.83%	38.88%
R	55.21%	51.83%	-3.38%	
U	25.00%	21.07% (?)	-3.93%	
Migrants	–	21.07% (?)		
Simulation 1: No immigration				
N	45.71%	38.88%	-6.83%	38.88%
R	55.21%	51.83%	-3.38%	
U	25.00%	10.64%	-14.36%	
Migrants	–	–		
Simulation 2: Immigration occurred but no effect on migrants				
N	45.71%	38.88%	-6.83%	38.88%
R	55.21%	51.83%	-3.38%	
U	25.00%	28.23%	3.23%	
Migrants	–	–		
Simulation 3: Immigration occurred and migrants captured most of the gains				
N	45.71%	38.88%	-6.83%	38.88%
R	55.21%	51.83%	-3.38%	
U	25.00%	23.36%	-1.64%	
Migrants	–	14.36%		
Simulation 4: Immigration occurred and migrants experienced a drop of 14.36% from initial poverty rate				
N	45.71%	38.88%	-6.83%	38.88%
R	55.21%	51.83%	-3.38%	
U	25.00%	15.51%	-9.49%	
Migrants	–	37.47%		
Simulation 5: Immigration occurred and migrants experienced an increase of 14.36% from initial poverty rate				
N	45.71%	38.88%	-6.83%	38.88%
R	55.21%	51.83%	-3.38%	
U	25.00%	5.77%	-19.23%	
Migrants	–	66.19%		

Source: Authors' estimations based on 1997 and 2003 CWIQ surveys.

The situation could be summarized in the Figure 12.

Figure 12: The Migration Effect.



Note: Each box provides the headcount ratio. Population shares in parenthesis.

At the national level, assuming no inter-country migration and keeping out within-groups poverty, the net absolute migration effect is to decrease poverty by around 3%⁹⁷. Therefore, migration in Ghana a priori might have had strong impact on poverty.

1.2. Inequality in Ghana.

What happened to inequality in assets-based wellbeing?

Going back to the Table 5 above provides inequality measures at the national level as well as in urban and rural areas. We use the Gini index as well as the Theil's General Entropy (GE) measures. Inequality in assets-based wellbeing is higher in rural than in urban areas, and over time, both the entropy measures and the Gini index suggest a mild

⁹⁷ This national migration effect is measured as: $\Delta P_N(z, \alpha) = \lambda \left(P_U(z, \alpha) - \frac{\phi(R)}{1 - \phi(U)} P_R(z, \alpha) \right)$. N,

R, U stand for national, rural and urban. λ is the absolute increase in the population share of urban group, ϕ the initial population shares for urban and rural. See Araar and Duclos (2005) for the effects of a proportional rather than an absolute increase λ .

decrease in inequality. This does not, however, imply that changes in inequality actually reduced poverty, because the changes in inequality, as captured through aggregate indices such as the General Entropy measures or the Gini index, may not represent an improvement in the part of the distribution of assets-based wellbeing where the poor are located.

1.3. Poverty Dynamics.

In order to measure the contribution of growth and changes in inequality to the reduction in poverty, we use the growth and inequality decomposition technique suggested by Ravallion and Datt (1992)⁹⁸.

Denoting by $P(\mu_t, L_t)$ the poverty level corresponding to a mean level of assets-based wellbeing μ_t and an inequality in wellbeing as captured by the Lorenz curve L_t , we have:

$$\Delta P = \underbrace{[P(\mu_2, L_\pi) - P(\mu_1, L_\pi)]}_{\text{Growth impact}} + \underbrace{[P(\mu_\pi, L_2) - P(\mu_\pi, L_1)]}_{\text{Inequality Impact}} + \underbrace{R}_{\text{Residual}} \quad (2)$$

The first two terms are the changes in poverty due to growth and changes in the Lorenz curve. The last component is a remainder term which can be eliminated by averaging the results of the decomposition implemented in both directions in time (Kakwani, 1997).

The results in the Table 5 suggest that growth accounted for a -5.2 percentage point reduction in poverty in rural areas, and -4.2 percentage points in urban areas. By contrast, changes in inequality led to an increase in poverty (+1.8 in rural areas and +0.3 in urban areas). However, at the national level, the changes in inequality led to a decrease in poverty between the two years. If we look at the poverty gap and squared

⁹⁸ There are many other decomposition techniques such as the Shapley.

poverty gap, we find a positive contribution of changes in inequality to the reduction in poverty.

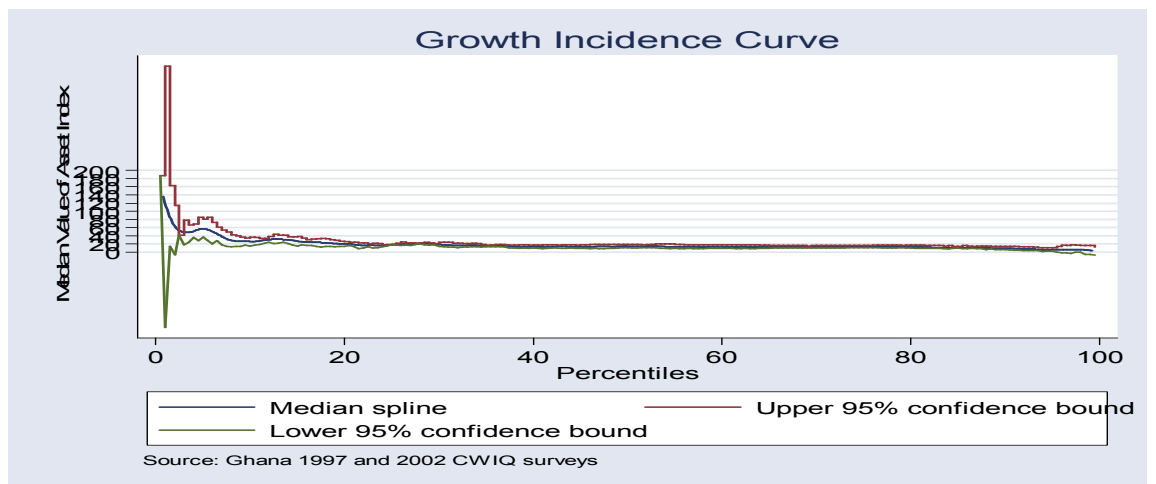
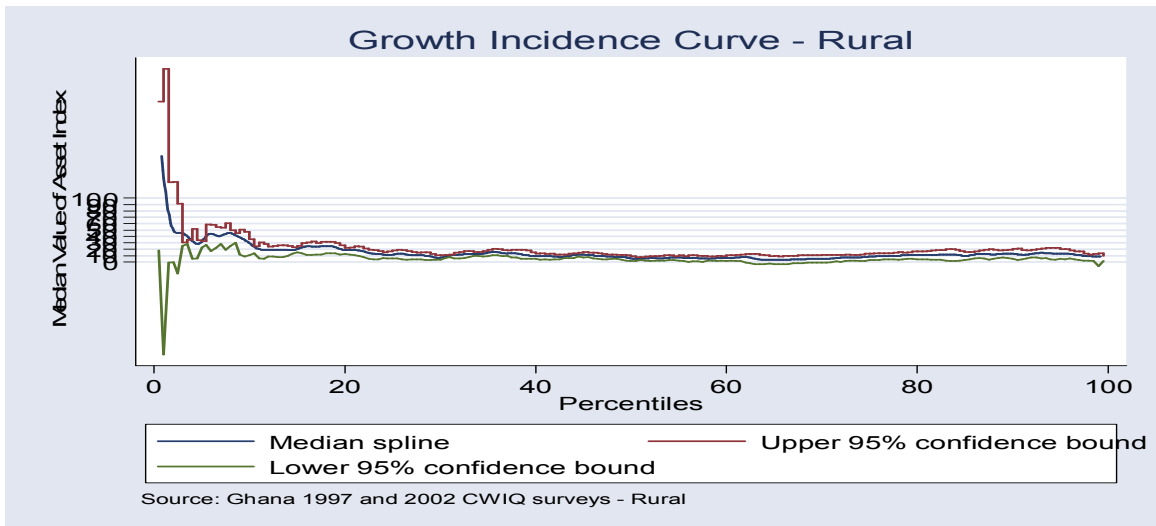
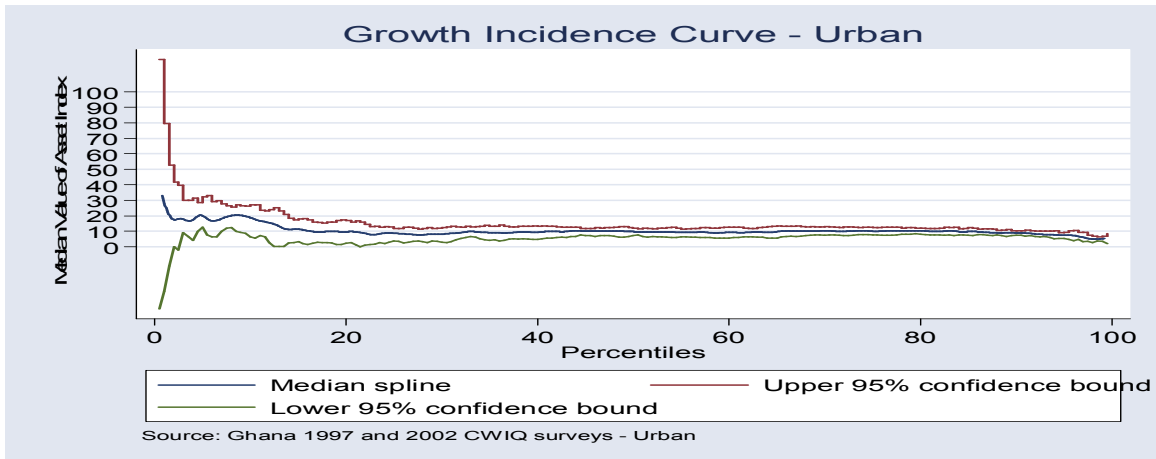
Thus, overall, it is legitimate to say that the mild reduction in inequality mentioned earlier did lead to a mild reduction in poverty.

The reason for the difference in some of the results on the impact on poverty of changes in inequality depending on the choice of the poverty measure can be explained intuitively using growth incidence curves (Ravallion and Chen, 2003). These curves graph the growth rates in assets at various points of the distribution of assets. Clearly, as shown in the Figure 13, the growth rates in the assets index has been strongly pro-poor. Integrating the growth curve up to the poverty line gives the total growth in incomes of the poor, which is much larger than the median and mean growth rates (Table 5). Yet, because the highest growth rates in assets are observed at the bottom of the distribution, they do help in reducing the poverty gap and the squared poverty gap, but not necessarily in reducing the headcount; indeed, for the households with assets values near the poverty line, the growth in assets was lower than that for the population as a whole, and therefore the change in the Lorenz curve lead to an increase in the headcount index. Still, as mentioned earlier, the overall evidence strongly suggests that there was a decrease in assets-based inequality, and that this led to a decrease in assets-based poverty.

However, one must be careful in interpreting these results and understanding their limits.

Many of the assets taken into account in the wealth index are such that it is somewhat natural over time to see access to those assets benefiting the poor more than the non-poor, simply because our measurement is categorical – we do not measure the quality of the goods listed in the survey, but simply whether a household has or does not have access to electricity, or has or does not have a television.

Figure 13: Growth Incidence Curves for Assets Wellbeing, Ghana 1997-2003.



Source: Authors' estimations based on 1997 and 2003 CWIQ surveys.

As access to basic services and goods expands over time, the poor tend to gain more than the rich, at least according to the limited measurement tools at our disposal. It could well be that better off households are accumulating monetary wealth at a higher speed than the poor in proportional terms (in which case growth would be said not to be pro-poor), but this would not be measured here unless it shows up through the categorical variables used to measure wealth (see again in tables A1 and A2 the list of assets included in the wealth measure).

Another technique is useful to provide further insights in the changes in assets-based poverty.

This so-called sectoral decomposition is typically used to provide a rough idea of the role of urbanization in reducing poverty (Ravallion and Huppi, 1991).

The overall change in poverty over time is decomposed into three components: an intra-sectoral change which captures changes in poverty within sectors or groups (i.e., within urban and within rural areas), an inter-sectoral change which assesses changes due to changes in the population shares of sectors or groups (i.e., migration from rural to urban areas), and an interaction effect which measures the possible correlation between intra and inter-sectoral changes.

Formally, denoting by P_{it} the poverty measure at time t for group or sector j , and by n_{it} the population share in group or sector j at time t , the change in poverty ΔP observed between periods 2 and period 1 is written as:

$$\Delta P = \underbrace{\sum_{i=1}^m n_{i1}(P_{i2} - P_{i1})}_{\text{intra-sectoral effect}} + \underbrace{\sum_{i=1}^m P_{i1}(n_{i2} - n_{i1})}_{\text{intersectoral effect}} + \underbrace{\sum_{i=1}^m (P_{i2} - P_{i1})(n_{i2} - n_{i1})}_{\text{interaction effect}} \quad (3)$$

The results of the decomposition for the headcount index are given in the Table 7.

Intra-urban and rural effects generated a reduction in poverty of -3.6 percentage points, but the contribution of urbanization was almost as large, at -3.2 percentage points.

The interaction term or residual is negligible (decrease in poverty by 0.06 percentage points).

The large impact of urbanization in the decomposition is due to the fact that urban poverty measures are about half those obtained in rural areas, and in addition the share of the population in rural areas has decreased from 69% in 1997 to 58% in 2003.

This is a rather large decline which may actually be overestimated.

But even if the decline in the rural population share has been lower than suggested by the CWIQ surveys, it must have been substantial (in many poor countries, the urban share grows by about one percentage point per year).

When the decomposition is applied to regions (Western; Central; Greater Accra; Volta; Eastern; Ashanti; Brong Ahafo; Northern; Upper East; Upper West), the intra-sectoral effect is larger (-5 percentage points), but population shifts between regions still contributed to the reduction in poverty (-1.6 percentage points).

The decomposition can also be applied to household groups defined according to characteristics such as the education of the household head (Not educated; Primary level; Junior Secondary level; Secondary or Technical level; and Post Secondary-Higher level) or the head's sector of activity (Agriculture; Mines-Transport-Manufacturing; Services-Finances-Commerce; or Unstated Sector-Unemployed).

For education categories at the national level, as it was the case for regions, the largest poverty reduction came from a reduction in poverty within education groups (5 percentage points), but the shift toward a better educated population also contributed to improve standards of living (-1.7 percentage points).

For the sector of activity of head, the contribution to poverty reduction from intra-sectoral improvements (-3.7 percentage points) was smaller than that of the shift away from agriculture to other sectors of activity (-4.7 percentage points).

Thus, in general, there were improvements both within groups, and through the decisions made by households to shift from one less advantaged group (such as households living in rural areas, and households with a head working in agriculture) to more advantaged group (urban areas, and households in services and industry).

Table 7: Sectoral Decomposition of Changes in Poverty Over Time, Ghana 1997-2003.

	Intra-Sectoral effect	Population shift effect	Interaction effect
Headcount Index P0			
National			
Area (urban-rural)	-3.550	-3.222	-0.059
Region	-4.964	-1.606	-0.260
Education of the head	-5.048	-1.734	-0.049
Employment of head	-6.252	-2.645	2.066
Sector of employment of head	-7.063	-1.257	1.490
Industry of the head	-3.709	-4.660	1.538
Sex of the head	-7.131	0.259	0.042
Age group of the head	-6.837	0.004	0.003
Head has land	-6.799	-0.020	-0.011
Size of household	-6.421	-0.378	-0.032
Rural			
Region	-3.130	0.516	-0.761
Education of the head	-4.041	0.672	-0.007
Employment of head	-4.623	-2.234	3.482
Sector of employment of head	-4.755	-1.143	2.523
Industry of the head	-3.405	-2.712	2.741
Sex of the head	-4.102	0.523	0.204
Age group of the head	-3.379	-0.010	0.014
Head has land	-3.616	0.072	0.168
Size of household	-3.197	-0.196	0.017
Urban			

Region	-4.263	0.288	0.046
Education of the head	-1.846	-1.911	-0.172
Employment of head	-4.055	-0.119	0.244
Sector of employment of head	-4.059	0.079	0.050
Industry of the head	-3.421	-0.620	0.112
Sex of the head	-3.681	-0.282	0.033
Age group of the head	-3.914	-0.018	0.002
Head has land	-4.411	0.389	0.093
Size of household	-3.682	-0.423	0.175

Poverty Gap P1

National

Area (urban-rural)	-3.213	-1.659	0.208
Region	-3.858	-0.742	-0.064
Education of the head	-3.811	-0.946	0.093
Employment of head	-4.640	-1.692	1.668
Sector of employment of head	-4.980	-0.781	1.096
Industry of the head	-3.605	-2.568	1.509
Sex of the head	-4.855	0.264	-0.074
Age group of the head	-4.666	-0.001	0.004
Head has land	-4.649	-0.010	-0.005
Size of household	-4.445	-0.234	0.015

Rural

Region	-3.991	0.757	-0.591
Education of the head	-4.246	0.466	-0.044
Employment of head	-5.021	-1.543	2.739
Sector of employment of head	-4.912	-0.778	1.865
Industry of the head	-4.375	-1.667	2.218
Sex of the head	-4.242	0.496	-0.078
Age group of the head	-3.834	-0.011	0.020
Head has land	-3.968	0.042	0.102
Size of household	-3.723	-0.131	0.030

Urban

Region	-1.983	-0.089	0.194
Education of the head	-1.030	-0.755	-0.093
Employment of head	-1.816	-0.319	0.257
Sector of employment of head	-1.926	-0.014	0.062
Industry of the head	-1.673	-0.320	0.116

Sex of the head	-1.821	-0.065	0.008
Age group of the head	-1.868	0.000	-0.010
Head has land	-2.093	0.172	0.042
Size of household	-1.767	-0.160	0.049
Squared Poverty Gap P2			
National			
Area (urban-rural)	-2.504	-1.091	0.201
Region	-2.932	-0.453	-0.009
Education of the head	-2.868	-0.636	0.111
Employment of head	-3.441	-1.178	1.225
Sector of employment of head	-3.648	-0.536	0.790
Industry of the head	-2.855	-1.711	1.173
Sex of the head	-3.527	0.224	-0.090
Age group of the head	-3.394	-0.002	0.003
Head has land	-3.384	-0.006	-0.003
Size of household	-3.261	-0.182	0.051
Rural			
Region	-3.275	0.668	-0.489
Education of the head	-3.386	0.349	-0.060
Employment of head	-4.000	-1.144	2.047
Sector of employment of head	-3.891	-0.550	1.344
Industry of the head	-3.581	-1.161	1.645
Sex of the head	-3.380	0.415	-0.132
Age group of the head	-3.105	-0.005	0.013
Head has land	-3.194	0.024	0.074
Size of household	-3.041	-0.111	0.055
Urban			
Region	-1.255	-0.104	0.148
Education of the head	-0.738	-0.432	-0.041
Employment of head	-1.128	-0.196	0.113
Sector of employment of head	-1.237	-0.020	0.047
Industry of the head	-1.103	-0.197	0.089
Sex of the head	-1.193	-0.015	-0.003
Age group of the head	-1.205	0.002	-0.008
Head has land	-1.330	0.096	0.024
Size of household	-1.148	-0.079	0.017

Source: Authors' estimations based on 1997 and 2003 CWIQ surveys.

Before shifting to the discussion of the assets-based poverty profile and the determinants of assets-based poverty, it is worth emphasizing that the results presented so far reflect trends in wealth as measured through assets, but may not reflect changes in wellbeing of households as characterized by other indicators such as consumption or health.

To the extent that some of the indicators included in the assets index (such as whether or not the household has electricity) depend as much on policies regarding network expansion as on actual changes in income or in the capacity to pay for the service on the part of households, we may very well overestimate (or underestimate) changes in consumption-based poverty measures with our assets index. It will therefore be important to use the upcoming GLSS5 survey to test whether consumption poverty has indeed declined substantially since the late 1990s.

One indicator available for measuring changes in wellbeing that tends to be correlated with poverty is child nutrition⁹⁹. While poverty is an important underlying determinant of child malnutrition, child malnutrition is also an important underlying determinant of poverty and growth. This is because children who are chronically malnourished or stunted in their first two years of life rarely meet their potential for personal growth and are often permanently stunted as adults.

There are a number of consequences from these effects of malnutrition, including reduced levels of productivity and earned income. Indeed, many studies show the link between better nutrition and productivity and growth (see for example Behrman and Deolalikar, 1988 for Brazil; or more recently Behrman et al., 2008 for Guatemala).

Higher economic growth rates and the subsequent drop in poverty seem to have also benefited to better child nutrition in Ghana. As shown in the Table 8, nutritional indicators based on the DHS conducted in 1993, 1998 and 2003 show a decline in the proportion of children who are underweight from 27% in 1992 to 22% ten years later.

⁹⁹ This discussion is based on material provided by Harold Coulombe using Ghanaian DHS reports from 1993 to 2003.

Wasting indicators follow a similar path. For stunting, there is an increase after 1998. If we concentrate on the underweighting indicator – which combines the other two indicators – nine out of ten regions have benefited from a downward trend.

However, the three northern regions along with the Volta region still have higher than average malnutrition rates in 2003 (as is observed for assets-based poverty; this will be discussed in the next section). Underweighting is rather more prevalent in rural than in urban areas even if rural children have done better recently.

Table 8: Trend in Child Nutritional Indicators by Region, Ghana 1993-2003 (%).

	Stunting			Wasting			Underweight		
	1993	1998	2003	1993	1997	2003	1993	1997	2003
Western	33.1	29.4	28.4	13.0	9.2	5.3	33.1	25.6	16.5
Central	23.0	26.8	31.6	11.5	10.3	3.0	21.5	26.3	22.0
Greater Accra	15.7	11.3	13.9	7.9	5.5	7.2	16.9	12.2	11.5
Volta	19.8	25.1	23.3	10.4	15.2	13.9	24.0	24.7	25.7
Eastern	25.0	23.6	27.4	5.9	8.7	6.2	20.6	22.3	17.3
Ashanti	27.9	27.6	29.1	8.4	9.2	6.7	22.6	24.7	20.8
Brong Ahafo	24.5	17.8	29.4	13.0	8.1	5.7	33.2	24.1	20.4
Northern	35.9	39.6	48.8	19.0	12.7	6.6	41.3	38.1	35.5
Upper East	26.0	34.6	34.1	14.5	7.1	11.0	32.8	28.4	25.9
Upper West	33.3	35.9	31.7	20.6	8.2	12.9	47.6	34.0	32.4
Urban	15.7	14.3	20.5	8.6	6.5	6.6	17.5	15.6	15.4
Rural	30.1	29.7	34.5	12.6	10.5	7.4	31.4	27.9	25.4
Total	26.0	25.9	29.9	11.4	9.5	7.1	27.4	24.9	22.1

Source: DHS.

Importantly, governmental programs on nutrition and health have been popular but unfortunately the participation rate in the nutrition component has been lower in the four regions doing worst in terms of their malnutrition indicators.

Their combined participation rate is half the national average. The issue of child malnutrition thus remains of great importance, despite some progress over time, and the same can be said about poverty.

II. Poverty Profile and Correlates of Poverty.

2.1. Poverty Profile.

Table A5 in the Annex provides a profile of assets poverty according to selected characteristics, along with their standard errors. As mentioned earlier, poverty measures are higher in rural areas, and most of the population still lives in rural areas, so that a majority of the poor are rural. Yet because the proportion of the population in rural areas decreased from 69% to 58% according to the CWIQ data, while 83% of the poor lived in rural areas in 1997, this proportion has decreased to 77% in 2003. Poverty is also higher in all the other regions than in Accra and Ashanti, and many of the better off regions had a larger drop in the headcount index of poverty than some of the poorer areas of the country.

In terms of demographic variables, Table A5 provides a profile according to household size, the sex of the household head, and the age of the head. Small families (1 to 3 members) are better off than larger families (5-10 members or more than 10 members), as expected, but the differences tend to be small. The reason for such small differences is that our indicator of wellbeing is the total “wealth” of the household and not the wealth per capita, so that a higher household size does not have an automatic negative effect on the wealth measure. Female-headed households are better off than male-headed ones, in part because it is more likely to have women headed household living in urban areas. Households with heads under 20 years of age and over 60 are poorer than households in the middle range, probably because younger heads have not had the time yet to accumulate wealth, while older heads are more likely to be rural. It can also be shown that single and divorced (or separated) heads are less poor than heads in union.

The incidence of poverty is lower when the head is better educated and when the head is employed either in the public or formal sector. The differences in headcounts according to education are very large, especially in rural areas. Households whose head has no education at all have a (population-weighted) probability of being poor at 72% in rural

areas, versus 10% for rural households with post-secondary or higher education. In urban areas, those with a post-secondary or higher education are very unlikely to be poor (headcount index of only 2%), while the headcount index is at 41% among households whose head has no education at all.

Households whose head is an employer or owner tend to be poorer, but this is because most of them work in the agricultural sector as self-employed individuals. This is also why the “private sector” category in the Table A5 shows much higher rates of poverty than the public and unstated/unemployed categories (those household heads who can afford to be unemployed for some time are not typically among the poorest). Also, households whose head works in the commerce and services sectors as well as in mining or transportation tend to be better off than their counterparts working in the agricultural sector. There is one surprising jump between 1997 and 2003 in the headcount index among rural households whose head is unemployed or did not state its occupation, but this may be due to misclassification in the survey, as it is unlikely that the unemployment rate among household heads doubled between the two years (said differently, a proportion of rural households whose head is classified as unstated/unemployed in 2003 are probably working in the agriculture sector, which would explain the sharp rise in poverty).

Ownership of land also matters for poverty reduction, although apparently more in urban areas than in rural areas according to our estimates. This is probably because land owners in urban areas are indeed wealthy, while in rural areas, those who do not own land tend to form a heterogeneous group made of both very poor households and wealthier households likely to be engaged in the non-farm sector (this heterogeneity among those who do not own land in rural areas would explain why the differences in poverty measures according to land ownership are small there).

One of the limits of standard poverty profiles is that they do not provide information on the determinants or correlates of poverty holding other variables constant. For example, the apparent impact of the age of the household head on poverty may be related to

education or geographic location rather than to age per se. In order to assess the correlates of the level of wealth of the household, we turn in the next section to multivariate regression analysis.

2.2. Correlates of Poverty.

We estimate a model of a general form:

$$Y = f(X_{Household}, X_{Community}) \quad (4)$$

where Y is the logarithm of assets index, and the X are characteristics of the household (size, age of head, his education, etc.) and controlling for location effects.

As a general rule, key findings from the poverty profile are also observed when assessing the determinants or correlates of poverty using regression analysis for the logarithm of the assets index separately for the urban and rural sectors, but there are a few exceptions.

Results are given in the Table A6. Test of functional form (Ramsey-Hausman) rejects any misspecification. Also, we find no evidence of endogeneity (using the Nakamura and Nakamura test) or heteroscedasticity (using the Breusch-Pagan test). Since information on assets obtained from the PCA has negative values, we rescaled the index of wellbeing by adding the inverse of its greatest negative value plus a small number for computing the logarithms, as suggested in Asselin (2002) and Sahn and Stifel (2003). In doing so, one inevitably changes the distribution of the assets index, and this modifies notably its mean and variance. The effect is to impact poverty and inequality measures. But as we stressed, we are not interested in absolute levels which have no meaning on their own, but rather, on trends.

In terms of demographic variables, apart from information on the number of infants, children, adults, and seniors (and their squared values), the covariates also include

whether the head is mentally or physically disabled, whether the head is female, the age of the head (and its squared value), and the marital status of the head.

Most household size variables have no or fairly small impacts on the logarithm of assets, for the reasons explained earlier (we do not divide assets by household size when measuring wellbeing because assets usually benefit all members the same manner so that there is no need to take into account the equivalent of scale). The results suggest that a larger number of children might have a negative impact on wealth, while having a higher number of adults has the opposite effect. This is consistent with other findings. Concerning older family members, they seem to impact negatively wealth only in urban areas. As previously mentioned, the magnitude of these effects is fairly low, suggesting that demography and dependency ratios have mild effects on assets accumulation in Ghana. This in turn suggests that adults are working as insurance for children and elders.

In 1997, but not in 2003, a handicap reduces the assets owned by households by about 6 percent in rural areas and at the national level (in 2003, the coefficient is still negative, but smaller and not statistically significant). This suggests a mild negative impact of handicap on assets-based wellbeing in 2003. One could argue these families with handicapped head were helped by their migrant members in urban areas, or at least benefit from solidarity in the village. Indeed, one could think that migrants not only benefit from growth themselves, but also share some of these gains with their families in rural areas.

In rural areas and at the national level, female heads have slightly higher levels of assets, with gains ranging from 2 percent to 7 percent, but this is not the case in urban areas. If one considers the matriarchal organization of the Ghanaian rural societies, such a result is not really surprising. In some rural areas, land and other important assets are held by the spouse family¹⁰⁰. The man only uses the land, but does not have any right on it. In this

¹⁰⁰ This depends of the society considered. It is true for the Akan and the Ewe, the most predominant groups. Not the case for Fulani for example.

case, a targeting policy geared toward women would have little impact and should instead benefit men.

In urban areas, the fact that there is no significant difference between male and female heads suggests that these two types of households have pretty much similar welfare levels.

It may be true that there is a difference in wages in the formal sector, but this is compensated by the fact that women are more often engaged in the informal sector which employs around 80 percent of the labour force in urban areas (Hormeku, 1998). Indeed, during the 1960s to 1990s, more and more people engaged in the informal sector in urban Ghana (Ninsin, 1991; Boateng, 1998) while formal sector employment has been declining over the same period due to structural adjustments (Gockel, 1998). Our results suggest that wage differences may not be pronounced in this sector.

Controlling for other characteristics, the age of the head does not have a statistically significant impact on assets in most cases, at the 5 percent level. This is counterintuitive, as we may expect an inverted U shaped effect of age on assets accumulation. But as stated above, as many people engage in informal or agricultural sectors, they may delay their retirement date (UNDP, 1997).

Finally, heads in a union have slightly higher levels of wealth, particularly in urban areas, probably related to the need for higher accumulation in order to support their wife and children.

The impact of education on assets wealth is confirmed and results are significant at the 5 percent level.

Literacy brings in a gain of about 5 to 7 percent versus having a head illiterate, and primary education brings in a bit more (gain of 2 to 4 percent in most cases).

Completing junior secondary school adds 6 to 8 percent in terms of assets versus no education (on top of the gain associated with literacy), while secondary/technical education brings in a larger gain of 13 to 18 percent. At the post-secondary and higher

level, the gain in assets wealth versus no education at all varies from 29 to 37 percent (to which one must also add the gain linked to literacy).

The impact of employment is lower, and actually in most cases not statistically significant in many cases, once education is controlled for.

For example, whether the head is employed or not does not make a large difference, and there is no systematic gain or loss associated with the private or parastatal/informal sector as compared to the public sector, except for rural areas in 1997. What does matter, however, is the sector of activity of the head: the assets gains of households whose head is not in agriculture are of 15 to 22 percent higher than households whose head is in agriculture.

Finally, even after controlling for all the above variables, geographic location still matters. In the national regressions, living in an urban area brings in a gain in assets of 31 to 37 percent. As for the regional gains or losses, they are also large, which helps explaining the relatively high levels of migration observed within the country.

Conclusion.

Using repeated CWIQ surveys for 1997 and 2003, this paper provides an analysis of the level of assets-based poverty in Ghana, and of the correlates of the wealth of households. The chapter follows up on the previous one to test whether the assets index could earn its place as a valuable indicator of socioeconomic status indicator as income or expenditure.

The short answer is that the assets index is indeed a good proxy of consumption¹⁰¹ to conduct poverty analysis. Both could yield the same consistent results as we show in the case of Ghana. Our study shows that material poverty rates dropped by 7 percentage points over 1997-2003, along with inequality. This is consistent with the 10% drop of monetary poverty rates found by Coulombe and McKay (2007).

¹⁰¹ The consumption it's question here is usually the smoothed or long-term consumption.

The results suggest that poverty has continued to be reduced substantially in all of its dimensions, thanks to sustained growth rates in per capita GDP that translated into higher access to basic services for households as well as ownership of a wider range of assets.

Our simulations show that migration effects account for 3% of the fall in poverty.

Growth and inequality decomposition shows that growth has been strongly pro-poor in Ghana, consistent with the drop in poverty and inequality rates. Indeed, growth in assets was still found to be pro-poor, at least for higher order poverty measures such as the poverty gap and the squared poverty gap. In particular, the poor rural peasants who migrated to urban areas have seen an improvement in their wellbeing. Sectoral decomposition also suggests that population movements across sectors and regions account for a large part in the drop of poverty rates.

Another important finding is that growth has improved also children nutritional status in the country.

Our estimation of poverty profile shows that the headcount index of poverty fell more in urban areas than in rural areas. The capital and southern regions are far better-off than the rest of the country. Welfare in Ghana is also associated with small family size, female head and higher education. Concerning the sector of employment, being engaged in agriculture leads to lower welfare, *ceteris paribus*.

In terms of the correlates of assets-based poverty, education, sector of employment, geographic location were found to have the largest impacts on the logarithm of the assets owned by households.

In terms of policy, the Ghanaian Government should continue to promote growth and sound fiscal and redistributive policies along with promoting human capital sectors such as health and education, and providing a better access to services.

Part 2 :
Health Status and Inequality in Health.

«Sans l'Homme, le Développement n'a pas de raison et sans la Santé le
Développement ne saurait trouver son assise.». (Quenum, 1978).

« Le premier qui, ayant enclos un terrain, s'avisa de dire 'Ceci est à moi', et trouva des
gens assez simples pour le croire, fut le vrai fondateur de la société civile. Que de crimes,
de guerres, de meurtres, que de misères et d'horreurs n'eût point épargnés au genre
humain celui qui, arrachant les pieux ou comblant le fossé, eût crié à ses semblables:
'Gardez-vous d'écouter cet imposteur; vous êtes perdus, si vous oubliez que les fruits sont
à tous, et que la terre n'est à personne' ».

Jean-Jacques Rousseau.
Discours sur l'Origine et les Fondements de l'Inégalité parmi les Hommes (1755).

CHAPTER 3:

MEASURING OVERALL POPULATION'S HEALTH: A CHILD MORTALITY APPROACH.

Introduction.

In this chapter, we investigate the concept of health, especially population's health. Particularly, we focus on its nature, how to measure it, especially for the whole population, and what its determinants are, whether at individual or household levels.

The aim of this chapter is to answer some of these basic questions: why children are still dying so much in SSA? What are the factors underlying this fact and what can be done to prevent it? Understanding the causes and determinants of child mortality has become thus a priority, not only for African countries and Governments, but also for the International Community as a whole. It is important, not only for reducing sufferance, especially amongst poor people, since they are the most affected by this phenomenon, but also in helping preparing and implementing policies that would help eradicating the problem. This is our second step in understanding inequality in health, which is the ultimate goal of this dissertation.

I. Understanding the Concept of Health.

1.1. Why is Health Important?

Many papers usually find that richer people have better health status mainly because they have better nutrition, low exposure to health risks, better access to health care and also

because they have better health behaviour. This means that the wealth covariate, in regression settings should be positively correlated to any health variable¹⁰².

As bad or ill-health is unanimously perceived as a negation to any human being of the right to live and enjoy a good existence (Sen 1985, 1987; Sen and Dreze 1987; Ravallion et al., 1995), its impact on children is even more dramatic and damaging. Not only a good health allows people to live longer and better, it also increases their productivity and thus their income, and thus an increase in their wellness. Increased productivity means higher growth rates via higher productivity, higher output and thus higher development. Another important aspect is that good health status will lower absenteeism at work. To wit, good health is good for economic development.

1.1.1. Health and Productivity.

Let's focus a bit on the productivity-effect of good health. As we've said in part I, good health increases a person's productivity and allows people to earn and consume more, thus to be non poor and in turn to invest more in their health (Grossman, 1972; Strauss and Thomas, 1997, 1998; Haddad and Bouis, 1991; Deolalikar, 1988; Pitt and Rosenzweig, 1985) and the economy. More generally, people in good health also invest more in their education and job-training, and therefore reinforcing their productivity (Becker, 1964, 1967; Ben-Porath, 1967; Mincer, 1974; Mushkin, 1962; Fuchs, 1966). It is a virtue circle, which leads to a higher growth (via the productivity effect) and a higher development. Other aspects concern the fact that better health reduces health costs and improves education's positive effects. Thus it increases the education stock and the total productivity factor (research and development) of the country, one of the major sources of economic growth.

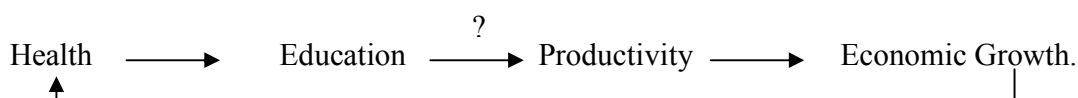
Indeed, people in bad health status won't be able to study correctly. As education has been hypothesized by many theoreticians to be essential to economic development, health

¹⁰² Defined in the "positive" sense, such as "good" health status. The "negative" sense will be related to "bad" health such as diseases, low anthropometrical status and mortality.

appears to be even more essential, as it is generally a prerequisite to education¹⁰³. As healthier individuals become more educated, this education will in turn allow them to be more efficient in the production process and improving their own health status and that of their children. Better nourished and healthier children will perform better in school, will be later in the future even more efficient than their parents in their adult life and earn higher incomes. Thus, the dynasty as a whole will become richer and healthier and better educated. For the country as a whole, this is a virtue path. Health thus enables individual to develop their full potential and live a happy and merry life, and put the whole country on the development track.

A longer, better life contributes positively to economic development, as each individual has time to fully develop his potentials, and to concretely implement his goals and aspirations.

Graphically, we could draw the simplistic relationship¹⁰⁴:



All these aspects are emphasized in the recent endogenous growth and human capital theories, that we do not discuss in this thesis.

1.1.2. Health and the Millennium Development Goals.

The MDGs are a renewed interest of the International Community on the positive effects of health. Even though health is a dimension of poverty, it has gained its own place alongside poverty reduction, in the MDGs goals. The goals can be summarized into eight broad groups with fifteen targets that are to be monitored through a set of forty-eight indicators. The MDGs framework is believed to foster and faster the downward trend, as

¹⁰³ Thought some very ill people such as Prof. Stephen Hawking are among the most talented and educated in the world.

¹⁰⁴ Some economists question the link between education and productivity, as “cognitive skills” and intrinsic ability rather than education could explain more the productivity of a person. That is, a well-educated person could be less productive than a non educated one and vice versa. But generally, high education is correlated with high productivity.

countries are committing themselves and coming into competition to reaching the goals by 2015.

In studying health, it is important to have a close focus on the poor as they constitute the majority in developing countries. Doing so will help establish close relationships between health and poverty: are they closely related? Do they move on the same direction over time or are they contra-cyclical?

1.2. What do We Mean by “Health”?

Health, as poverty, is multidimensional, by essence. This multidimensionality opens the door on a huge universe that, in turn, complicates the tasks of the researcher. Defining and measuring it is neither easy nor new exercise. Concerns with health and disease have been a major preoccupation of humans since the Antiquity. However, the use of the word “health” to describe human “wellbeing” is recent. For long, health has been viewed as a state of absence of illness. But this notion is rather limitative and economists have used a broader definition. According to WHO, health is a “complete state of physical, mental and social wellbeing, and not merely the absence of disease or infirmity”. The word “complete state” may lead to various interpretations, but many researchers content with this definition. Many other definitions exists in the literature to try to soften the WHO’s definition, from Saracci (1997)’s “health is a condition of wellbeing, free of disease or infirmity, and a basic and universal human right” to Bircher (2005)’s “health is a dynamic state of wellbeing characterized by a physical and mental potential, which satisfies the demands of life commensurate with age, culture, and personal responsibility”. Bircher’s definition takes into account changes in health needs through time (aging, experience) and space (cultural factors). Sarraci’s definition is an intermediate concept. It tries to link the WHO’s ideal to contemporary issues of human rights, equity, and justice. Üstün and Jakob (2005) provide a good discussion.

Today, health is viewed from various perspectives. Under the angle of functionality, for example, where the researcher is interested on the respondent’s ability to perform certain

tasks or daily activities. It can be perceived positively, as fitness or wellbeing, or negatively, as the absence of illness or disease or injury (physical or mental). “Health” therefore is a balance under various perspectives¹⁰⁵. Good health implies good prospects for survival, and therefore for the future, as it is a basic and dynamic force that constitutes a resource for everyday life, not just an object of living. It leads to a state of total physical, mental, emotional and social wellbeing. It is influenced by our circumstances, beliefs, culture and social, economic and physical environments.

The taking into account of the dynamic nature of health and the cultural or religious factors is recent. This is why health’s notion has evolved to a “dynamic state of complete physical, mental, spiritual and social wellbeing and not merely the absence of disease or infirmity” (WHO, 1998, 2000). Some authors even go beyond and talk about the health of the whole community and link it to its customs and spirituality. Many also include longevity in health definition, as both as quality of life (see recent indicators such as the QALYs)

These definitions have limitations and are not so easily accepted. Some authors consider for example that the WHO definition confuse happiness and health through the notion of social wellbeing. These two notions are distinct life experiences. They do not always move in the same direction. Thus, any decrease in happiness for example can be perceived as a health problem, even if it is not, per se. The definition is also judged to be impracticable as no one could be reasonably is a state of “complete” health for a long period of time.

So, to wit, for our purpose, we will consider health as closely associated to a disease-free situation¹⁰⁶. However, a disease can be dormant and appear very lately. Conversely, some people can be sick but seem to be in good health. The diversity of illnesses also complicates the task of defining and measuring health.

¹⁰⁵ The Greek philosopher Hippocrates (460-377 BCE) thought that health is an adequate balance between blood, yellow bile, black bile, and phlegm. He is the first to theoretize health and recommends hygiene, sanitation and good nutrition to improve health status. Before him, a good health status was thought to be a gift from the Gods.

¹⁰⁶ And also to the absence of death.

The greatest difficulty in conceptualizing health nowadays is how to take into account the uncertainty associated to it. Arrow (1965) has shown that this is an important aspect that impacts greatly health, along with many market failures and the absence of insurance market. The patient cannot solely bear the costs of this uncertainty and thus it necessitates some dose of public intervention.

1.3. How do We Measure Health?

Health could be thought at the individual and the broader population levels.

How to measure individual “health”? In fact, it is not directly observed, but rather inferred through some proxies for the “health status”. To measure the individual health status, Deolalikar and Behrman (1988) explored four paths, each leading to many dimensions of health¹⁰⁷. We present the four ways in a decreasing order of difficulty of implementation (in terms of costs, inputs, time, etc.) but increased order of measurement errors.

- The first way is to measurement health clinically by examining in depth the body of the person (clinical examination). This is perceived as an objective measure of health status.
- The second is to look at the stature of the person (anthropometric measures such as weight, height, arm circumference, etc., or triceps skinfold thickness, etc.).
- The third is to assess health status by asking the respondent about his own perceived health status and his mortality history (the so-called self-respondent health status). These are rather subjective perception of health status.

¹⁰⁷ Behrman and Deolalikar also warned that each alternative is linked to many dimensions of health status, rather than to a sole unidimensional construct. This truly complicates the puzzle.

- Finally, the authors provide a fourth alternative: asking the respondent to perform some basic tasks or normal activities such as carry an object, or perform some physical exercises.

The increasingly difficult steps above lead to defining health indicators from the simplest (morbidity and mortality rates, malnutrition rate, etc.) to the most sophisticated (invalidity score test, quality of life measures such as DALYs and QALYs, etc.). This is acknowledged by many authors and international organisations such as WHO and UNICEF. However, measurement of 1) to 4) is prone to errors so due cautious is required.

In this thesis, we are concerned with the health of the population as a whole. One way to measure it is to aggregate individuals' health status. For long, life expectancy at birth has been the primary tool to measure it and everyone agrees that it is one of the best indicators, especially in the case of developing countries. But with the DHS data on hand, it is not possible to compute that variable and we could only infer on observations on children. Therefore, we rely on child health, especially child mortality as a proxy for the overall population's health¹⁰⁸. Child mortality could be seen as the extreme case of ill-health.

By analyzing child mortality rather than adult one, we limit considerably the risk of reverse causality from health to income.

1.4. Child Mortality as a Proxy for Overall Population's Health.

Child health, especially child mortality, had received early a great attention from economists, particularly over the past two centuries.

¹⁰⁸ Many authors have used child anthropometrics as proxy. However, we think that the measurement of such indicators may be prone to more errors than the mothers reporting on their children death. Few papers have tried to link child anthropometry and mortality (see Martorell and Ho, 1984, for a review of the literature). See the last section of this chapter for more details.

Why economists focused so much on child mortality? Because, strictly speaking, mortality per se is not an economic phenomenon¹⁰⁹. Mortality statistics are belonging mostly to the world of demographers and health agents (Sen, 1998).

The short answer is that many factors influencing child mortality have an economic background. Mortality can also be viewed as part of human rights¹¹⁰ and necessitates therefore a great consideration from demographers, statisticians, sociologists, economists, decision-makers, etc. Each occurrence of death or disease of any being is the manifestation of our society's incapacity on achieving wellbeing and happiness. Ultimately, death is the manifestation of our economic failure.

Child mortality, as poverty, is a test of economic performance. This is indeed the prime justification of the economist's invasion in a world that *a priori* does not belong to him. A society that fails to provide basic services (good education for all, safe environment, medical services, medical insurance, good jobs and salaries), especially in the deprived areas will end up with a high mortality and morbidity rates amongst its population. Moreover, as Sen (1998) emphasized, these diseases and deaths occur mostly in the poorest groups and amongst the female and child groups, shedding a light on the social inequalities and gender biases that prevail in the society.

We also have a certain emotional perception of death: we are, to a certain point, afraid of it, and for the common of us, it is perceived as a bad thing. We have a sense of protecting our children, which we perceive fragile and needing our assistance to survive in this world, until their majority. A second argument of studying child mortality thus lays in the values we attach to children and the fact that they ultimately determine the

¹⁰⁹ In a cynical way, death by itself is not a so bad thing, compared to morbidity. Once dead, one can assume that we rest in peace, while when sick, we suffer all the duration of illness. But death means the end of everything. We all desire to live as long as possible, eternally if possible, for some of us. And the more we live, the more we enjoy life and the more we have time to perform the important tasks we think we have to fulfill before dying and living this Earth. The extra-time gained in a society, as well as the improvement in productivity due to a better health status, can be translated into growth and economic development. The secular fight against death has led to a gain in life expectancy, even for the poorest countries.

¹¹⁰ See the Declaration of Human Rights, 1948.

future of the human fate. They are intended to be our projection, our prolongation into the future. They are our future. Children's health today tells us how our population will fare tomorrow. Ironically, because we fail to avoid death, they are the best response we could address to it. So, our moral duties are to make every effort to help them grow safe and in a good health.

To resume, our sense of justice combined to the fact that much human sufferance is involved command us to seek causes of mortality and the ways to reduce it, especially in the children's, defenseless, population. Children are indeed the segment of the population the most vulnerable, the most at risk of dying. Morality and justice command us to protect them.

In the theory of justice, living a long life is also considered an inalienable human right. Incapacity to achieve that goal is the sign that we doubly fail: fail to avoid death for ourselves but also for our descendants (see for example Rawls).

The third argument is linked to the consensus among economists that child's health is a good predictor of the family and of overall population's health and wellbeing. Studying child health is to study overall population health. Empirically, this statement is verified by comparing children's health in the developed and developing world, and within each country, between children from rich and poor groups: the first ones have better health outcomes and better survival prospects compared to the second ones.

A fourth argument is that growth theories have shown the importance of population growth in determining the steady-state output. Fertility and mortality processes are two key determinants of population changes. Thus, a reduction in child mortality will reduce fertility. In turn, this will mechanically slow population's growth and will increase the share of the pie (aggregate product) available to people in the economy.

A fifth argument is that improving child health and lowering child mortality will reduce health costs and will free more time that can be devoted to other productive activities.

Indeed, children's bad health status or death entails a huge cost for the family and the society, either emotionally, either on the time invested, either monetarily by the enormous money devoted to cure them. Thus, children's ill-health diminishes social welfare. As we have seen, maximizing social welfare is the overarching priority of any society. Thus, knowledge of the causes that impact child health or mortality would help use more effectively resources, design effective policies and improve considerably social wellbeing.

Nowadays, in modern economic theory, child mortality is amongst the best predictors of overall population's health and could be used as a measure of economic development, (Sen, 1998). Because mortality and health conditions depend on the quality of the health system and availability of health care, which in turn depend on the development level of the country, they can serve as proxies to measure the success or failure of an economic development process.

1.5. Measuring Child Mortality.

Departing from postulates posed by previous economists, especially economic demographers, we'll try in this chapter to measure child mortality as well as analyze the determinants usually employed in its regressions, and assess whether there are some regularities across time and space.

Children die mostly for three major reasons:

- morbidity and exposure to illnesses (especially in the first year of life),
- they have poor health endowments (genetic traits inherited from parents and ancestors; this is the "stock of health" inherited from the family),
- they have an unhealthful mix of inputs (not adequately breastfed, not given enough foods and more generally they have a poor nutrition, not cared sanitarily, etc.).

These conditions are not necessarily mutually exclusive. Their conjunction usually leads to higher mortality rates in the society.

There are typically two reactions to child mortality in the family or the society: “hoarding” and “replacement”. Hoarding is the family’s response to expected mortality. Replacement is the answer to experienced (and unexpected) mortality. In many cases, as children die very young, and as mothers can have other children, researchers focus on replacement.

Among possible sources for child mortality analysis, vital registrations are the best in that they record accurately births and deaths along with the causes of death and the family’s background characteristics. In developing countries however, they are rarely available. Thus, the researcher relies on household surveys, in which mothers are questioned about their fertility history and their health and that of their children. Other sources may be found in clinical registrations, in the compilation of international data.

Let’s now focus on the methods developed by economists and demographers.

Child mortality is usually measured through two methods: life-table models and death rates (probabilities of surviving) models. The first entails using mostly non parametric methods while the second could be done via flexible parametric ones. In other words, parametric methods explicitly model the impact of covariates on mortality, while non parametric ones do not rely on covariates but instead “let the data speak”. Our estimates suggest that non parametric approaches seriously underestimate true child mortality.

Non parametric models are generally of the life-table class. The best know life-tables models are the Bart model (Bart, 1983), the Demeny and Coale (1966, 1983) model and the Trussell and Menken (1984) model. The latter two are based on the Brass method (Brass and Coale, 1968; Brass, 1975)¹¹¹.

¹¹¹ Other models are mortality tables (Adhlaka, 1972) and mortality laws (de Moivre, 1975) both linking mortality to child age.

The parametric approach originated back to the work of Derrick (1927) and have been formalized by Cox (1972) and others in subsequent years. Among the parametric models, logistic and count data¹¹² along with duration or survival¹¹³ models have gained increased popularity.

In studying child mortality, one should bear in mind that it often occurs that the unit under observation is not usually the child (except for stature and clinical examinations), but rather his or her mother. So strong caution is due in interpreting results.

In this thesis, we compute child mortality rates based on fertility histories arising from DHS data. Indeed in these surveys, women of fertile age (usually 15-49 years) are asked questions about the total number of children they ever gave birth to, and among them, the ones that have deceased.

The fertility history in the DHS datasets is “complete” in the sense that for each child, the woman is asked his date of birth, and in the case the child has deceased, the date of his death. This kind of data is indeed suitable for survival analysis or other multivariate methods such as count models. However, survival models are superior in this case. On the other hand, incomplete fertility history is the case where we only know for each woman, the total number of children born and the number still alive at the date of interview.

In this case, the only way to assess child mortality is through a non parametric way, for example by comparing the data to a population of reference as in the Demeny and Coale model abovementioned.

We investigate the levels and causes of both infant and under-five child mortality.

¹¹² Tobit, poisson, zero inflated, binomial, etc.

¹¹³ Semi-parametric Cox, Exponential, Weibull, etc.

1.6. Literature Review on Child Health and Child Mortality.

Many papers have attempted to establish empirically the determinants of child health and mortality. Both macro and micro economic factors affect them. The rationale is again that understanding these determinants and investing in child health is good for the economy and ultimately for the society. A good survey of the literature is found in Appaix (2003) , Grigoriou (2005) and Belli et al. (2005). Relatively few papers have studied the macroeconomic determinants of child health. This is not the case with micro economic ones.

1.6.1. Macro Determinants.

While the level of development plays undoubtedly a significant role in lowering mortality, evidence seems to point out that, in poor countries, child survival is partly determined by a mix of household's production and demand of health care. It is not clearly established what part of child mortality is due to aggregate determinants (such as the country's level of development and other macroeconomic factors), what part is due to proximate determinants (such as health infrastructures and clean environment) and what part is due to underlying effects (such as the household's intrinsic inability of delivery a good care to children).

Many studies as shown below have established evidence for a strong correlation between the level of development (mostly thought as the increases in GDP per capita and its redistribution) and child mortality. Corollary, other macro indicators such as urbanization, changes in fertility rates and behaviour, the improvement in nutrition, the growth of primary health care and the expansion of the educational system also contribute to the rapid decline in child mortality. While these studies are showing an impact of health (generally low mortality and high life expectancy) on macroeconomic variables, the converse (i.e. the studies of the impact of macroeconomic variables on health, especially child health) seems to our knowledge to have been less investigated.

Concerning the overall country's development level, Huck (1995) for example has shown that there exists a strong correlation between infant mortality, living standards and economic development in North England during the Industrial Revolution period. Kunitz (1983) shows that the improvement in sanitation and the environmental situation in European countries as well as the rollback of illnesses, better nutrition, and availability of vaccines and better cares had resulted to a decline in child mortality.

These results are later confirmed by Mokyr (1993). More, he establishes a clear effect of technical progress on reducing child mortality.

Concerning the effects of health on aggregate variables, many studies have been conducted for the whole world. Sala-i-Martin (1997a, 1997b), Barro and Lee (1994), Jamison et al. (2001), Bloom and Malaney (1998), Sachs et al. (1998) and Barro (1996) have all attempted to measure such health effects on economic output. Their researches door-open on the development of the endogenous growth theories, which emphasize the role of human capital such as health and education.

Sala-i-Martin for example runs "one million"¹¹⁴ regressions, his own words, and find a significant impact of health (approximated by life expectancy) on economic growth for the period 1960-1992.

Barro and Lee consider two periods (1965-1975 and 1975-1985) and a sample of 95 countries to test the same effect. They find that a gain of five years in life expectancy increases growth rate by 58%. This effect latter reduced to 46% in Barro and Sala-i-Martin (1995) and to 33% in Barro (1996) studies. Bloom and Malaney obtain an elasticity of .21.

At a regional level, Bloom and Sachs (1998) show that the deterioration in health status in Africa explain half of the gap in growth rates between that region and the rest of the world, while Bloom and Williamson (1998) find that a reduction of one percentage point in child mortality result in an increase of 31% of growth rate in Asia.

¹¹⁴ He actually runs 32000 regressions on 60 variables.

Meyer (2001) does the same study for Latin America and finds an elasticity of .4 for life expectancy.

On country-level studies, Jamison et al. (1998) show that a 1% increase in life expectancy results in 13% increase of output in India.

Fogel (1994, 1997) shows that an increase in anthropometrical status has led to an increase in aggregate output by 30% in England, over the period 1780-1979. (See Appaix, 2003 for a complete survey).

The WHO's Macroeconomic Commission on Health (2001) in its study shows that countries with high level of human capital have unambiguously higher growth rates. More recently, Kawachi et al. (2002) and Reilly et al. (2007) also find a strong correlation between the level of development (approximated by per capita income) and health.

1.6.2. Micro Determinants.

Traditionally, economists distinguish between neonatal mortality conditions (which are related to foetus and delivery conditions) and infant or under-five mortality conditions (more related to socio-economic and health factors).

Socio-economic analyses focus mostly on the second type of conditions to determine the underlying and proximate factors that make children vulnerable to morbidity and death. Medical and epidemiology sciences focus solely on the impact of diseases on child mortality (Chen and Mosley, 1984; Klasen et al., 2002).

In studying micro determinants of child health and mortality, economists have increasingly relied on the framework developed by Chen and Mosley in their 1984 seminal article.

Their paper came as a criticism of previous papers that studied child mortality in a medical science approach. Their major critic is that these studies are too compartmentalized and often biased to the disciplines to which the authors belong. For them, it is better to study mortality through the lens of a social science approach, where correlations between mortality and socioeconomic characteristics are used to infer about the causal determinants of child mortality. They propose a set of “proximate” determinants (mothers’ characteristics, sanitation, prevention, nutrition and morbidity) to study mortality. Nowadays, economists add to these proximate determinants, the so-called “underlying” ones (such as child characteristics) to complete the model (Wagstaff, 2005).

Thus, the modified Chen and Mosley model would consider the following set of characteristics and indicators that we study in depth in following sections:

1.6.2.1. Morbidity, Illness and Injury.

According to the World Health Organization, morbidity (such as diarrhoea, fever, tuberculosis, etc.) accounts for more than 50% of child mortality. This morbidity effect has been confirmed by many studies such as Black (1984), Bradley and Keymer (1984), Foster (1984), Gray (1991), Brown and Breese (2003), Agarwal and Denic (2007), etc. Other studies have found a negative impact of morbidity on other health indicators (low anthropometrical status, low mental development, low cognitive skills, etc.).

Likewise, increased risk of sickness or injury and accident may shorten children life expectation.

1.6.2.2. Nutrition.

Another factor that influences child mortality is nutrition such as breastfeeding, milk and liquid foods intakes, vitamins supplementation, etc.

Great consideration has been given to breastfeeding which is crucial to child development in its initial period of life. For instance, the effect of breastfeeding is established by Da Vanzo and Habitch (1984, 1986) who find that increased breastfeeding has a strong impact on child survival in Malaysia. Conversely, Wolfe and Behrman (1987) find no impact of breastfeeding on child mortality in the Nicaraguan case.

Considering other health status indicators such as anthropometrical status, many studies found positive association between health outcomes and nutrition (Taylor et al., 1978; Chernichovsky and Kielmann, 1978; Clark, 1981; Blau, 1984; Magnani et al., 1985; or more recently Brahin et al., 2001 and Lang, 2003)¹¹⁵.

1.6.2.3. Children's Characteristics.

Many studies find that sex is a determinant of child mortality, as boys tend to survive less than girls at early stages of life, while the converse is true for latter stages. Likewise, increased birth interval is positively correlated to child survival. Birth rank is also presumed to be a strong determinant of survival. Other characteristics are sometimes considered such as size at birth, whether child is twin, premature birth, handicap, etc. Genetic effects are sometimes captured by taking heterogeneity into account in model regressions references.

1.6.2.4. Mothers' Characteristics.

The most considered maternal characteristics are her education (some authors consider instead her literacy or the ability to write and read), her age, whether she is currently active, as well as her knowledge of health signs, health treatments, health centers location and whether she uses them or not.

¹¹⁵ However, some authors such as Behrman and Deolalikar (1988) urge strong caution in including nutritional variables in child mortality estimates, because we rarely observe intra-household allocation of food, and because information on nutrition intakes is collected over a short period, while health status is a cumulative process over a longer period. We follow this advice and do not consider nutrition in our regressions.

In a seminal paper, Panis and Lillard (1994) show that child mortality is strongly correlated to the use of health care by mothers. In another important paper, Benefo and Schultz (1996) explore the links between child mortality and fertility in Ghana and Côte d'Ivoire and could not conclude to the exogeneity of child mortality, vis-à-vis fertility. They show that mother education is negatively (but weakly) correlated to child mortality, controlling for community, prices and health factors.

Apart some rare cases (such as Shultz and Benefo above cited), mothers' education in particular has received great attention. It is one of the strongest correlates of infant and child mortality, according to many empirical papers. It is believed that education provides women with a decision-making power, and makes them more aware of their children's health status and welfare.

It increases their knowledge about childhood diseases and their ability to understand illness and provide timely treatment (Cleland and van Ginnaken, 1988) or use adequately modern health services (Caldwell, 1993).

For example, Klasen et al. (2002) analyse the causes of child mortality in Zambia using a discrete-time survival model and find that breastfeeding and mother's age and education (along with children characteristics such as sex, birth interval) have all a negative impact on child mortality. They inspire from the work of Mosley and Chen above mentioned.

Da Vanzo and Habitch (1986) in their study show for example that a one year increase in mother education has a strong impact on child mortality. The same strong effect is detected by Behrman and Wolfe (1987) in Nicaragua. Some authors, such as Merrick (1985), combine father and mother education and find that they jointly reduced significantly child mortality (in Brazil in Merrick's paper). Even when controlling for potential variables that are associated with education, its effect is still significant in many studies (Caldwell, 1979; Farah and Preston, 1982; O'Toole and Wright, 1991; Breierova and Duflo, 2002; Dust, 2005).

Among potential explanations for the maternal education effects, we have the fact that education increases the productivity of health inputs, it reduces the costs of information about the optimal use of health inputs, it increases the mother's time costs, it increases the household's overall income and finally it changes the preferences for child health and family size.

Other authors also considered mother's current employment status. This can have two effects. On one side, this may increase the available income for the household, and thus be beneficial to child survival. On the other hand, mother's work will leave little time devoted on child care, and this may be source of increased risks for the child survival (Peterson et al., 1986). For poor countries, some authors such as Farah and Preston view mother's work as a sign of economic hardship.

Very few authors consider fathers' characteristics.

1.6.2.5. Households' Characteristics.

The most used household variables are its size, its composition (number of children, adults, seniors, etc.), its dependency ratio (number of active members versus inactive ones) and its socioeconomic (i.e. wealth) status. Pritchett and Summers (1996) find for instance that an important proximate of child mortality is the wealth of the family. It is also often found that bigger household size impacts negatively child survival as fewer resources are available for him.

Conversely, wealth appears positively correlated to survivorship, as found in many studies. Intra-household allocation of resources is of great concern of economists as it might determine why a given child is favoured vis-à-vis another.

For example, children who are more robust, therefore more likely to contribute to household's revenues, often tend to receive greater attention and resources from parents, *ceteris paribus* (see for example Shultz and Rosenzweig, 1982, for a study in India).

1.6.2.6. Access to Health Care, Hygiene and Sanitation Services.

Access to health care infrastructures is empirically shown to be beneficial for child survival. Likewise, a clean environment and good hygiene practices have all strong impact in lowering child mortality. For example, Shi (1999) using a world level of cities database shows that access to potable water and sewerage connections reduces significantly child mortality.

Conversely, he evidences that children who lack access to health care facilities have higher risk of death. Merrick (1985) also shows that access to piped water significantly reduces child mortality in Brazil. The same result is found by Da Vanzo and Habitch (op. cited) in Malaysia, as well as Lindskog et al. (1988).

1.6.2.7. Communities' Characteristics.

Community variables play a strong role in child mortality. The place of location (urban or rural residency) has been given a special attention. All studies currently point to the fact that living in urban areas unambiguously reduces the risk of mortality for children, because of a better environment, a better nutrition, and the proximity of health services. On average, large city residents enjoy favourable living conditions as compared with other urban cities and villages. This is the result of the concentration of publicly financed services, infrastructure, and the highest incomes in large and medium cities (Harrison, 1982; Shi, 1999).

Infant and child survival rates are affected not only through reduced public expenditure on city infrastructures, but also through the way in which the urban infrastructures are managed. However, in urban areas, child mortality rates are several times higher in slums and suburban areas than in more privileged neighbourhoods or even in some rural or semi-rural areas (Harpham et al., 1988; Stephens, 1996; Timaeus and Lush, 1995; Shi, 1999).

Other community variables are considered by economists, such as the number of infrastructures, social norms and beliefs, social practices (such as genital cutting), etc. For instance, Rosenzweig and Schultz (1982) assess the impact of a wide range of community variables (number of hospital beds, number of family planning programs, time to infrastructures, temperature, community average market prices, and the average of women schooling in the community), interacted with women schooling, on child mortality in Colombia.

Among other effects, they find for urban areas that family planning programs have strong impact on the mortality of children living in poor families with less educated mothers. They find no such impact in rural areas. They attribute the lack of these effects to the greater dispersion of family planning programs in rural areas. Soares (2007) find similar results for Brazilian communities.

1.6.2.8. Other Determinants.

Finally, some economists include in their analysis, variables such as the ideal or desired number of children to account for the replacement effects (Schultz, 1969; Schultz and Da Vanzo, 1970; Da Vanzo, 1972). Others focus on siblings or on the presence of older girls in the household, etc.

Inequality in the community as well as the expenditures could also play a role. Wagstaff (2000) examines the inequalities in child mortality in nine developing countries. He finds consistently that rates are higher in poor and deprived groups, as compared to the better-off ones. Finally, Filmer and Pritchett (1997) estimate the impact of public health spending on child mortality and find a strong negative relationship.

1.7. Trends in Child Mortality.

Since the beginning of the 20th century and regardless of economic development level, many developing countries are facing an impressive decline on child mortality, especially

under-five. The global death of young children, which was far higher than 200 per thousand before 1900, comes under 100 these last 50 years. In fact, many countries enter the era of “demographic transition”, a period characterized by the fall of both fertility and mortality rates. Historically, for developed countries, the transition has occurred in early nineteenth century, mostly after the Industrial Revolution, (even earlier in eighteenth century for France)¹¹⁶. Thus, mortality decline is strongly associated with economic and social development¹¹⁷.

Today, both advances in medicine and the rollback of many illnesses and epidemics as well as improvement in nutrition and sanitation, coupled to other factors such as (women) education, have played a crucial role in lowering mortality in most developing countries.

Even in SSA, the poorest region of the world, we are witnessing a decline in child mortality rates¹¹⁸, along with a decline in fertility rates¹¹⁹, following in this, worldwide trends. This is considered as being part of the normal world development process.

But even in this context of global decline, rates remain high and the trends are even reversing these recent years for some poor countries, especially for SSA countries^{120,121}, hampering progress accomplished. In SSA, child mortality rates are still desperately and disappointingly high. Child mortality is more experienced in rural areas of the sub-continent, even though this is also true in other developing countries, but at a lower magnitude.

¹¹⁶ These countries have witnessed an impressive decline in child mortality from higher rates of more than 300 deaths per thousand, to less than 10 today.

¹¹⁷ The two main reasons explaining this secular decline in mortality in developed countries are among others the advances in medicine such as vaccines and drugs (Hill and Pebley, 1989; Ahmad et al., 2000), in technology, in sanitation and hygiene (Preston, 1975; Preston and van de Walle, 1978), but also the improvements in nutrition (see the thesis of the British epidemiologist, Thomas McKeown, 1976). This even has led to a controversy between the “nutritionists” and the “medical” schools. Among those who support the hypothesis of better nutrition, we have Meeker (1972), Higgs (1973, 1979), Langer (1975), and Kunitz (1986) while those favoring the alternate approach are for example Razell (1974), Lee (1980), Winter (1982), Perrenoud (1984), Fridlitzius (1984) and Livi-Bacci (1983, 1991).

¹¹⁸ This is one of the “stylized facts” in health economics.

¹¹⁹ Whether there is a correlation between the two processes is passionately discussed among economists.

¹²⁰ In 1998, infant mortality rates in SSA were on average 94 ‰, compared to 9 ‰ in Europe, 35 ‰ in Latin America and 56 ‰ in Asia (WB’s WDI 2000).

¹²¹ Each year, about 10 millions children are still dying in the developing world, of which more than half in the sole SSA, according to UNDP’s Human Development Report 2002.

Explaining that high mortality rates is not an easy task because little is known about the decisions concerning life and death (are they rational choices?) and about the household information about health care and medicines, their costs and availability (McIntosh et al., 1986).

At the empirical level, this is more evidenced by the seminal work of Hill and Pebley (1989) that studies the secular trends in child mortality in the world and finds that the pace of decline has slowed in many regions, particularly in Africa, where the rate of decline is also the smallest. They attribute this latter finding to initial high mortality rates in child mortality in Africa. Another finding is that while a global downward trend is observed, disparities are very great between countries and are widening throughout the years. Indeed, some countries are not performing that well, according to their study.

These considerations of child health and child mortality, as well as many other development challenges such as poverty and low education, have led the international institutions and leaders from all the countries to establish a framework to evaluate the progress made in reducing child mortality, along with other indicators. These are the so-called MDGs, described *en long et en large* in the paragraphs above.

A gnawing question is why the decline is so slow and rates still high in Africa, and why for countries of the same level of development, some are doing better than others?

As previously said, trying to provide some answers to these questions will be the goal of this third chapter.

II. The Weibull Model and Estimates of Child Mortality.

As almost all African countries currently engaged in implementing their PRS documents and are struggling to attain the MDGs to which they subscribed by 2015, this section is an attempt to identify and estimate the major determinants of child mortality at the household level using a Weibull model.

2.1. The Model.

For long, economists have modelled child mortality through the lens of a logit or a probit (is your child still alive? Yes or no). Since many deaths can occur in the same household, count models such as the Poisson have been later proposed. To take into account the fact that mortality is often expressed in rates and so is bounded by zero and 100 or 1000, Guillaumont, Grigoriou and Yang (2005) and Grigoriou (2005) have proposed a transformed logit of the form $\ln(1/1-t)$ with t the mortality rate to take into account the boundaries of t . All these models are satisfactory only when we are dealing with rates or count number of deaths. We are however missing one important dimension in the model: time.

A common hazard function that has been used in the literature to analyze child mortality and account for time dimension (that is, the time to death) is the Weibull model¹²². We focus extensively on this model because it has proven to adequately fit child mortality.

A usual notation for the Weibull is to begin with a *hazard function* of the form (Jenkins, 2004):

$$\begin{aligned} h(t) &= pt^{p-1} \exp(\beta^T X) \\ &= pt^{p-1} \lambda \end{aligned} \tag{1}$$

where $h_0(t) = pt^{p-1}$ is the baseline hazard and $\lambda = \exp(\beta^T X)$ is the positive function. The shape parameter is denoted by p . For each p , larger values of λ imply a larger hazard rate at each survival time t . The hazard function increases monotonically with time if $p > 1$, decreases monotonically with time if $p < 1$ and is constant over time if $p = 1$. This latter case is a special case of the Weibull known as the Exponential model.

¹²² The Weibull is a sub-class of a more general model called “survival” or “duration” models which’s general framework is presented in the chapter’s Appendix.

The cumulative function is of the form:

$$\begin{aligned} H(t) &= \int_0^t pu^{p-1} \exp(\beta^T X) du \\ &= H_0(t) \exp(\beta^T X) \end{aligned} \quad (2)$$

with cumulative baseline hazard $H_0(t) = \int_0^t h_0(v) dv = t^p$ for all t .

The survival function in the Weibull case is given by the expression:

$$\begin{aligned} S(t) &= \exp(-H(t)) \\ &= \exp(-\lambda t^p) \end{aligned} \quad (3)$$

This yields a density function:

$$f(t) = pt^{p-1} \lambda \cdot \exp(-\lambda t^p) \quad (4)$$

From equation (2) above, we can derive the log-likelihood equation as¹²³:

¹²³ Many authors link the hazard function to another parameter. $\lambda = \alpha^{-p}$ where α is referred to as the scale parameter. This is the two-parameters Weibull distribution. In this case, the log-likelihood is:
 $\ln L = r \log p - rp \log \alpha + (p-1) \sum_{i \in U} \log t_i - \alpha^{-p} \sum_{i=1}^n t_i^p$ where r is the number of uncensored observations.

$$\begin{aligned}
\ln L &= \sum_U \log(p t^{p-1} \exp(\beta^T X) \exp(-\exp(\beta^T X) t^p)) + \sum_C (-\exp(\beta^T X) t^p) \\
&= \sum_U \log p t^{p-1} \exp(\beta^T X) + \sum_U -\exp(\beta^T X) t^p + \sum_C -\exp(\beta^T X) t^p \\
&= \sum_U p t^{p-1} + \sum_U \beta^T X_i - \sum_{i=1}^n \exp(\beta^T X_i) t_i^p \\
&= u \log p + (p-1) \sum_U \log t_i + \sum_U \beta^T X_i - \sum_{i=1}^n \exp(\beta^T X_i) t_i^p
\end{aligned} \tag{5}$$

where u and c denotes the uncensored and censored samples respectively and u is the number of uncensored or complete observations. Recall that $n = U + C$.

The First Order Conditions (FOC) are:

$$\begin{aligned}
\frac{\partial \ln L}{\partial \beta} &= \sum_U X_i' - \sum_{i=1}^n X_i' \exp(\beta^T X_i) t_i^p = 0 \\
\frac{\partial \ln L}{\partial p} &= \frac{u}{p} + \sum_U \log t_i - \sum_{i=1}^n \log t_i \exp(\beta^T X_i) t_i^p = 0
\end{aligned} \tag{6}$$

The solutions to equations (4) cannot be solved analytically. They are instead found numerically. We use the EM algorithm for optimization.

The Second Order Conditions (SOC) are given by:

$$\begin{aligned}
\frac{\partial^2 \ln L}{\partial \beta^2} &= -\sum_{i=1}^n X_i' X_i \exp(\beta^T X_i) t_i^p \\
\frac{\partial^2 \ln L}{\partial \beta \partial p} &= -\sum_{i=1}^n X_i' \log(t_i t_i^p) \exp(\beta^T X_i) \\
\frac{\partial^2 \ln L}{\partial p^2} &= -\frac{u}{p^2} - \sum_{i=1}^n (\log t_i)^2 \exp(\beta^T X_i) t_i^p
\end{aligned} \tag{7}$$

For robustness purposes, we confront the Weibull model to Cox and Exponential ones. We also test if there is any evidence of frailty. Results are shown below in the following sections.

Now the pertinent question is why we choose the Weibull approach?

Indeed, the DHS website maintained by Macro International provides estimates for child mortality rates and one can also compute them easily using non parametric methods such as the Kaplan and Meier as described below. However, we choose to proceed so for three major reasons:

- First, because we particularly affectionate parametric models (as the majority of economists did) as they allow for a greater flexibility in modelling child mortality and to assess the effects of particular covariates of interests such as the impact of mother's education or household's wealth. Conversely, non parametric do not allow such an assessment;

- Second, it is very difficult to reproduce by calculation official DHS estimates for child mortality rate. For example, the infant mortality for Malawi (1992) is 134.6 per thousand according to official DHS estimates¹²⁴. However, Dr Gwatkin and his team at the World Bank for example find for the same dataset a rate of 136.1¹²⁵. This is also the case for many other authors including the author of this current thesis. Though the difference may seem small and negligible in this particular case, it can be huge (up to 10 or 20 points) in some other situations. This is very unpleasant when preparing official reports to have huge discrepancy between own mortality estimates and official DHS ones. The main reason is that the raw datasets used by DHS team to compute official rates is often different from the recoded datasets available for download on their website. More, these official rates are computed using a fictive cohort approach that is not very "scientific" since it is based on artificial groups;

¹²⁴<http://www.statcompiler.com/tablebuilderController.cfm?userid=254799&usertabid=276579>

¹²⁵<http://siteresources.worldbank.org/INTPAH/Resources/400378-1103635502766/MALAWI1992-Total.xls>

- Finally, non parametric and fictive cohort methods usually tend to underestimate true child mortality rates. As many researchers rely heavily on non parametric methods, we urge a strong caution in interpreting their findings.

2.2. Data.

Our data sample consists of 111 country-years where DHS has been conducted¹²⁶.

To refresh the reader's memory, let us recall briefly the data we use.

The DHS are a set of nationally representative surveys conducted in more than 70 countries since the early 1980s (Sahn and Stifel, 2000).

They collect information on health (mortality, morbidity and treatments, vaccination, contraception and family planning, feeding, excision, etc.), fertility and demography, as well as on education, access to basic services, migration, occupation of adults and aids knowledge and sometimes aids prevalence¹²⁷. In order to undertake survival modelling, we use children dataset, constructed from individual data (usually women of 15-49 reproductive ages) and covering 5 years since the day of interview¹²⁸.

As said in the Chapter 1, the most prominent advantage of the DHS is that many sections of the surveys have been standardized to allow comparability¹²⁹, while the remaining sections vary to take into account country-specific information.

Another advantage is that they contain information on assets that enable us to compute the assets index, which has served in the poverty analysis for the Chapter 1. Finally, DHS is usually carried out by countries about once every five years. At least 25 countries in

¹²⁶ We define a country-year as a country where a DHS survey has been conducted during a particular year. For example, two DHS surveys have been conducted in Benin (1996 and 2001). This represents two country-years, or observations points in our sample. This represents a total of 111 observations.

¹²⁷ See <http://www.measuredhs.com> for more information.

¹²⁸ Some datasets cover only three years from the year of interview. Uganda (1995) covers 4 years.

¹²⁹ This is an advantage for our study, because many authors usually avoid cross-country or within-country mortality because of lack of reliable data (Srinivasan, 1994).

SSA have two or more surveys. This enables an accurate trend analysis and to even projecting future trends.

Surveys have been sponsored by the USAID ¹³⁰ since 1984 and implemented under the technical assistance of Macro International Inc. For each country benefiting of the DHS, at least one round have been conducted, while for others like Ghana, four surveys have been implemented so far.

We focus our study on infant and under-five child mortality. These are one of the most important outcome variables related to child health. The use and the comparability of DHS enable us to overcome the problem of accuracy and appropriate data usually encountered in child mortality studies. Moreover, the availability of dates for different outcomes (birth, day of interview) allows us to estimate directly the mortality, as opposed to indirect estimation which usually is believed to be less accurate.

2.3. Results.

2.3.1. Non Parametric (Kaplan-Meier) and Fictive Cohort Results.

Fictive cohort method is the official method followed by Macro International Inc. to compute child mortality on DHS datasets. In this setting, child mortality is calculated using synthetic cohort probabilities of death (Rutstein, 1984). Each probability is the ratio of the number of actual deaths on the number of children exposed to death in each cohort, for each period 0, 1-2, 6-11, 12-23, 24-35, 36-47 and 48-59 months. Formally, one can write the mortality rate as:

$${}_n q(x) = 1 - \prod_i (1 - q[i]) \quad (8)$$

$$i \in [x, x + n]$$

¹³⁰ This has in fact led to a certain bias since the majority of the countries covered are those under USAID assistance (UNFPA, 2002).

with x the time window variable.

For ${}_0q_1$, we have the neonatal mortality (deaths occurring in the first month of life), for ${}_1q_4$, we have the infant mortality, for ${}_0q_5$, we have the under-five mortality, etc.

The fictive cohort results have been computed using a program kindly provided by Macro International Inc., called ICMR (Infant and Child Mortality Rates) and implemented in STATA by Nicholas D. Hill.

The KM product-limit function is a particular form of life-table models, where time is treated as a continuous outcome, instead of just grouped into intervals. But the user can split still split it into step function intervals as we do.

In this setting, observations are considered over very small samples. We present in this section the survival curves based on the Kaplan and Meier (1958) life-tables formula.

$$\hat{S}(t) = \prod_{j|t_j \leq t} \left(\frac{n_j - d_j}{n_j} \right) \quad (9)$$

where $\hat{S}(t)$ is the survival past time t_j , n_j is the number of individuals at risk at time t_j and d_j , the number of deaths (failures).

Our non parametric estimates are displayed in the Table A7 in the Appendix. We estimate both infant (children that are less than one year old) and under-five child mortality rates.

Comparing the two methods, our fictive cohort results appear slightly higher on average than the Kaplan-Meier ones. They are however comparable to the official Macro

International Inc.'s estimates with are also supplied in the table¹³¹. Concerning the KM product-limit, results have been computed using Stata's internal command STS LIST.

Overall, over the period under study (1990-2005), infant mortality rates range from 12 ‰ in Vietnam (2002) to 138 ‰ in Malawi (1992) in the fictive cohort model, with an average of 68 and a standard deviation of 26.

For under-five child mortality, the average is 110 deaths per 1000 live births, with a standard deviation of 60. The minimum is 22 ‰ for Colombia (2005) and the maximum is 319 ‰ for Niger (1992). For the KM estimates, infant mortality rates range from 12 to 146 deaths, with a mean of 72 and a standard deviation of 29. Under-five mortality rates range from 21 to 283 deaths, with a mean of 101 and a standard deviation of 54.

One possible explanation of the differences between the two methods (and also the Weibull) is that the age intervals considered in the fictive cohort model are much higher than in the KM one. In the Weibull model below, age is treated as a continuous variable. So it seems that the smaller the age interval, the greater the child mortality rate.

As for the trends, in general and according to both models, most countries have witnessed a decrease in infant and under-five mortality rates, except in some Africa countries (see Figures A4 and A5 in the Appendix). For the SSA region as a whole, the progress has been very mild and moderate.

In Africa, the countries that have not succeeded in reducing child are Benin, Cameroon, Colombia, Cote d'Ivoire, Ghana, Kenya, Mozambique, Nigeria, Rwanda, Uganda and Zimbabwe. Many of these countries have first witnessed an improvement over the first and/or second periods before collapsing in the third. Others have experienced a continuous deterioration over the three periods. While the trends can be fairly understood for some countries such as Uganda (for poor economic performance in earlier periods) or

¹³¹ Again, the differences are due to the fact that DHS team often uses raw data, while we used the recoded ones. They also use SPSS and ISSA to compute mortality rates while we use Stata. There can be computational differences between these softwares.

Rwanda (because of the genocide), it is harder to comprehend why we observe a reversed trend for others. For example, Ghana, Cote d'Ivoire, Benin and Kenya are considered top performers economically speaking and yet, they are doing very badly in terms of child development.

At the higher extremity, we have Rwanda, Uganda, Cote d'Ivoire, Benin and Zimbabwe with an average of two additional children lost each year. Cote d'Ivoire particularly is the country with the poorest performance with an additional 7 deaths per year, passing from 78 to 115 deaths on average. One can assume that we are witnessing the premises effects of the social tension that have led the country to civil war in 2002 and are still tearing the country into two antagonist parts. Indeed, this civil war disrupts the organization of the health system, which has had severe consequences on child mortality.

For other countries, we think that the performance and the organization of the health system (in many parts due to an inadequate financing and other factors) may be part of the puzzle. We'll come back on these disturbing results later in the paper to see if they are confirmed by the parametric predictions. We also try to understand them by investigating some key determinants using the Weibull framework below.

The remaining countries have managed to decrease death rates, some of them significantly. In SSA, among top performers, we have Malawi, Ethiopia, and Niger. All have managed to save on average three infant deaths per year. Note that countries that had initial high mortality rates have managed to decrease them significantly.

In the case of Niger, for example, infant mortality rate drops from 142 deaths per thousand in 1992 to 107. Since the country's 1998 children survey available online only provides a sample on children aged 3 years or less, we couldn't compute the under-five mortality rate for this year. However, looking at the DHS website, we see that rates obtained using the fictive cohort methods dropped from 318 to 274 deaths¹³². At the time

¹³² The fact that Macro International team could provide that information illustrates once again the difference between the data they use to compute official DHS rates and the data online.

we made the calculations, the Niger 2006 survey was not yet available. But looking recently on the website, we see that mortality rates continue to improve, dropping from 274 to 198 deaths for children under-five. However, due to the recent famine crisis in Niger in 2007, we should await the new DHS survey to see if the country keeps sustaining this pace.

In the rest of the world, Haiti is the only country to increase child mortality rates and this is understandable when looking at its economic and political turmoil.

The remaining sample performs very well. Top performers are Brazil and Vietnam. Brazil makes the greatest effort over the period 1991-1996. The country manages to save on average 6 to 7 live births per year, dropping from a level of 75 infant deaths per 1000 to 40 (KM figures).

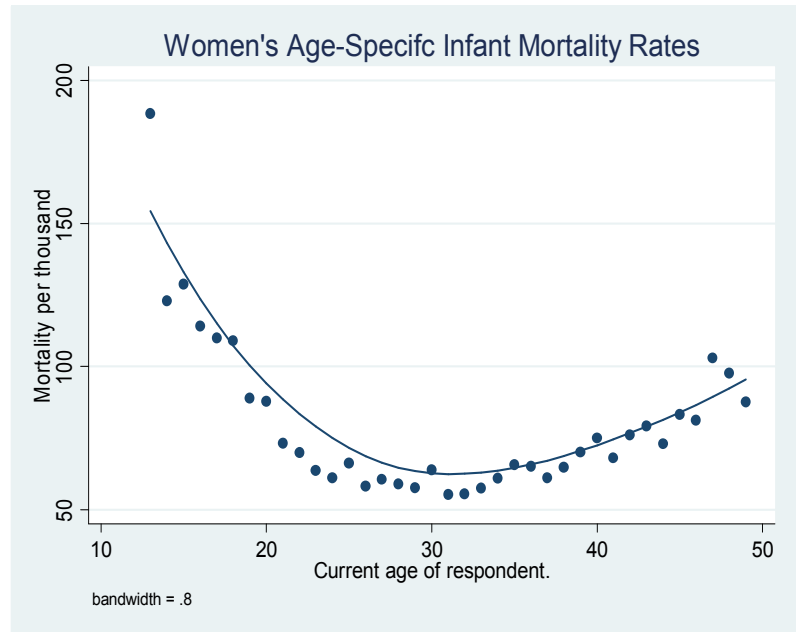
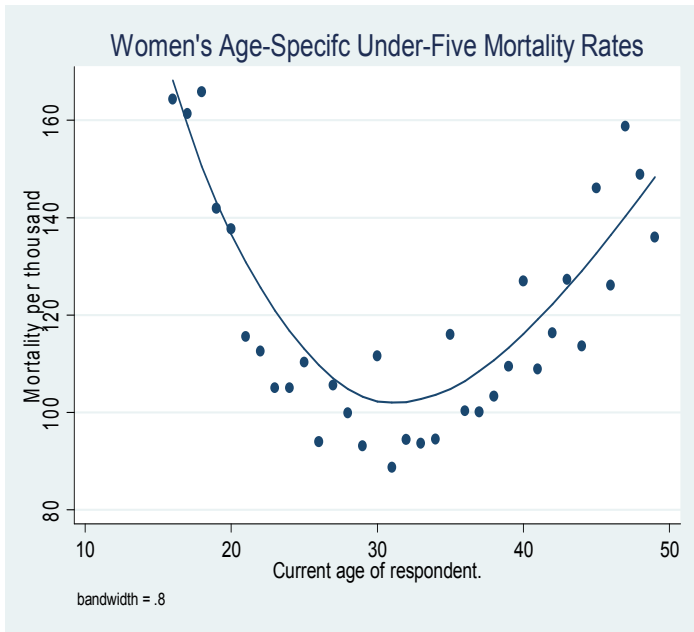
At this point, we investigate whether our results verify some basic hypotheses. Concerning the link between infant and under-five mortality rates and mother's age, our estimates yield a U shape ("bathtub") relationship for the world sample, as found in many studies (Figure 14).

For the fictive cohort model, the return point is around 30 years old for both graphs below, where women experience the lowest child mortality (approximately 50‰ for infant and 100‰ for under-five). Looking at country-level relations (not shown), we find that low-middle and high-middle income countries have a U shape while the poor income ones have a backward J shape.

While aggregate mortality rates are interesting on their own, it is worth scrutinizing what are the survival prospects for various groups or categories. Estimated survival curves are displayed below in the Figure 15.

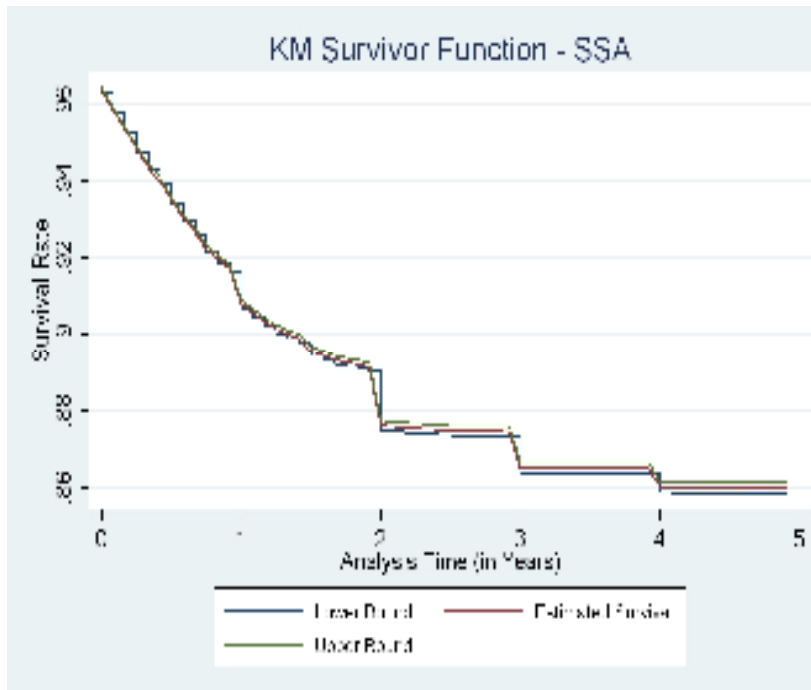
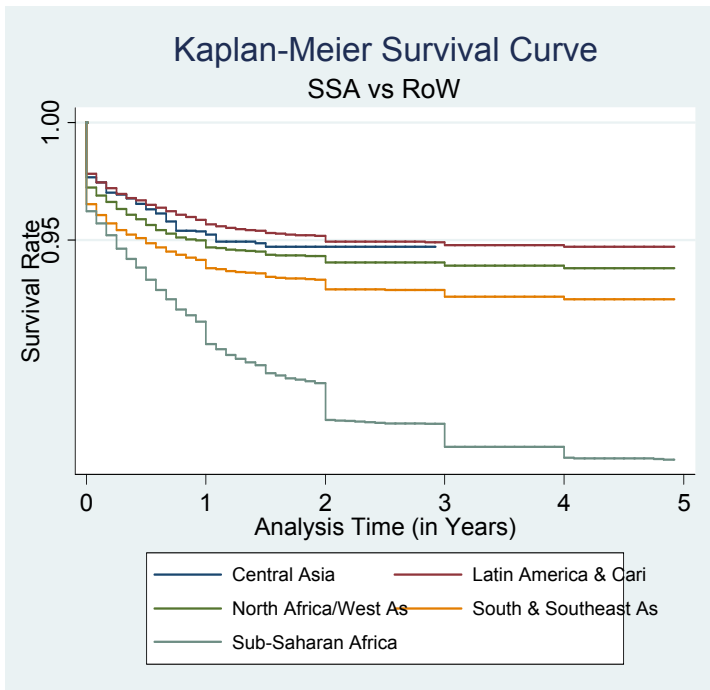
As these curves are the proportion of children still alive at each period, it is a decreasing function of time. We also only considered age intervals, so our survival curves are steps function, where "jumps" occurred at the threshold of each observed even time.

Figure 14: Relation Between Child Mortality and Age of Mother. World Sample.



Source: Author's calculations based on DHS data.

Figure 15: Non Parametric Survival Curves for SSA versus the Rest of the World.



Source: Author's calculations based on DHS data.

Looking at regional location, children in SSA clearly have lower survival prospects than others in the rest of the world. More, there is a clear gap between the region and the rest of the world. The survival graphs for other regions are closer.

The second most at risk region is South and Southeast Asia, followed by Central Asia and North Africa. Children in Latin America and Caribbean have better survival prospects.

The second graph of the Figure 15 below provides also interval confidences for the survival curve of SSA¹³³. The median survival time is 125 on average for the full SSA sample.

Focusing on SSA, we compare also survival curves for some key groups (see Figure A1 in the Appendix). Survival rates are unambiguously higher for more educated mothers. The more a woman acquires education, the more her child has a chance to survive in Africa. Gaps are clearly distinguished between curves, especially between “tertiary and more” and “no education”.

Looking at household’s socioeconomic status, only children born in very rich family clearly demark themselves. For the four remaining groups, survival curves are closer, though we observe a ranking from the poorest to the richest families.

Children that have been delivered in medical facilities and those whose mothers have benefited from prenatal care also have better chances to survive.

¹³³ The confidence bounds are computed as $\hat{S}(t)^{\exp(\pm z_{\alpha/2} \hat{\sigma}(t))}$ where $z_{\alpha/2}$ is the $(1 - \alpha/2)$ quantile of the normal distribution and $\hat{\sigma}$ is the square root of the asymptotic variance of the function

$$\ln(-\ln(\hat{S}(t))). \text{ It is defined as } \hat{\sigma}(t) = \sqrt{\frac{\sum \frac{d_j}{n_j(n_j - d_j)}}{\left(\sum \ln\left(\frac{n_j - d_j}{n_j}\right)\right)^2}} \text{ where sums are calculated over}$$

$j/t_j \leq t$ (Greenwood, 1926; Kalbfleisch and Prentice, 2002; StataCorp, 2007).

Children living in households led by a woman have slightly better survival chances, presumably because head women tend to adopt strategies that are more beneficial to child survival. Finally, female children have a little bit higher survival than male ones.

We obtain roughly the same results for the rest of the world.

Another important question is whether the observed subgroups survival differences are statistically significant (i.e. whether they did not occurred simply by chance or hazard). To test this, we rely on the most commonly used log-rank test¹³⁴. The test is of the general form (Kalbfleisch and Prentice, 2002; Klein and Moeschberger, 2003; Collet, 2003):

$$H_0 : \lambda(1) = \lambda(2) = \dots = \lambda(t)$$

$$H_1 : \neq \lambda(i)$$

where the null hypothesis is that hazard rates are equal and the alternative is that at least one hazard function is different¹³⁵.

If the chi-squared value associated with the test is sufficiently large and the associated p-value, sufficiently small, then we reject H_0 .

¹³⁴ Other tests results such as Peto-Peto, Wilcoxon, etc., are available upon request.

¹³⁵ Under the null, the expected number of failures in group i at time t_j is $E_{ij} = \frac{n_{ij}d_j}{n_j}$. The test statistic

T is distributed as a Wald Chi-square (χ^2 with $r-1$ degrees of freedom, r the number of groups or categories) and has the quadratic form $T = u'V^{-1}u$. The row vector is:

$$u' = \sum_{j=1}^k W(t_j)(d_{1j} - E_{1j}, \dots, d_{rj} - E_{rj})$$

and the $r \times r$ variance matrix V of u has individual elements:

$$V_{il} = \sum_{j=1}^k \frac{W(t_j)^2 n_{ij} d_j (n_j - d_j)}{n_j (n_j - 1)} \left(\delta_{il} - \frac{n_{ij}}{n_j} \right)$$

with $i = 1, \dots, r$, $l = 1, \dots, r$. $\delta_{il} = 1$ if $i = l$ and 0 otherwise. $W(\bullet)$ is a positive weight function that characterizes the various tests. It is nil when n_{ij} is zero. If n_{ij} is nonzero, then $W(t) = 1$ in the case of the log-rank test.

Looking at results for geographical region, we obtain a χ^2 value of 5154.38. The test shows that SSA has a relative hazard of 1.47 while the rest of the world has 0.74. The probability that the observed differences between SSA and the rest of the world occurs by chance is less than 0. Therefore, we can safely reject H_0 .

Likewise, performing the test for various groups (educational level, sex, mothers age group or education, household quintile, etc.) in SSA and the rest of the world, we found no evidence of supporting H_0 , except for “mother is currently working” in the rest of the world, where we cannot reject H_0 .

2.3.2. Parametric Results.

To assess the determinants of child mortality, we use the general reduced-form equation:

$$M(t) = f(X_{Child}, X_{Mother}, X_{Household}, X_{Community}, X_{Country/Year}) \quad (10)$$

where M is the mortality function over time t , and the X are characteristics of the child, the mother, the household and controlling for time and location effects.

In a first step, we try to determine what is the most adequate model (i.e. the functional form) to fit. We've asserted earlier above that the Weibull is the best model, but is really the case?

We had the choice between the commonly used Cox, Weibull and Exponential that are found in the literature. We rely on the AIC and BIC information criteria to discriminate among them. Table 9 below shows that the Weibull model has the lowest AIC and BIC and therefore is the most adequate model to fit. This result holds whether we test it at the country, regional or full sample levels.

In a second step, we consider five specifications for our Weibull model:

- a constant-only model with no covariates
- a constant-only model but with country-year fixed effects,
- a model based on child characteristics only
- a model based on household and mother characteristics only
- and finally a model accounting for child, mother, household and community characteristics.

Table 9: Testing for the Appropriate Model to Analyze Child Mortality.

Model	Observations	Log Likelihood (Null model)	Log Likelihood (Full model)	Degrees of Freedom	AIC	BIC
Weibull	320439	-205351	-199917	86	400006	400924.2
Exponential	320439	-287678	-282360	85	564890.8	565798.4
Cox	320439	-438336	-433268	84	866704.8	867601.7

Source: Author's calculations based on DHS data.

Models 2 to 4 control for unobserved country-year fixed effects. For each model, we perform two tests based on the well-known likelihood-ratio (LR) as well as a Hausman test to see if there is no evidence of misspecification. All the tests have rejected the null hypothesis at the 5% level. We also perform the above mentioned AIC test to see which model is the most adequate. Results show that model 5 is the best one to consider, both for SSA and the rest of the world¹³⁶.

Model 5 coefficient estimates are displayed in the Table 10 below for the full sample and for SSA and the rest of the world and for urban and rural areas. The pseudo Student's t and the corresponding p-value have been computed using standard errors adjusted for clustering. The table provides also estimates for subgroups in Africa region. All the regressions presented have been controlled for country and year fixed effects by including in each of them a dummy variable for each country-year and excluding Bangladesh 1994 as a reference group. However, we did not presented the coefficient

¹³⁶ We also test more complex models with interactions terms. There is no significant difference with the simple model that is presented here. These results are also available from us.

estimates of these dummies for space problem. The full regression tables can therefore be obtained upon request. Individual country-year based estimates for infant and under-five child mortality are also available from the author. They convey roughly the same messages than the more aggregate results that we are presenting below. We'll like to stretch the stability of our estimates.

The Table 10 displays coefficient estimates, instead of the traditional hazard ratios, because most of the readers are accustomed with the first ones. To retrieve the hazard ratios (HR) or death risks, one should simply take the exponential of the coefficient.

A negative coefficient (and correspondingly a HR below one) means that the variable has a decreasing or negative impact on mortality, and vice versa. Likewise, the shape parameter, p , is presented in a logarithmic form. One should simply use exponential to retrieve initial values. In general, all estimates are statistically significant at the 5% level.

A Wald test of the coefficients being statistically different from zero is performed on each variable, as well as on their joint significance, in the regression models. The null hypothesis is often rejected (this is denoted by the stars appearing on the coefficients and the joint Wald's Chi2). A Seemingly Unrelated Test (SUREG) is also performed to see whether SSA coefficients are comparable to those of the rest of the world. This hypothesis is rejected at 5% level, meaning the covariates used for regression may perform differently in each sub-group.

For all model, STATA reported shape parameter values below one. This means that overall, the hazard rate is decreasing over time for all groups under study. In other words, the more the child is ageing, the better his survival prospects. Wald tests for these parameters to nil (i.e. whether they differ of zero only by chance) are rejected. As infant and under-five estimates are usually consistent (i.e. convey globally the same message), we shall focus, from now on, on the under-five mortality determinants.

Looking at children characteristics, it appears that the sex of the child has a high impact on child mortality, either considering the full world sample, or by looking at sub-group estimates. We find a wide supporting evidence that boys have a higher mortality risk than girls. For the world sample, the estimate for boys is .12. The corresponding HR is 1.13 ($\exp(.12)$). This means that a baby boy has 13% higher risk (or “chance”) to die compared to a girl.

Comparing urban and rural areas regressions separately, it appears that boys are more at risk in urban (HR of 1.22 in urban versus 1.11 in rural meaning that boys have 11% more chance to die in urban than in rural). This result is really intriguing.

However, controlling for sex and area of residency in the full sample, one can see that leaving in urban areas favours more children than living in rural ones (HR of .96 meaning that leaving in urban decreases the death risk by 4%). The difference is small though. We came later on this below.

Likewise, boys are slightly more at risk in Africa than in the rest of the world, presumably because they receive less care and attention, *ceteris paribus*. This result is statistically significant, regardless of the sample considered. For infant mortality, the risk is about 14% for boys compared to girls in the full sample, 23% for urban compared to 12% in rural, and 15% in SSA compared to 13% in the rest of the world. These results are consistent whether we look at various desegregations in SSA region¹³⁷.

The fact that boys are more at risk than girls has been confirmed by other studies (Klassen et al., 2005), although other authors do not find any significant difference between the two sexes (see Wagstaff, 2002). One possible explanation could be that boys have lost, little by little, all of the privileged they hold over girls in African societies and both groups receive the same level of attention and care. Thus, we could view this as a sign the modernization of African societies.

¹³⁷ For infant mortality, one should expect to have the inverse result, i.e. girls being more at risk as found in many studies. But this seems to be only the case for neonatal mortality in our sample.

The variable related to fertility control (increased birth interval)¹³⁸ is negatively and statistically significantly correlated to reduction in child mortality in most of the cases. For example, compared to the reference group (first born), children whose mothers have waited at least 2 to 3 years have 27% more chance to survive in the full sample (a HR of .73 or a coefficient of -.32). In SSA, the chance is 29% against 26% in the rest of the world, and 13% in urban against 32% in rural. Chances appeared thus higher in SSA and in rural areas, possibly denoting earlier higher mortality levels, and thus a higher beneficial impact of birth control programs in these areas. These beneficial birth interval results imply that as mothers increase the time frame between two succeeding births, they have more opportunity to take care for their children. The fact that children first born have lower survival than those who have less than two years of interval denotes that they are more at risk and this is a sign of mother's inexperience. As she has more children, she gains more and more knowledge.

To summarize, models also show that increased interval is better for survival prospects.

Another important result is the height (size) of the child at birth. Height or weight at birth may be both a result of genetic traits and of maternal nutritional status during pregnancy. Our estimates show that, compared to children born with a small weight¹³⁹, children with average or middle height have higher survival rates (coefficient of -.08 or 8% more chance of surviving than the reference group) in the full sample.

The chances are higher in the urban sample (13% less chance of dying) while it is more narrowed in the rural one (7% less probability of dying comparably to small sized children) denoting the fact there is less variability in size for rural children. The same pattern is observed for SSA sample (5%) as compared to the rest of the world one (11%). As the size at birth increases and crosses a certain level, the relation gets inverted. Thus oversized children are more at risk than small sized ones (42% more risk of death in the full sample according to our estimates). All the coefficients are statistically significant at the 5% level.

¹³⁸ Either by lengthening the breastfeeding time or by using family planning services or other methods.

¹³⁹ According to the DHS team, less than 2500 grams.

Table 10: Determinants of Child Mortality from the Multivariate Regressions, Controlling for Country-Year Fixed Effects.

	World (Full Sample)	Urban Sample	Rural Sample	Rest of the World Sample	SSA Sample	SSA - Urban	SSA - Rural	SSA - Rich	SSA - Poor	SSA – Urban Rich	SSA – Urban Poor	SSA - Rural R
U5M												
Child is Male	0.124***	0.195***	0.105***	0.114***	0.126***	0.194***	0.113***	0.152***	0.114***	0.197***	0.178***	0.124*
Birth Interval (ref: First Birth)												
Less than 2 years	0.196***	0.256***	0.165***	0.285***	0.144***	0.142**	0.133***	0.152***	0.137***	0.172***	0.079	0.128*
2-3 years	-0.321***	-0.134***	-0.380***	-0.305***	-0.338***	-0.210***	-0.371***	-0.256***	-0.378***	-0.169***	-0.289***	-0.316*
3 years and more	-0.575***	-0.290***	-0.675***	-0.595***	-0.635***	-0.269***	-0.734***	-0.417***	-0.753***	-0.194**	-0.441***	-0.605*
Size at Birth (ref: Small)												
Medium	-0.083***	-0.139***	-0.070***	-0.112***	-0.052***	-0.103***	-0.043**	-0.064**	-0.045**	-0.079*	-0.166*	-0.057
Large	0.351***	0.541***	0.299***	0.502***	0.253***	0.427***	0.220***	0.336***	0.218***	0.434***	0.407***	0.273*
Current age of mother	-0.054***	-0.079***	-0.045***	-0.063***	-0.048***	-0.047**	-0.046***	-0.069***	-0.037***	-0.054**	-0.015	-0.072*
Current age of mother sq	0.001***	0.002***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001	0.001*
Age of mother at first birth	-0.047***	-0.041**	-0.057***	-0.063***	-0.051***	-0.074**	-0.050***	-0.115***	-0.024	-0.104***	0.043	-0.127*
Age of mother at first birth sq	0.001**	0.000	0.001***	0.001	0.001*	0.001	0.001**	0.002***	0.000	0.002**	-0.002	0.003*
Mother Education (ref: No Education)												
Incomplete primary	-0.003	-0.070**	0.013	-0.039	0.021	-0.027	0.029	-0.007	0.031	-0.027	-0.067	0.005
Complete primary	-0.138***	-0.161***	-0.137***	-0.212***	-0.097***	-0.077	-0.108***	-0.123**	-0.075**	-0.155**	0.157	-0.096
Incomplete secondary	-0.264***	-0.260***	-0.243***	-0.285***	-0.189***	-0.175***	-0.166***	-0.231***	-0.129**	-0.209***	-0.196	-0.246*
Complete secondary	-0.634***	-0.543***	-0.623***	-0.599***	-0.620***	-0.566***	-0.577***	-0.623***	-0.588***	-0.598***	-0.680	-0.577*
Tertiary and Higher	-0.741***	-0.633***	-0.641***	-0.716***	-0.409***	-0.343**	-0.315	-0.431***	-0.457	-0.309**	-2.567**	-0.553*
Mother is working	0.094***	0.050**	0.104***	0.068***	0.093***	0.014	0.109***	0.065**	0.107***	0.041	-0.063	0.076*
Head of household is a woman	-0.006	0.078**	-0.035*	0.037	-0.144***	-0.041	-0.166***	-0.095**	-0.174***	-0.048	-0.045	-0.136*
Medical delivery	-0.005	-0.097***	0.010	-0.071***	0.033*	-0.058	0.045**	-0.039	0.063***	-0.118**	0.097	-0.007
Prenatal Care	-0.528***	-0.551***	-0.522***	-0.485***	-0.538***	-0.588***	-0.534***	-0.554***	-0.544***	-0.635***	-0.542***	-0.520*
Polygamous household					0.294***	0.208***	0.311***	0.277***	0.309***	0.200***	0.198**	0.318**
Asset index	0.072***	-0.018	0.101***	0.071**	0.064**	-0.030	0.130***					
Asset index sq.	-0.022***	-0.003	-0.033***	-0.019**	-0.025***	-0.004	-0.050***					
Household size.	-0.114***	-0.115***	-0.117***	-0.204***	-0.123***	-0.119***	-0.128***	-0.116***	-0.138***	-0.149***	-0.116***	-0.121*
Household size sq.	0.002***	0.002***	0.002***	0.005***	0.002***	0.002***	0.002***	0.002***	0.002***	0.003***	0.002***	0.002**
Safe water	-0.055***	-0.077***	-0.044**	-0.096***	-0.032	-0.104**	-0.003	-0.061**	-0.024	-0.108**	-0.202**	-0.044
Urban area	-0.043**			-0.105***	-0.019			-0.087***	0.044			
Constant	-1.812***	-2.162**	-0.180	-1.044**	-1.100***	0.520	-0.257	0.741**	-1.469***	0.351	-4.639***	1.705*
Observations	662449	217533	444916	341539	277983	73770	204213	115191	162840	60298	13472	54895
Log Likelihood	-321255	-72353	-248468	-119798	-172860	-30490	-142155	-58677	-114038	-23656	-6728	-3487
Wald Test of Joint Significance	17687***	6703***	11710***	6099***	7700***	1800***	6140***	3002***	5098***	1693***	474***	1710**

Ln(p)	-1.662***	-1.739***	-1.641***	-1.883***	-1.522***	-1.586***	-1.509***	-1.557***	-1.505***	-1.610***	-1.502***	-1.521*
IMR												
Child is Male	0.137***	0.210***	0.117***	0.125***	0.143***	0.218***	0.128***	0.169***	0.129***	0.230***	0.180**	0.137*
Birth Interval (ref: First Birth)												
Less than 2 years	-0.319***	-0.367***	-0.322***	-0.315***	-0.304***	-0.362***	-0.301***	-0.341***	-0.295***	-0.373***	-0.351**	-0.332*
2-3 years	-1.036***	-0.929***	-1.074***	-1.057***	-1.008***	-0.899***	-1.035***	-0.937***	-1.048***	-0.877***	-0.953***	-0.967*
3 years and more	-1.475***	-1.250***	-1.560***	-1.566***	-1.468***	-1.108***	-1.564***	-1.243***	-1.599***	-1.064***	-1.222***	-1.382*
Size at Birth (ref: Small)												
Medium	-0.132***	-0.161***	-0.127***	-0.162***	-0.102***	-0.131***	-0.098***	-0.105***	-0.101***	-0.101**	-0.177*	-0.109
Large	0.248***	0.466***	0.187***	0.330***	0.172***	0.389***	0.131***	0.281***	0.123***	0.409***	0.363***	0.208*
Current age of mother	0.172***	0.190**	0.168***	0.201***	0.144***	0.146***	0.144***	0.136***	0.151***	0.166***	0.112**	0.121*
Current age of mother sq	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001***	-0.001***	-0.001***	-0.002***	-0.002***	-0.001	-0.001*
Age of mother at first birth	-0.126***	-0.089***	-0.151***	-0.156***	-0.129***	-0.126***	-0.135***	-0.139***	-0.129***	-0.141***	-0.067	-0.150*
Age of mother at first birth sq	0.001***	0.000	0.002***	0.001***	0.002***	0.001*	0.002***	0.002***	0.002***	0.002*	0.000	0.002*
Mother Education (ref: No Education)												
Incomplete primary	0.064***	0.015	0.065***	0.067**	0.062***	0.030	0.059**	0.021	0.073**	0.034	0.057	0.001
Complete primary	-0.021	-0.040	-0.021	-0.025	0.007	0.030	-0.007	-0.002	0.015	-0.043	0.401***	0.016
Incomplete secondary	-0.101***	-0.084*	-0.080**	-0.113***	-0.013	-0.036	0.054	-0.050	0.078	-0.043	0.085	-0.006
Complete secondary	-0.523***	-0.361***	-0.561***	-0.462***	-0.551***	-0.489***	-0.473***	-0.526***	-0.449**	-0.457***	-0.895	-0.527*
Tertiary and Higher	-0.684***	-0.547***	-0.573***	-0.672***	-0.181	-0.133	-0.019	-0.181	0.149	-0.061	-1.742*	-0.336
Mother is working.	0.197***	0.180***	0.198***	0.236***	0.150***	0.138***	0.150***	0.143***	0.150***	0.138***	0.062	0.135*
Head of household is a woman	0.004	0.063*	-0.015	-0.003	-0.112***	-0.019	-0.131***	-0.073	-0.136***	-0.033	-0.036	-0.117
Medical delivery	0.100***	0.054*	0.105***	-0.048**	0.205***	0.197***	0.203***	0.179***	0.217***	0.151***	0.318***	0.180**
Prenatal Care	-0.851***	-0.983***	-0.819***	-0.597***	-0.993***	-1.300***	-0.941***	-1.149***	-0.932***	-1.397***	-1.081***	-1.009*
Polygamous household					0.224***	0.160***	0.234***	0.197***	0.237***	0.140***	0.147	0.222*
Asset index	0.124***	0.091***	0.140***	0.151***	0.116***	0.101*	0.164***					
Asset index sq.	-0.023***	-0.013**	-0.033***	-0.027***	-0.027***	-0.016*	-0.051***					
Household size.	-0.126***	-0.138***	-0.126***	-0.248***	-0.116***	-0.123***	-0.118***	-0.112***	-0.127***	-0.162***	-0.100***	-0.112*
Household size sq.	0.002***	0.003***	0.002***	0.007***	0.002***	0.002***	0.002***	0.002***	0.002***	0.004***	0.002***	0.002**
Safe water	-0.031*	-0.029	-0.028	-0.063***	-0.015	-0.078	0.020	-0.010	0.002	-0.064	-0.158*	0.009
Urban area	-0.005			-0.070**	0.020			0.015	0.065			
Constant	-1.337***	-3.991***	-0.768***	-2.261***	-0.969***	-0.834	-0.852***	-0.796*	-0.833***	-0.884	-0.056	0.836
Observations	199727	60822	138905	96648	89630	22548	67082	35686	53957	18203	4345	17486
Log Likelihood	-209637	-47531	-161673	-84025	-107459	-18849	-88383	-36469	-70843	-14590	-4159	-2171!
Wald Test of Joint Significance	20723***	7351***	14624***	7856***	11579***	3181***	8898***	4003***	7499***	2286***	1173***	1948**
Ln(p)	-1.584***	-1.658***	-1.562***	-1.737***	-1.478***	-1.553***	-1.461***	-1.517***	-1.458***	-1.577***	-1.457***	-1.474*

Source: Author's calculations using DHS data and sample weights.

Amongst mothers' characteristics that impact the most child survival, age at first birth is a strong predictor of child mortality. Mother's age has an inverted U shape relationship on child survival, with a threshold around 30 years old. The same relation is observed for age at first marriage. When mothers are very young (and get married very young), their children are more at risk. But as they get older, the risk diminishes accordingly up to a certain level when it starts to rise again. Thus, as mothers become very old, the risk is unambiguously high for their children. This is consistent across all our regressions. For the full world sample for instance, any additional year of the current age of the mother decreases the mortality risk by 5% (HR of .95 for a coefficient of -.05). For age at first birth, figures are similar (HR of .95).

As found in numerous studies, mothers' education appears to be a strong determinant of child mortality in our study¹⁴⁰. The result holds, even when controlling for country-year fixed effects and community variables such the area of residency. This contrast with some results that showed the vanishing effect of mothers' education when such controls are included (see for instance Benefo and Schultz, 1996). Lavy et al. (1996) also found no impact of mothers' education.

One remarkable result is that our estimates are showing that education should reach a threshold of complete primary before being beneficial to children. Indeed, children born from mothers with incomplete primary education appear to share the same risks with those whose mothers have no education. The results however are not statistically significant, except for the urban sample. From the top of that level (that is, a minimum of complete primary school), education starts to play a strong role.

Another remarkable result is that the more the mother is educated, the less her child is exposed to the mortality risk, except in SSA and its subgroup regressions, where the impact is a bit lower for "Tertiary and Higher" level, compared to lower levels. For the world sample, and for urban, rural, and the rest of the world, we observe a monotonical

¹⁴⁰ See Caldwell (1979) or Rutstein et al. (1985) using DHS data. More recently, see Rosenzweig et al. (1997), Guilkey and Riphahn (1998), Wagstaff (2002) and van der Klaw and Wang (2004) for a full discussion on the effects of mothers' education on child mortality.

increase in education effects. Taking the full sample regression into consideration, children whose mothers have university level have up to 52% more chance to survive than those whose mothers are uneducated, anything else being equal. The figures are 47% for complete secondary level and only 13% for complete primary level. Considering urban and rural samples separately, it appears that the beneficial impact of education is slightly higher in the latter, denoting again the small disparity in education in urban areas and possible other effects such as better access to services that might mitigate educational effects.

For SSA, estimates show that the ideal for a child is to have a mother with a complete secondary level (HR of .54) instead of one with a higher one (HR of .66). The latter will have a 12% higher risk of death. The same results appear for urban and rural, as well as poor and rich sample in SSA region.

This could be the result of inadequate attention received by those children. Indeed, as mothers are very educated, they will probably be engaged in an economic activity, thus having less time to devote to their children, transferring the care to servants (often with little or no education). These servants are usually less willing to really take care of the kids.

Indeed, estimates show that the fact that the mother being working is paradoxically detrimental to child survival.

Whatever the level considered, results are statistically significant at 5% level, except for urban rich and urban poor samples in SSA. For the full world sample, mother's activity reduces the chance of survival by almost 10% (a coefficient of .09 or a HR of 1.1). This is an intriguing result.

As mothers are working, they normally earn more money and thus higher revenues for the household. Therefore, one possible result is that this does not translate automatically into child wellbeing, especially when she lacks control over that resource. Another possibility is that it is the poverty situation of the household that pushes mothers to

engage in these activities. Whatever the reason, estimates suggest, as stretched above, that these mothers have less time to take care of their children.

When households are run by women, this tends to be beneficial for children, though the effects are weakly significant, except in SSA and particularly in rural African areas and among the poorest African households.

Conversely, for SSA region, polygamy appears unambiguously detrimental to child survival. For the subcontinent as a whole, a child in a polygamous household has 34% higher risk of death. This result is strongly statistically significant, and remains when we run regressions on SSA subgroups. Indeed, polygamy deprives mothers of their rights and rank in the household. Also, it tends to increase the household size along with the number of children in the household. This puts children into competition for food and attention.

In our regressions, we also consider medical health interventions. Everything being equal, medical assistance at delivery seems to benefit children only in rural areas (where the impact is quite high because of already low health care) and those living outside Africa. In the urban sample, medical delivery lowers child death risk by 9% (HR of .91). For the rest of the world, there is 6.8% less risk associated to mortality, thanks to medical assistance. Surprisingly, in the African subcontinent, there is no clear difference between the two groups of those who benefited and those children who did not. Worse, results seem to indicate again that only children in the rich group benefit from this intervention, but they are not significant. This suggests that poor households tend not to use, or benefit of, medical delivery services. They may possibly rely on it only in urgent situations. The lack of effect of medical delivery in our paper is contrary to general findings (Wagstaff, 2002). However as a whole, these services are indeed important for child mortality.

One of the most significant results of our analysis is the strong impact of prenatal care on child mortality. More than the medical assistance at delivery per se, it seems that the best

intervention for child survival is to give medical attention to the mother during her pregnancy. If the primary effect of prenatal care is to increase the mothers' health and survival, it can also have a strong impact of the foetal health through better dietetic nutrition, vitamin A, monitoring, early detection of health and pregnancy problems, etc. Our findings suggest that on average in the world, a child whose mother have had at least one prenatal care visit will have 41% lower risk to die. This result holds for any subgroup regression and is statistically significant in all cases.

Considering household characteristics, results are mixed. Surprisingly, household's wealth appears not to be a strong determinant of child mortality¹⁴¹. Our results show that wealth impacts child mortality only at very high levels, denoting that children basically face the same risks associated to death. This confirms the univariate results found and abundantly discussed above in the Kaplan and Meier case (Figure A3 in the Appendix). Only in the urban sample wealth seems to be beneficial to child survival, regardless the level, but the result is not significant.

This result is not new and has been found in many other studies involving assets index (see for example Baker, 1999; and Harttgen and Misselhorn, 2006). Wagstaff (2002) using consumption variable also find no impact of the welfare indicator on child mortality in Vietnam. As in our case, welfare effects vanish when controlling for community factors and especially mothers' education.

One possible explanation for our findings is that the assets index may be poorly correlated with true household's wealth or may be poorly related to child survival¹⁴². Another source may be measurement errors in the assets owned by the household. Finally, some authors have argued that the welfare measured by this index may not directly translate into child better health, but instead may have indirect effects on him

¹⁴¹ There is a debate among economists about whether to include household's income or wealth in studying child health or mortality. Some authors think that household's wealth may not impact child mortality, once mother's education is controlled for. Behrman and Wolfe (1982) provide an interesting discussion about this issue.

¹⁴² For instance, having a bike or a TV may not directly matter to child survival if there is no health facility in the area. But it could have an indirect effect if for example the household learns through the TV that a new facility is available in the neighboring district and that they could take the child to it on the bike.

through other variables such as better education or better health practices (Abou-Ali, 2003).

Instead of the composite assets index, we've run several regressions (not shown) where we include each asset owned by the household as in Aguilar (2007). We observe that some assets lower the mortality risk (this is the case of having a radio or owning a bicycle), but in their vast majority, they have the same effect than the composite index. Finally, to account for possible errors measurement in our assets, we consider substituting for the assets index, by replacing it by its polynomial regression (up to power 3) and by its non parametric spline regression, but results do not differ much.

As for the household size, estimates show that the higher, the better. On average for the pooled sample, an additional family member (especially an educated adult) tends to lower child mortality risk by 11%. This is probably due to the benefit of additional sources of revenues for the household, better health education knowledge shared and pooling together risks and resources.

But a too huge family size hampers child survival prospects, mostly due to the competition effect between children as described above¹⁴³. These results hold whatever the sample under consideration and are all significant.

Access to safe water and sanitation is also good in general for child health and survival. This is a strong and statistically significant result, for the pooled world sample and for subgroups ones, except in the SSA full sample and some of its subgroups.

The effect of water is ambiguous across studies. While some papers find a positive impact (for example Ridder and Tunali, 1999), others find little or no significant impact (Lee et al., 1997). Studies in fact tend to show that while water favours rich children, it has in fact no general impact for poor children (Esrey and Habitch, 1988; Rosenzweig et al., 1997; Jalan and Ravallion, 2001), as our chapter suggests for poor groups in SSA.

¹⁴³ There is also overcrowding effects along with poor sanitation and hygiene, leading to an environment that is detrimental to children, especially the fragile ones.

It seems in our case that, even when poor households have access to safe water in SSA (generally from public tap), its utilization is inefficient in improving children's health. For example a poor conservation in dirty recipients may lead to the proliferation of bad germs that can increase illness risks for children. This is also the case if the "safe" water from taps is not well-treated, though the probability is lower.

In our full sample, having access to potable water reduces death risk by 5% (HR of .95 or a coefficient of -.05). Considering urban and rural samples separately, the effects are higher in the first (HR of .93 versus .96). While access to water unambiguously lowers child mortality risk in the rest of the world by 9% (HR of .91), the figures are not significant for the SSA sample, though it is also observed a mild decreasing impact (3% less risk).

For Africa, estimates distressfully show that only the urban and the rich groups benefit fully for access to safe water, mainly because the poor groups and the rural areas have almost no access at all or very little¹⁴⁴. When the poor has access to water, they seem to inefficiently use it. Compared to the situation with no access, safe water therefore still matter for child survival in SSA, especially if properly used by households.

Finally, we also consider area of residency effects in our models. Once again, estimates also show a weak effect on child survival, once controlled for other factors such as education.

This is truly a surprising result, since there is a clearly established empiric gap in child mortality between urban and rural children. In our case, the gap is very tin, especially in SSA. For the full world sample, estimates show that children living in urban areas have only 4% less risk of dying compared to those living in rural ones. Results are significant only at the 10% level.

¹⁴⁴ See Chapter 4 below and Diallo and Wodon (2005) for more detail.

Considering the rest of the world only, we retrieve the traditional result. Children have in this case 10% more chance of surviving (statistically significant at the traditional 5% level).

For the African region, there is no significant difference between children living in urban and rural areas with the first ones have a slight better survival prospect¹⁴⁵. More, only children residing in better-off urban households have better prospects, *ceteris paribus*. According to our estimates, they have 8% less chance of dying. Once again, these results tend to emphasize the fact that children living in rural areas and poor families face almost identical death hazards. It also shows that mortality is high in suburban (slums) areas.

2.3.3. Oaxaca Decomposition.

As we've seen, the coefficients for SSA and the rest of the world are statistically different according to the SUREG test. We confirm this with a decomposition technique and go beyond to explain which part is attributable to differences in covariates and which part is due to differences in coefficients.

The Oaxaca-Blinder decomposition (Oaxaca, 1973; Blinder, 1973) shows the differences between the two models. The gap in endowments (or variables) is the "explained" part (that is, the difference in SSA and the rest of the world characteristics evaluated using either SSA or the rest of the world characteristics as reference). The gap in coefficients is the "unexplained" part (due to unobserved factors for equal characteristics between the two samples).

It appears that the differences in estimations between the two regions are mainly due the interaction effects between variables and coefficients. The second largest effect is explained by differences in coefficients. This means that both the interactions between

¹⁴⁵ van de Poel and van Doorslaer (2007) also reported the weak urban-rural difference in child mortality once several covariates (especially wealth) are controlled for.

the levels of the variables and the levels of the coefficients, as well as the differences between the coefficients are important for reducing child mortality rates in SSA.

Since the coefficients term is relatively small, this means that, in terms of policy analysis, SSA Governments should focus more on other factors than the covariates used in regression (education, age, etc.) such as the improvement of overall health system performance, the availability of drugs, vaccination campaigns, etc., before shifting attention on them through health advices, etc.

Indeed, the results show us that it is the combination of the availability of this “macro” variables coupled with households characteristics that matters for child survival (i.e. a “systemic” approach coupled with the “determinants” one). It is no use for the mother to be well educated if her children could not receive adequate vaccines and health care at birth. It is no use to have good health facilities if households are not educated enough to use them efficiently.

Table 11: Oaxaca Decomposition for Mortality Estimates.

Total	Coef.	Std. Err.	Z	P>|z|	[95% Conf. -Interval]	
Endowments	-0.91	0.4	-2.25	0.02	-1.7	-0.12
Coefficients	0.55	0.12	4.67	0	0.32	0.79
Interaction	1.13	0.42	2.7	0.01	0.31	1.96

Source: Author’s calculations based on DHS data.

2.3.4. Explaining Child Mortality Results: A Poor Health System Organization and Performance.

We assess mortality rates in this section and wonder why there is no much improvement. As we will see and postulate, a bad health system can be one part of the puzzle, the other being, in our opinion, high inequality in health.

Using the Weibull model, we’ve run country-based as well as aggregate regressions for children under five and for children less than one year old to retrieve parametric infant and under-five mortality rates. These rates are displayed in the Table A8 in the

Appendix, along with life-table and KM results. They confirm the global decreasing tendency found as in the non-parametric case.

At this point, it is striking to see how the parametric (Weibull) results differ in their magnitude, comparably to non parametric. Assuming parametric models are better, they show that in most cases, non parametric methods highly underestimate true mortality by almost half. This is not the first study to find such a discrepancy in child mortality estimates using different methods. Adetunji (1996) for instance shows that direct methods based on the fictive cohort approach provide lower estimates than indirect ones based on the Trussell-Brass approach.

The estimates in general show a disturbing, rather a distressing, panorama.

The late 1990s (1995-2000 and even the earlier 2000-2001) have been a lost decade for child mortality reduction in many SSA countries. During that period, while many of these countries (Benin, Burkina, ...) have managed to reduce assets poverty, they have also witnessed a rise in child mortality, leading to what we call the “African Poverty-Mortality Paradox”.

This is indeed yet another puzzle to solve, the gnawing question being that, if health is positively related to welfare as many studies seem to indicate, how a country can simultaneously experiment a decline in assets poverty and an increase in child mortality.

One of the possible explanations that come in our mind is the performance of the health system. If it is poor, even if households get wealthier (but could not easily migrate), child health can diminish¹⁴⁶. Then the question arises why and how the health systems in some SSA countries are not improving? We try to answer this in sections below.

In the rest of the world, we do not observe such a situation.

¹⁴⁶ China and Cuba, with a good health system and a poor population (that sees however a slow improvement in welfare) illustrate very well our statement.

Thus, despite Africa great efforts, the mortality situation is still preoccupying. Out the 29 African countries considered in this study, only nine have overall seen a notable decline in child mortality. The other 20 are either stagnant (with a mild decline) or are seeing in their majority an increase at some point of time in mortality rates. Several other studies confirm this tendency to stagnation, or worse to a reversal in child mortality trends.

Hill and Amouzou (2004) evidence this situation for Africa using DHS data. For the whole sample, their study is showing a small increase in under-five child mortality for the full sample (see their Figure 1, p.4). They do not use any regression framework as we do, but instead compile the rates from the DHS sources and graphically assessed the relationships between mortality and various macroeconomic indicators such as the urban population, the percentage of illiterate women or the GDP per capita, etc.

Garenne and Gakusi (2006) using a logit regression also find that mortality rates have stalled (“plateauing” in their own words) in Africa over the last decades, despite overall economic progress. Moser et al. (2004) also confirm this result. Their estimates show a stagnation of mortality in many SSA countries and an increase in Cameroon, Tanzania, Uganda and Zimbabwe. Their results however differ significantly of those reported in this chapter mostly because they use a ten years recall period child mortality datasets while we use a five years ones¹⁴⁷.

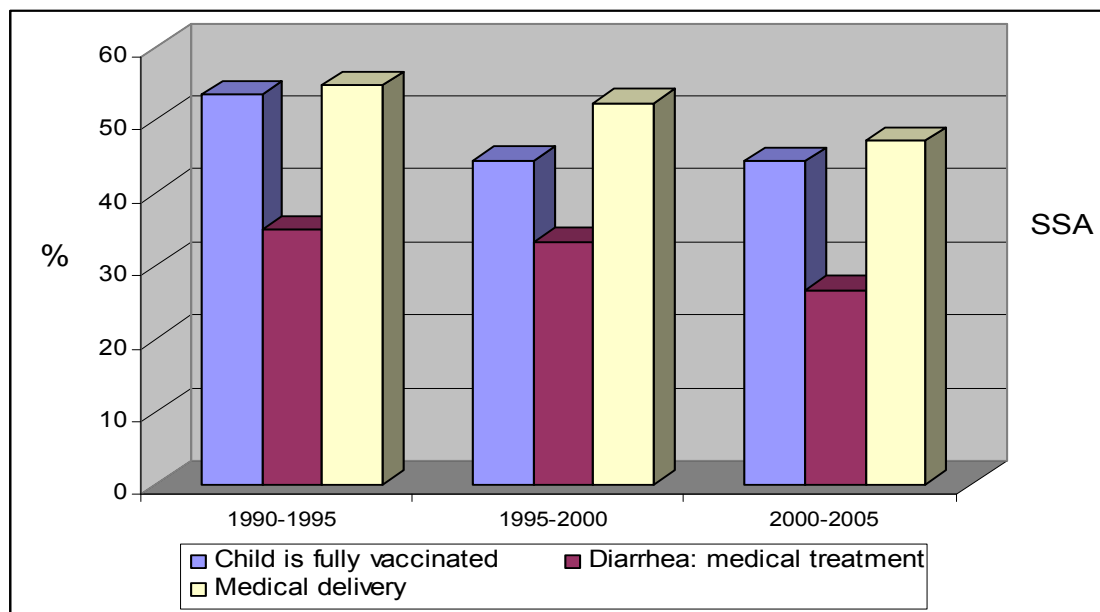
No study provides however a clear and convincing explanation of the causes of this setback. Among possible explanations advanced by authors, economic drawbacks, AIDS epidemic (this effect might probably be among the highest) and civil conflict are the major candidates. However, they are just often mentioned as possible causes but with no further investigation. But we have quite another possible and more global suggestion: a poor performance and organization of the health system.

¹⁴⁷ The same trends are observed for other mortality rates. For instance the WHO’s World Health Report (2005) indicates that neonatal mortality is stagnant in Africa, while it has decreased everywhere else in the world.

Indeed, looking at some key indicators from DHS data (see Chapter 4 below), we see that full vaccination coverage in all SSA countries dropped from 53% to 44% and 44% over the periods 1990-1995, 1995-2000 and 2000-2005.

For diarrhoea treatment, figures are 35%, 33% and 27% respectively. Finally, for medical assistance at birth, we have 55%, 52% and 47% for the three periods. Thus, the performance of the system is deteriorating in the African region (Figure 16).

Figure 16: Health System Performance in SSA for Selected Indicators.

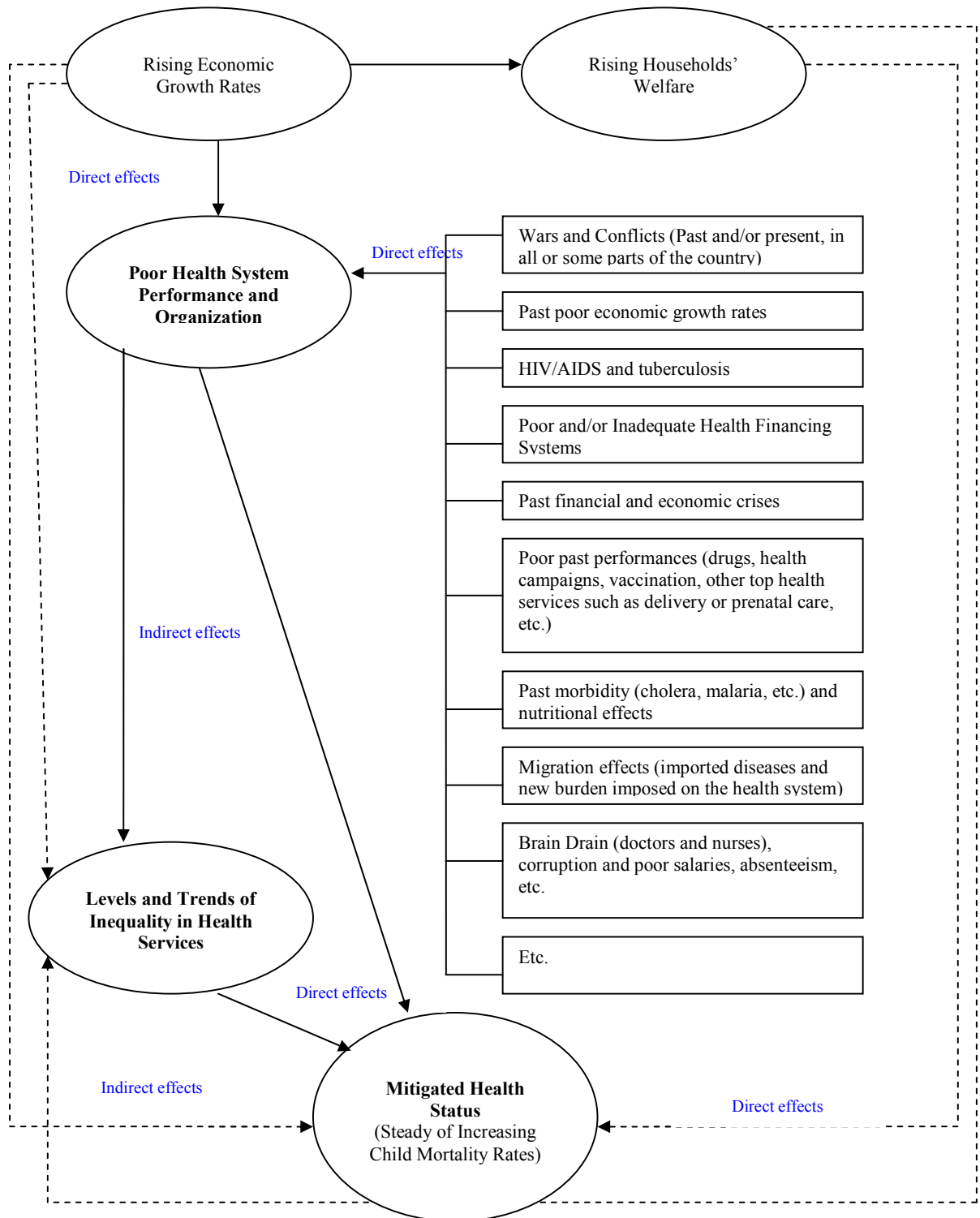


Source: Author's calculations based on DHS data.

Thus, even if a country is indeed experiencing a period of positive economic growth rates and an improvement in households' welfare (as shown by the drop in our material poverty rates), a poor performance of, and mismanaged health system could hinder progress in child mortality and even reverse trends.

We provide below a Figure 17 explaining what could be the possible causes for poor health system performance and efficiency.

Figure 17: Explaining the Performance of SSA Countries in Child Mortality.



Source:

Author.

Let's review these potential causes one by one.

2.3.4.1. Past Poor Economic Performances and Lack of Economic Development.

One way past growth performances could impact health system's performance is through delayed or lagged effects and (still) inadequate financing. This could also have a psychological effect on users that still have in memory past poor health performances and could first want to improve other aspects of welfare before starting to re-use the health care services once again.

Likewise, the lack of economic development, despite positive growth rates, could lead to higher inequality and therefore only a small fraction of the society will benefit from health care services and health sanitation services such as safe water and waste disposal. Even if economic growth is positive for time to time, recent studies show that its variability and the vulnerability it generates for the poor in the economy, the lack of redistribution, etc., could be detrimental to child health and mortality (Guillaumont et al., 2008).

2.3.4.2. Past Poor Health System Performances and Poor and Inadequate Health Financing Schemes.

Since we have economic and welfare progress worldwide, one possible fact that could impact current health system's efficiency are past performances, especially if lessons from past mistakes are not learned, if the same practices and customs are maintained, if no auditing is performed, if no strategic planning or reflexion is put in place, etc.

This could maintain some *inertia* in the system, forbidding making progress toward a better health care system.

Likewise, poor or inadequate health financing (some regions receiving more funds than really required while other needy regions receive less) also impact negatively the health system performance.

Even if more funds are available, it's their allocation that matters. Indeed, recent studies show that the amount devoted to health care has increased in SSA. In 1996, African Governments devoted about 6 US\$ per capita to health expenditures. This amount has increased to 20 dollars in 2000 and 40 dollars in 2005¹⁴⁸.

Usually, these funds are often devoted to curative cares while in fact preventive and less expensive cares could be put in place and save more lives. The lack of, or poor financing also deprives the country of adequate drugs and vaccines, medical tools and apparels, etc. Finally, costly but ill-placed health centers often fail to attract users because of customs, health care habits, poor performance, bypassing, etc.

Finally the quasi-absence of mutuals and health insurances impedes efficiency.

2.3.4.3. Past Wars and Civil Conflicts.

As we've seen above in the case of Cote d'Ivoire, or more recently in the Democratic Republic of Congo, a civil war or conflict could disrupt the organization of the health system in a country. Indeed, if a region or some group of regions are experiencing a conflict, this could impede other regions to receive drugs, financing, communications, health staff, and so on, leading to unequal health results and so that overall, the situation will not improve.

There is a huge literature, notably publication by Prof. Paul Collier on this issue.

2.3.4.4. HIV/AIDS and Tuberculosis.

HIV/AIDS cases in SSA region accounts for 68% of the 33.2 millions cases in the world according to the most recent USAID 2008 estimates, with average prevalence ranging from 2 to 15. 76% of the total 2.1 millions HIV deaths occurred in the region due to lack

¹⁴⁸ According to the WHO' statistics, between 1990 and 1996, African Governments expended 1.3% of their GDP on health expenditures, while they used at the same time 3% of their budget on military expenses. Since 1996, substantial efforts have been made with 4.8% in 2000 and 5.1% in 2005 of the GDP devoted on average to health care and services. Donors contribute between 1 to 3% of Africa's GDP to health expenditures. On this amount; the major part goes toward recurrent expenses such as salaries and bureaucracy. Key components such as drugs and vaccines received less than 20% of the total amount. On average, the poorest 20% receive 17% of the public spending on health against 29% for the 20% richest (a ratio of 1.7, almost the double).

of financing and care, while 80% of the children (generally under-five years old) orphaned by the disease live in the area¹⁴⁹. Out of all SSA countries, only two of them (Zimbabwe and Swaziland) managed to reduce significantly AIDS prevalence.

The remaining countries are either stalling (not improving much) or increasing their prevalence rates (in adult and child population).

These results unambiguously could impact the overall health system's performance and increase child mortality rates (by increasing death rates and bringing opportunistic epidemics such as tuberculosis and cholera).

2.3.4.5. Past Morbidity, Nutrition and Mortality Effects.

Everything being equal, a region heightened by high mortality and morbidity rates, or impacted by high malnutrition rates will have greater difficulties to catch-up with the remaining regions.

If in addition as it's often the case the region receives less financing than others, it will have more difficulties catching-up and will perform poorer in terms of child health and mortality, *ceteris paribus*.

2.3.4.6. Migration effects.

Let's now consider how migration could affect health system performance. Two effects are possible.

First, new migrants could bring new or previously eradicated diseases (such as cholera, measles, etc.) in the country.

¹⁴⁹ http://www.usaid.gov/our_work/global_health/aids/Countries/africa/hiv_summary_africa.pdf

Generally, these migrants tend to live in unclean and unsafe areas (slums, refugees camp, etc.), favourable to the development of new diseases. Second, these migrants will impose indubitably new burden (diseases and financial) on the overall health system.

2.3.4.7. Brain Drain, Corruption and Absenteeism.

African countries lack dramatically qualified health care staff. Usually, we have in these countries one doctor for 50000 people or more, one nurse for 20000, etc. In some countries, we have less than a hundred doctors for the total population. The dramatic fact is that SSA countries are loosing the few qualified personnel they have (either in the health sector or other ones).

This is the case for Zambia for example where out of the 500 doctors formed since the independence, only 60 remained actually in the country¹⁵⁰. Qualified staffs flee abroad seeking better pay, better job environment, better opportunities for their children, security, etc. Likewise, SSA countries expend millions of euros forming young students in the universities of developed countries. Unfortunately, only a tin fraction of them return to their homeland.

For the rest of the staff remaining in place, absenteeism and corruption put an additional burden to the costs of health financing. Despite the so-called Bamako's Initiative that promoted free health care for all, out-of-pockets expenditures have kept many users off health centers.

More, only a tiny fraction of the financial resources devoted by the Central Ministry of Health arrives at destination, the rest being diverted by many intermediaries¹⁵¹. Final high absenteeism rates and ghost staffs are costly to the health system and impede greatly is efficiency.

¹⁵⁰ <http://www.bmj.com/cgi/content/full/331/7507/2?ecoll>

¹⁵¹ A recent study to which we participated at its earliest stage at the World and finalized by Wane and Gauthier (2007) shows that only 1% of the budget granted by the central authority to the smallest health centers arrives at destination in Chad Republic.

2.3.4.8. Poor Sanitation and Environmental Effects.

We also consider the negative impact that a poor sanitation and a bad environment could have on the performance of the health system. This is mostly a demand-side effect but could indirectly impact performance.

Indeed, on direct cause of such factors is to increase the likelihood of diseases and deaths. No matter how good a health system is, it will have no effect on health indicators if households continue to live in poor areas, especially with limited access to clean water and toilet, and have poor health habits and behaviours.

2.3.4.9. Past Economic and Financial Crises.

One factor to take into account is the potential effect a financial and/or an economic crisis can have on the performance of the health system. Quite few papers to our knowledge link economic imbalances with increases in child mortality¹⁵². We will therefore extend quite a bit our discussion on this topic as we think further research should be conducted to account for their potential impact on SSA's health system.

¹⁵² The reader should observe that the period under study (1990-2000) have been characterized by serious economic crises in the world (currency and exchange rates crises, monetary and financial imbalances in the international monetary system, etc.). Crisis in countries such as Eastern Europe (1992-1993), Mexico (1994-1995), Thailand and East Asia (1997), Russia (1998), Brazil (1998-1999), Argentina (2000-2001), etc. have all quickly spread to the rest of the world and might probably have had serious consequences on socioeconomic indicators such as health and mortality. French-Speaking countries of our sample have witnessed deterioration in exchange rates leading to the devaluation of the CFA franc in 1994. The immediate effect was to reduce the purchasing power of the population, along with a mild inflation in food prices. Another consequence was to lower the provision of public services, including health and education. The promised "mesures d'accompagnement" policies have not been implemented, leading to a deterioration in the living standards of millions of people. In other countries such as Ghana, exchange rates imbalances and financial crises have resulted in severe inflation. However, overall, economic and financial crises only indirectly impact SSA countries due to a poor banking system and a poor exposure to the world financial markets, a poor FDI in these countries, etc. However, indirect effects are possible through low commodities and other export prices, low investments, low tourism and transfer revenues, etc. These factors can slow, but not totally annihilate, economic growth rates.

Paxson and Schady (2004) using DHS data evidence an increase in child mortality in Peru after the economic shock experienced by this country in the late 1980s¹⁵³, principally due to reductions in public health expenditures and the utilization of health care services. Cutler et al. (2002) find the same result for Mexico. Several studies on the 1997-1998 Southeast Asia financial crisis show that child mortality has slightly increased in Indonesia (Frankenberg et al, 1999; Rukumnuaykit, 2003; Pradhan et al., 2007). Lin (2005) also shows that child mortality has risen in many Chinese provinces, following periods of economic instability. Some papers however find no effect of severe economic crises on child mortality. This is the case for Argentina (Ricci, 2004) and the Soviet Union (Shkolnikov et al., 1998; Cutler and Brainerd, 2005).

No study to our knowledge has been conducted in the African case.

If crises are truly one possible explanation, then the question that pertains is why mortality has not responded the same way during these crises in SSA and the rest of the world? It may be due to the underlying and inherent organization and the performance of the health systems, along with the overall level of development of the countries.

In SSA, responses to the different crises (sometimes through the pressure of IMF and other donors) have been through various fiscal and budgetary restrictions. That came to the cost of a cut in budgets previously devoted to social services such as health and education. As we have seen through the multivariate regressions above, child mortality in Africa appears to be very sensitive to the provision of health care services. A reduction in this provision (coupled to other factors such as wars, epidemiology, etc.) may have impacted seriously child survival prospects.

This explanation is also emphasized in Lin (2005). He shows that, during economic shocks, mortality has risen only in the Chinese provinces that have reduced (or devoted

¹⁵³ The authors also provided possible reasons why economic crises may negatively be correlated to child mortality, among which a reduction in household's revenues that impact child and maternal nutrition and the provision of health care to the household. At the macroeconomic level, the reduction in public funds allocated to health care may also have negative impact on child survival. See Martorell and Ho (1984), Palloni and Hill (1997), Ruhm (2000) and Paxson and Schady (2005) for more detail.

less) resources to health care. In our own DHS data, as described in the next chapter, the provision of vaccination services in SSA, without any doubt, declines over the years of crises.

Conversely, Costa et al. (2003) show that Brazil has witnessed a sustained decrease in child mortality even during crises, because the country has managed to maintain sound health policies such as medical interventions, the provision of drugs, the supply of safe water, etc. We can also observe that the above countries that did not observe a rise in child mortality during economic and financial crises are those that have a strong and well-organized health system.

As a generalization, one can assume that in other countries than those in Africa, the adjustments to economic instabilities may have been through maintaining strong health policies (that have had a strong impact on the provision of health care services) possibly coupled other strategies (such as devaluation) and a strong and well-organized health system. Therefore, these crises have had no or only marginal impact on child mortality. In SSA, the crises could have disorganized severely the health systems as well as a cut in their financial and material resources.

To illustrate and defend this argument, let's look at countries that have had an increase in child mortality and that have at least 3 observations points (these countries are Burkina-Faso, Cameroun, Ghana, Kenya, Madagascar, Nigeria, Rwanda, Senegal, Tanzania and Zambia).

All of them (except Ghana and Nigeria) have witnessed an increase of child mortality rates between the first two periods (1990-1995 and 1995-2000). But most of them, since the resorption of the crises and the return of stable and durable economic growth rates, have also made great strides and managed to reduce these rates to at least initial levels or less (some of them even far beyond).

Only Cameroon, Ghana, Kenya and Nigeria have observed an absolute increase in child mortality over the period under study (see graph A4 and A5 in the Appendix).

The consequence of this is that Africa has lost on average seven percentage points of life-expectancy over the period 1990-2000 (Goesling and Firebaugh, 2004).

Assuming our theory is valid (that is, economic crises, amongst other things, explain partly the slowdown in child mortality trends in SSA during the 1990s), the key point is that we need more data and information to understand why this continent's story is different.

A validation of this theory in turn has important policy implications. This suggests that in countries with less well organized health system, responses to economic and financial crises might take various and coordinated forms aimed at strengthening the system.

2.3.4.10. Inequality in Health Status, Health Care and Health-Related Services.

We discuss this further in the next chapter.

2.3.4.11. Other Causes.

Finally various causes such as households' health behaviour (for example excision, the usage of traditional healers' services, etc.), the quality of health centers (welcoming, cleanliness of buildings,...), the quality and competition of private and traditional health sector, the efficiency of the pharmaceutical system, etc., could impact the usage of modern health care centers and thus undermine global performance.

2.3.4. Policy Implications of Poor Health System Performance.

The ideas we develop above call for some important policy strategies¹⁵⁴.

¹⁵⁴ Depending of the country, a prioritizing of these actions could be required. A sound system of targetting the poor is also required.

- First, Governments should pay particular attention to the health budget (even increase it whenever possible, but in any case not decrease it!). This can be done by cuts in unnecessary Government other expenditures such as some recurrent administrative costs (galas,...).

Efforts should also be done to improve the overall health system performance (reduce shortages and linkages of drugs and personnel, provide if possible freely drugs and care, combat corruption and absenteeism, increase salaries and incentives, etc.). These efforts should be backed and fostered by donors and the international community.

A sound and well-thought planning and financing strategic should be done, so that all the regions receive the financial and material resources they really need.

- Second, Governments should promote good health behaviour and a clean and healthy environment for households. Likewise, health staff should also promote whenever possible health education, especially for women.

- Third, at the community and household levels, the Government can provide financial and material assistance through safety nets, food supplies (milk for babies for instance), etc., to mitigate the effects of malnutrition.

Likewise, consistent with the results of our regressions above, health campaigns could be conducted with emphasis on key health behaviours such as birth spacing, children vaccination, the usage of impregnated bednets against mosquitoes, etc.

2.3.5. Macroeconomic Indicators and Child Mortality.

We now focus on the links between some macroeconomic indicators and our mortality rates estimates.

Our study and others tend to emphasis that child mortality in Africa is less sensitive to macroeconomic indicators such as growth or income (unless there is serious economic crisis) than the rest of the world but rather to more microeconomic factors such as

education, access to health services (especially antenatal and vaccination) and sanitation, and to a lesser extent safe water .

We suggest that economists should explore further these paths, to really understand how mortality is connected to these microeconomic factors.

To keep consistency across the chapters of this dissertation, we compare our mortality estimates to assets poverty rates obtained in the Chapter 1. We obtain a contrasting picture for Africa. As a general message, assets seem to have a weak effect of child mortality, as found in our Weibull estimates above.

As the continent has generally managed to decrease assets poverty (even in the turmoil of economic and financial crisis of the 1990s), many countries that have witnessed an improvement in welfare from the assets perspective have also witnessed a deterioration in welfare from the child health perspective. This is the case for example for Benin, Burkina, Cameroon, etc., according to the datasets available.

These results reinforce the findings of the multivariate regression, that is, a weak correlation between assets index and child mortality in Africa.

Does this mean that assets and mortality are totally uncorrelated?

We plot the level of assets poverty below with the level of child mortality. We observe that, as a general rule, countries with low assets poverty (and thus high assets index) tend to have low child mortality with an estimated OLS coefficient of 56.8 and a R squared of 22% (table not shown). This is displayed in the Figure 18 below.

This indicates a growth-effect (or a development level effect), rather than a direct impact of assets on child mortality.

Therefore, as a general rule, we can say that high levels of assets ownership is linked to low levels of child mortality in SSA, but the dynamics over time between these two indicators are poorly correlated.

We also plot our mortality estimates with some macroeconomic indicators from the World Bank, namely the level of GDP per capita and its growth rate.

It appears that high levels of GDP per capita are unambiguously linked to low mortality rates. This is a derivation of the famous Preston curve (Preston, 1975)¹⁵⁵. However, the curve is flatter for its growth rate (Figure 19 below).

Simple OLS regression (not shown) reveals that if the level of the GDP per capita (PPP constant 2000 international \$) increases by 1%, infant mortality will drop by 11.4 points while the under-five one will drop by 18.9 points (R^2 of .46 and .57 respectively).

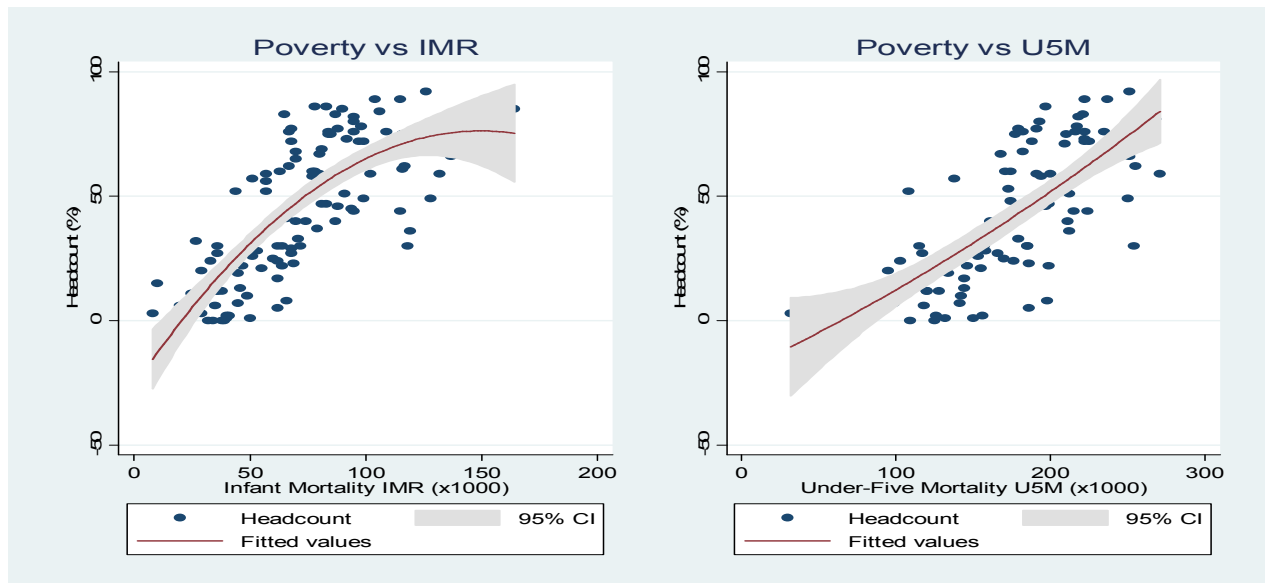
However, controlling for other factors, GDP per capita's growth is not strongly correlated to child mortality. Our estimates display a coefficient of only -.3 and -.45 for both models, but they are not statistical significant.

2.3.6. Child Malnutrition versus Child Mortality.

Finally in this section, we consider another useful indicator of child health. That is, child malnutrition. Malnutrition is not as a whole concept (in the sense of capturing overall population's rate) as mortality. But it is used in various studies to assess child health.

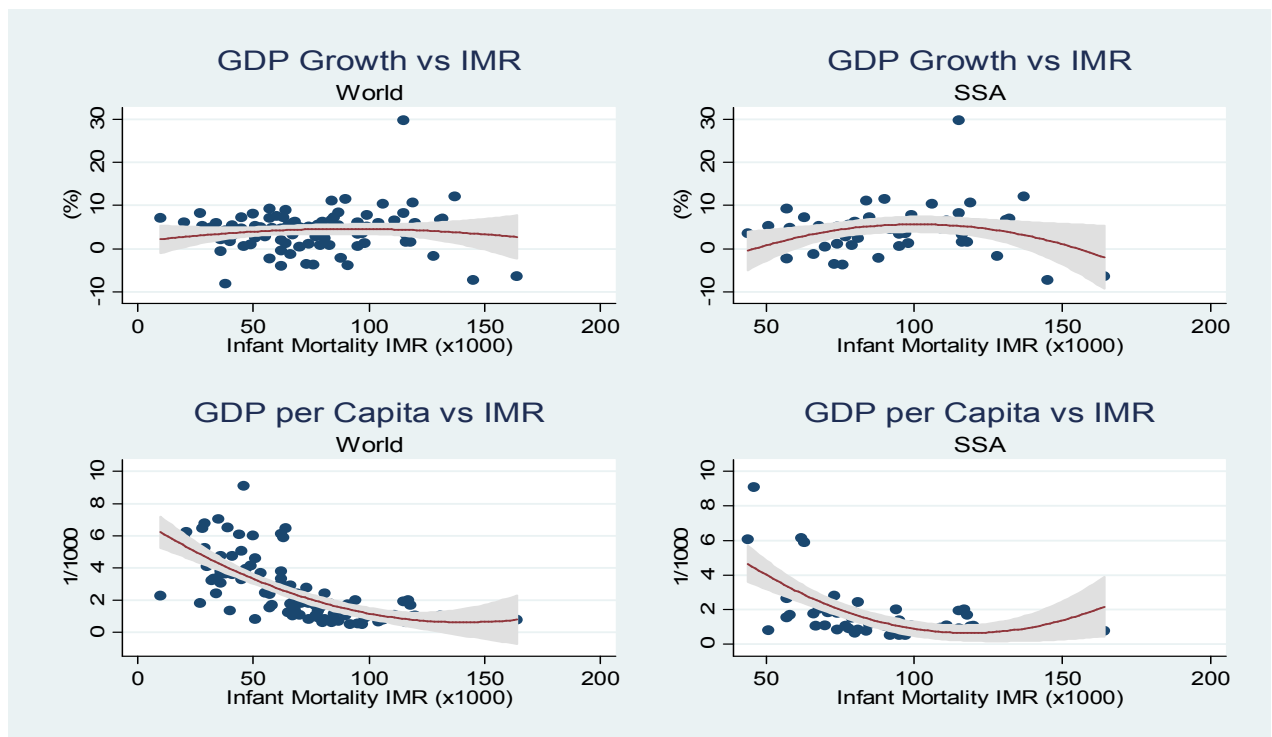
¹⁵⁵ More precisely, the Preston curve links GDP per capita to life expectancy. Preston established a positive relationship. We assume here that lower mortality translates into higher life expectancy.

Figure 18: Assets Poverty versus Infant Mortality.



Source: Author's calculations based on DHS data.

Figure 19: GDP per Capita and GDP Growth versus Infant Mortality.



Source: Author's calculations based on DHS data.

As we said earlier, malnutrition accounts for a large part in explaining child mortality rates. The idea is to assess whether we observe roughly the same general trends as child mortality.

There are usually three used indicators for child malnutrition.

- Weight-for-age measures underweight (that the child's total body mass, it is a measure of long term malnutrition) prevalence. It is the most common measure.
- Height-for-age measures stunting (the child's stature in relation to his age and captures chronic malnutrition), while
- Weight-for-height captures wasting, or in some cases overweight (it captures thinness or fatness, along with recent malnutrition shocks following diseases or food deficiency).

The methodology consists of first constructing these ratios for the children's population under study, then to compare them to a population of reference (usually NCHS). These are the so-called z-scores = (actual anthropometrical value – median reference value) / standard deviation of the population of reference.

If the value for a given child falls below minus two standard deviations from the median value of a comparable child in the reference population, he is said to be moderately malnourished. If it falls below minus three standard deviations, he is severely undernourished.

We provide in this chapter only the most common underweight values for sake of space, and because the other indicators convey essentially the same messages. Their results are available upon request.

Our results are displayed in the Table A8 in the Appendix.

These results above confirm that mortality and malnutrition are massively concentrated in poor countries, especially SSA.

But is the progress (i.e. the drop in rates) faster in these poor countries, as compared to the rich ones (mostly because rates were very high in the formers) as found in the Chapter 1? The general answer is no.

As in the mortality case, poor countries have in general high malnutrition rates. In SSA, Niger has the highest rate (49% or almost half of children are underweighted) while Gabon has the lowest (12%). In the rest of the world, India has the highest value (53% in 1992 and 47% in 1998 followed by Bangladesh with 48%). At the other tail, Paraguay and Egypt has the lowest rates (4%).

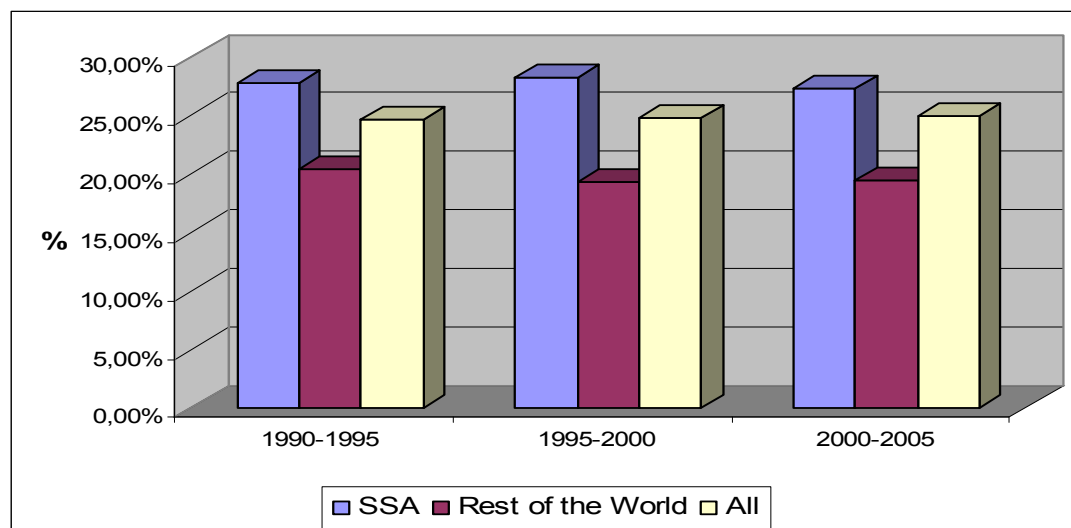
Malnutrition remains concentrated in poor groups and rural areas as shown in the table. Indeed, the same general tendency found in mortality is also observed for child malnutrition. Very rich children (fifth quintile group) tend to have the lowest malnutrition rates, while the other four remaining groups tend to have very similar ones (though there is a small decrease when one moves along the socioeconomic gradient from the poorest to the richest).

As exceptions, in countries such as Madagascar, Egypt, Tanzania, Colombia and Turkey, children in the richest group have higher malnutrition rates than those in the poorest one. However, there is a clear gap between urban and rural areas, with the former experiencing far a lower frequency of reported deaths and under-weighted children than its rural counterpart.

The trends are quite similar to mortality ones. Overall, malnutrition has remained unchanged in SSA (around 28% over the three periods), the same being true for the rest of the world around 20% (Figure 20).

For the whole world, rates remained at 25% for the 3 periods indicating a no change over 1990-2005 (and for SSA, rates are stagnant around 28% in the first two periods followed by a slight decrease in the last period: 27%). Thus, worldwide, one child in four remains malnourished.

Figure 20: trends in Malnutrition in SSA and the Rest of the World.



Source: Author's calculations based on DHS data.

Figure 21 below compares levels of malnutrition and mortality for each country-year for SSA and the rest of the world. Unsurprisingly, high mortality rates tend to be correlated with high malnutrition rates.

However, when having a closer look for each country, we have the following results. A huge reduction in mortality is often associated with a significant one in malnutrition, while a small reduction or no change in mortality could lead to a small variation in malnutrition. The surprise comes when some countries that performs well in mortality witness an increase in malnutrition. Or vice versa. Benin for example increases its infant mortality rate from 78 to 99 deaths between 1996 and 2001, while its malnutrition rate drops from 29 to 23. On the other hand, Niger drops from 164 to 106 deaths of children under one year old between 1992 and 1998, while its malnutrition rates rise from 42 to 49 over the same period. Many other countries are in the same paradoxical situation in SSA and elsewhere (Table A8). This suggests that the two phenomena, thought strongly linked, do not react synchronously. A lagged effect must therefore be sought when analyzing both in depth.

Conclusion.

In this chapter, we assess population's health approximated mainly by child (infant and under-five) mortality rates. We analyze the levels and the determinants of child mortality in SSA and compare it to the rest of the world. One major result is that, despite huge progress in medicine and technology in the world, the African continent is still lagging behind in child survival, as compared to the rest of the world. Indeed, each year, about 3 millions children are still dying in Africa because of poverty and diseases.

Using DHS data, we show that mortality rates are stalling or even reversing in many African countries (especially during the economic and financial turmoil of the 1990s and early 2000s which had probably led to cuts in public health budgets), despite overall progress accomplished in economic growth over the period of analysis (1990-2005). This poses therefore the question of the causes of this preoccupying failure. .

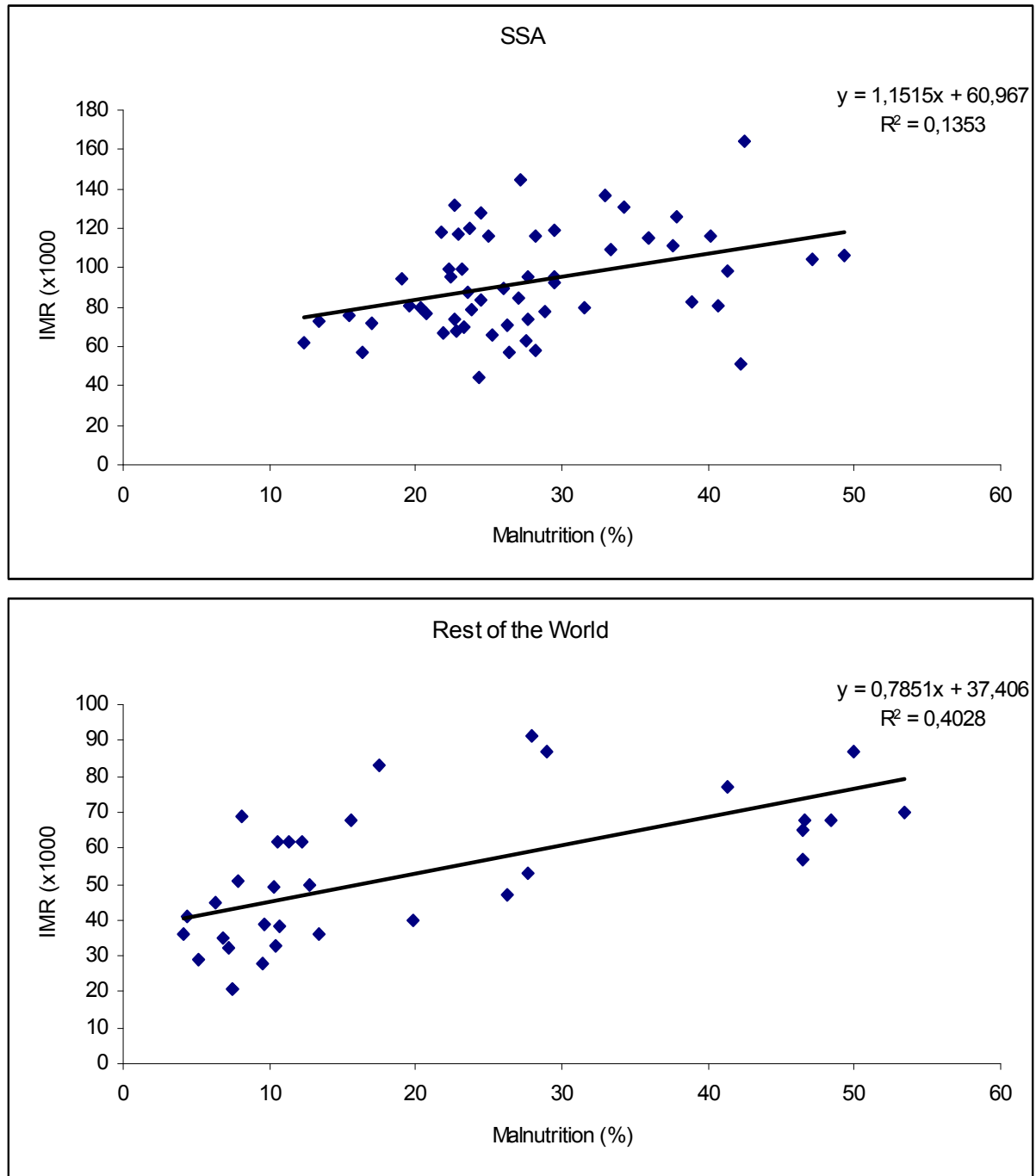
After these periods of crises however, many African countries managed to reduce substantially child mortality. But the setback of the 1990s make unlikely that African countries will reach on time the MDGs in reducing child mortality rates. This is essentially the message delivered by this paper and also other studies. The Human Development Report (2005) emphasizes this point (UN, 2005; Dyer, 2005).

Another important result of this chapter is to show that usual non parametric approaches used by many economists to estimate child mortality rates seriously underestimate true values, as evidence by rates obtained with the parametric (Weibull) approach.

The paper then attempts to understand what are the main determinants of child mortality and how they can help understanding these (lack of) results in SSA.

Multiple regression analyses as well as non parametric (univariate) approaches were used to identify these determinants.

Figure 21: Malnutrition and Infant Mortality Trends in SSA and the Rest of the World.



Source: Author's calculations based on DHS data.

The underlying idea is that these variables would help in understanding the relative contribution of the regression coefficients and their effects in the context of the other countries studied. The use of multivariate regression analysis makes it possible to study the mortality risks associated with each variable independently of the influence of all other variables. For categorical variables, the regression coefficients reflect the excess mortality of a given category in relation to the reference category of a variable, once the effects of all other variables are controlled for. The independent variables which influence significantly infant and child mortality are mother's education, access to health care and sanitation and to a lesser extent the availability of safe water.

Contrary to many findings, our results show that household wealth (assets index) and urban residency plays no role in child mortality in SSA, contrary to the rest of the world.

The final chapter below shows that while African countries have made remarkable efforts to increase access to health-related services (toilet, water and electricity), they are backing-off on health care services (primary care, antenatal and delivery).

At the margin, the increased access in health-related services has in its majority benefited mostly to the better-offs, digging further inequality in access at the margin.

This may be *the* key to understand the lack of progress in child mortality in Africa, as the regression framework indicates that these access variables are more or less important to reduce child mortality, along with mothers' education.

Even though African countries have witnessed an increase in assets-based welfare as shown in the Chapter 1, this has little impact on child mortality, as suggested by the multivariate results above in the current chapter.

Indeed, these are contrasting results. While, in general, many countries with high levels of assets index tend to have low levels of child mortality, a look at African specific countries reveals that many of them that have witnessed an increased in welfare through a higher assets possession have in the same time experienced an increase in child mortality.

Our results, also suggest that there is on average no very marked difference in inequality in child mortality between Africa and the rest of the world. However, looking at quantiles of predicted survival probabilities (not shown but available upon request), results show that inequality in survival is more pronounced in SSA, between poor and rich, and between rural and urban.

Finally, confronting mortality rates to another useful indicator for child health (namely child malnutrition), we see that they tend to be correlated, but there exists a lagged effect.

CHAPTER 4: INEQUALITY IN HEALTH STATUS AND ACCESS TO HEALTH AND SANITATION¹⁵⁶.

Introduction.

The first two chapters have introduced the notion of assets index as a measure of welfare and show that assets poverty is decreasing in the world, including SSA.

The third chapter introduces the notion of health and shows that child mortality (our proxy for overall population's health), though following a declining worldwide trend, is somewhat stalling in SSA and even reversing in some African countries.

We thus have the paradoxical situation where poverty on the sub-continent is falling back, while health is not quite improving in the same direction. As we've seen, theoretically, health and welfare should move in the same direction. But, regression analyses showed that the assets index is not a good predictor of child mortality in the datasets we used. We labelled this the "African Poverty-Health Paradox". We've made above in the rationale of our thesis the hypothesis that a great part of this paradox is probably due to high inequalities in health, the rest being the fact of inefficiencies in the health system and the AIDS epidemic.

The goal of the present chapter is to try to pursue the exploration of ways to explain further the paradox and test our hypothesis. We thus explore in depth the relationships between the inequalities in the assets index and various health indicators, including child mortality, to see what links they do truly share and in which directions these relationships are running? Are the African poor really less healthy than the richer ones? By how much?

The objective of this chapter is threefold.

¹⁵⁶ Parts of this chapter has partly been used in the WB's WDR 2006. It also served as a basis for the book on infrastructures in SSA by Diallo et al. (forthcoming).

- First, to assess and quantify the existing levels of health status, access to health care services¹⁵⁷ and to sanitation services¹⁵⁸ in a wide range of countries using comparable household surveys.
- Second, to assess whether progress in expanding access has been achieved during the 1990s and 2000s.
- Third, to identify who benefited from the increase in access where such an increase was observed (that is to analyse inequality in access). The question that is attempted to be answered is whether, at the national level, poorer households benefit more or less than other households from an increase in health status and in access to a number of public goods or services, namely health care, water, sanitation and electricity.

We first explain what we mean by inequality; then we focus on the results found in our estimations.

I. Inequality.

1.1. The Notion of Inequality and Theories of Social Justice.

What is inequality, especially in health? As in the case of poverty and health discussed in earlier chapters of this dissertation, the idea of “inequality” (and subsequently those of “equity” or “inequity” and “justice” it conveys) is difficult to grasp and definitions varies from an author to another.

For a long time, economists have focused only on efficiency (Pareto) criteria in the allocation of (limited) resources to meet (unlimited) human needs. This paretian allocation is supposedly optimal, in the sense that it avoids wastes. However, as optimal as redistribution may be, it unavoidably has winners and losers.

¹⁵⁷ Child nutrition, delivery care, diarrhea treatment, vaccination, and whether a child death occurred in a household.

¹⁵⁸ Such as electricity, toilet and piped water.

The Pareto optimum thus does not tell anything about the fairness or equitability of such a distribution.

Sometimes, equity has even been opposed to efficiency, as focusing to the former can lead to situations where we lack the second. This is precisely what theories of (social) justice are about of. The branch of economics that deals with equity and equality concerns is thus labelled “normative economics”. Amartya Sen has illuminatingly provided a good discussion of these theories in his introductory chapter of the “Handbook of Income Distribution, volume I”. Basically, one might distinguish four broad schools: Utilitarians, Libertarians, Rawlsians and “Capabilitists” (Capeheart and Milovanovic, 2007).

For all these schools, the pertaining question is how to define justice and what are the characteristics of individuals composing the society. In other words, all these theories are attempting to define what is a “just” society, a debate as old as the world as illustrated by the controversy and debates between Aristotle and his former master Plato some 3 hundred centuries BC ago.

For Utilitarians (Harsanyi, Atkinson, etc.) and their elders the Welfarists (Marshall, Pigou, Sidgwick, Bentham, Smith, Mills, etc.), an action is just when it provides the maximum utility to the greatest possible number of individuals. The greatest critic to that theory is first to use utility as a measure of welfare¹⁵⁹ and also as a measure of justice or what is “good”.

Libertarians (Hayek, Nozick, Buchanan, etc.) view justice and “goodness” as a set of basic rights and liberties that must be fulfilled. In any case of a violation of one of these rights, there is a lack of justice. These rights go beyond – and can include – utility. But where Utilitarians focus on global welfare and pay no attention to a single individual, libertarians focus on this particular unit. The theory faces the same limitations as others.

¹⁵⁹ Sen also has a discussion on utility – or preferences - as a valid proxy for welfare and more seriously how to aggregate individual utilities; see also Arrow (1951) on the latter. The part I’s introduction of this thesis provides further discussions.

What are these rights? Are they equal for each person? Where do one person's rights and liberties start and end?

Professor John Rawls has profoundly marked normative economics. His books, "A Theory of Justice" and "Justice as Fairness", are still giving rise to a passionate debate among various ideologies. He mainly views justice (and goodness) as fairness. He then develops his ideas around what is fairness. Building in the tradition of Kant and Jean-Jacques Rousseau, his theory comes essentially as a criticism of Utilitarianism/Welfarism. Reproaching them of treating individuals as anonymous entities, he tends to place these individuals as a central piece of his theory. Human beings are the ends, not means to achieve ends (such as achieving the greatest possible utility of the community in the Utilitarianism theory). They are moral entities, capable of discerning "good" from "bad". The notion of "Good" not needs necessarily to be identical across individuals. Instead of utility, Rawls think that each person must be given a set of "primary goods"¹⁶⁰. What is most important is that these individuals can, though they are blinded by a "veil of ignorance" about others' welfare, freely altogether sign a social contract or arrangement in a democratic way that will ensure that everybody has a fair share of the pie.

For the contract to be signed, there must be two requirements:

- equal liberty for all individuals,
- there must be the same opportunities given to all, so that the less well-off individuals are brought to the level of the most well-off ones through various strategies such as the maximin (difference principle).

This contract will then be enforced by democratically elected institutions.

The major critic to Rawls is how to bring all of the individuals to sign that contract. Another critic formulated by Sen (also applicable to the other schools) is that Rawls is focusing on means rather than ends.

¹⁶⁰ They are "things that every rational man is presumed to want" such as freedom, wealth, health, respect, power, etc. (Rawls, 1988; p. 256-7). In this, his theory is broader than Libertarianism.

In his famous theory of “functionings” later refined to “capabilities”, Sen (1987) argued that “primary goods” or alike, including welfare or liberties, are means, not ends. For example, he showed that a handicapped person that is given the same basket of goods and rights as a well-bodied one may not be able to benefit of it the same way. As means, primary goods are necessarily limited, as compared to functionings. What is most important for Sen, it is the freedom that individuals have to use these means. We can decide to go to a movie or not, to consume or not, to vote or not, etc. This is extensively developed in the Part I of this dissertation.

For our part, we view inequality as a phenomenon that is inherent to the (human) nature. Even in the animal world, the strongest have always the lion’s share.

As long as this world is bounded by limited resources and human beings having unlimited needs, there will be always inequality.

A world where everybody has unlimited resources (foods, clothing, health, knowledge, even life, etc.) according to his needs, and no less than others is indeed the Paradise so much described in the Holy Scriptures. The problem lies thus in this boundary (limited resources) and also in the heterogeneity of people. Quoting Amartya Sen, “People’s attitudes toward, or reactions to, actual income distributions can be significantly influenced by the correspondence-or the lack thereof-between (1) their ideas of what is normatively tolerable, and (2) what they actually see in the society around them”. This heterogeneity in the perception of what is “good” will make impossible to have a single definition of “justice”. As Aristotle said, no theory of justice will be entirely satisfactory.

However, we think that instead of trying to define an ideal society, the best way is to (re)bring to life the “goodness” that lies in every human being, say through (civic) education and morale teachings, especially at primary schools. As naïve or odd or even old-fashioned this idea may be, we think it is worth scrutinizing. True, we have in us a primitive spirit (an “esprit prédateur” quoting Schumpeter) that is sharpened by the intense competition to gain access to limited resources. This predatory spirit makes the

strongest usually taking the share of lion¹⁶¹. But, more remarkably, we are also inclined to goodness. Every single person, more or less, has this strange ability to distinguish good from bad, right from wrong. Though this may not necessarily coincide across all, at least there can be a minimum agreement.

Thus from our modest point of view, a “just” and equitable society is that where everyone is trying to do and act in his best interest, but also in the whole society’s best interest.

In such a society, a rich person will try to get richer, but he will also try to help the poor (through donations or any other means - job, training, education, etc.) to reach what is the minimum standard that he thinks is acceptable from his own judgment or value.

Inequality is a more general phenomenon than poverty. While poverty focuses on the absolute living standards of the fraction of the population below a given poverty line, inequality is concerned with relative living standards across the whole population. Technically, a maximum inequality where one person has everything and the rest nothing is accompanied with the highest poverty. A contrario, minimum (zero) inequality can be coupled with no poverty (nobody is poor) or maximum one (everybody is poor). Nowadays, with the PRS process, many Governments in developing countries tend to be more concerned of poverty while the debate in developed countries is more about inequality.

Many authors wonder whether we should focus on (in)equality or more merely on equity. This indeed depends on the purpose of the study and whether the data at hand are adequate in each case.

Equality is a matter of treating everyone the same (“doing the same”) and equity is a matter of doing what is just or fair.

¹⁶¹ This is the very reason why a justice system is needed to protect the weak and most disadvantaged people.

Thus, the latter has more focus on judgment values. Where the first is concerned with pure distribution questions, the second focuses on the “adequacy or fairness” of such a distribution.

As the second notion is more difficult to grasp, we shall limit ourselves to equality concerns.

1.2. The Importance of Accounting for Inequality.

Inequality (in health or income or any other indicator) is a concern for every country, developed and developing alike. As the world has become a small village, all the population has a greater access to information, so that any small increase in inequality is arguably quickly perceived by everyone else in the community. This is why it is hard to hide inequality issues from a policy point of view and decision-makers could difficultly ignore that issue, even in developing countries. This is why there is growing number of PRS and poverty assessments that include a significant section on inequality issues, alongside poverty ones.

Inequalities tend to reinforce each other...

That is, in an unequal society, if inequality in one period is not dealt with swiftly and properly, it will be worsened in the subsequent period. Inequality in one dimension (say income or health) also will tend to reinforce inequality in other dimensions (say education or labour market) that will worsen the situation in previous ones (the famous vicious circle). The WDR (2006) has particularly insisted upon this and warned that this is an impediment to economic growth and development. Kawachi and Kennedy (2002) show that inequality in health hampers democracy, quality of life, social wellbeing and favours social exclusion. This in turn put serious brakes to economic development. Kuh et al. (2002) also show that health inequalities tend to lower people’s human capital, rise morbidity, psychological stress and mortality, and reduce productivity.

The extreme consequence of a too high inequality is to lead to a greater impoverishment, violence, social unrest or worst, civil war (Wilkinson, 1996). This has a profound and durable consequences on the economy. The single idea that the rich are getting richer (and healthier) and the poor are getting poorer (and sicker), thus widening gap between rich and poor, is indeed socially and morally unacceptable. The situation is worsening with the spread of capitalism in the world and the globalization process.

Capitalism in itself is thought to be a not so bad thing. It may be the most efficient system to date that human beings have invented to create wealth since it is mostly about rewarding (at the margin) the factors of production, labour and capital. But extreme capitalism is characterized by rewarding mostly the capital (and thus shareholders, businessmen and industrials) while the remuneration of labour tend to be more steady and an increase, if any, is painfully obtained through long and hard negotiations with labor unions. Capitalism thus needs some form of control, though the reins need not to be too tight.

At the international level, the widening inequality between rich and poor countries has severe consequences, the most prominent being the vague of massive immigrations that the rich ones are facing, with its cohort of deaths and sufferance, and the resurgence of terrorism and world criminality. Another consequence is the distortion in world trade, and the greater need for assistance of poor countries.

On the health side, inequality has put heavy burden on developing countries that are seeing millions of their population dying from AIDS and other plagues, due to unequal access to drugs and vaccines. This has a huge cost not only for these countries, but also the rich ones who have to increase the amount of their foreign aid to assist the formers, and the risk of spread of these diseases around the world.

At the national or country level, the same above-described phenomena are arising, with increased rural-to-urban immigration, poverty and crime in some areas, etc.

Alesina and Rodrick (1994) also show that income or assets inequality has severe setbacks on the economy: it distorts the tax system which makes the Government loose revenues and put more tax burden on the middle and poor classes (which is totally unfair). The tax distortion in turn can seriously hamper economic growth.

Another aspect is the pure distributional impact of assets and wealth on economic growth. Everything being equal, a more equitable distribution of assets tends to be correlated to a higher economic growth and stable economy.

On the health side, inequality distorts the health system organization (poor or inefficient allocation of resources). Another drawback is that poor households (who already suffer from diseases and ill-health) also expend more (as a proportional share of their revenues) on health than rich ones. This is totally unjust.

At the local (community) level, a greater inequality, as said, may also lead to social instability, along with a disorganization and inefficiency of publicly-delivered social services.

Finally, at the individual and household levels, inequality (whether income-related or health-related) in the household or outside household may either lead to a mental depression or psychological stress for individuals that may aggravate their health status (even causing death) and lead to a loss of revenue and welfare for the household. Thus once again the vicious circle: limited access to credit and capital, limited access to job markets, poorer health, etc. The inequality situation keeps increasing. On the other hand, it can push individuals to revolt themselves against the system and become criminals or renegades.

Sen (2002) argued that health inequality is more important than any other type of inequality because health conditions people's ability to function properly in the society.

Thus, for all reasons, inequality has become of great concern for economists and policy makers alike, with no-easy-to-found solutions for its eradication. It is a problem for both developed and developing countries.

In France, increased inequality (whether in income or health, etc.) is a hot debate nowadays. There is a 7 years gap in life expectancy between an unskilled worker and a skilled one in the country. There is a say in the country to describe the general feeling: “l’ascenseur social est en panne” (the social ladder is out of service).

1.3. Measuring Inequality in Health.

There are many ways to measure inequality in health (Rochaix, 2003) and many indicators¹⁶² have been proposed throughout the literature¹⁶³.

We’ll present here only those used for health indicators in this chapter. They are often built around the Lorenz curve and the Gini index described in the Chapter 1.

¹⁶² Among which the Gini coefficient, the Lorenz curve, the Coefficient of Variation (CV), the Schultz Index, the Robin Hood Index, the Interquantile or Intergroups Ratios (i.e. comparing one group to another), the Relative Mean Deviation, the Standard Deviation of Logs, the Kakwani Index, the Mehran’s Coefficient, the Piesch Measure, the Concentration index, the GIE, etc. Particularly, the interquantile ratio (usually Q1/Q5) is used to infer about inequality in health. The World Health Organization (WHO) also

defines a health inequality index:
$$I = \sum_{i=1}^n \sum_{j=1}^n \left(\frac{|H_i - H_j|^3}{2n^2 \sqrt{H}} \right)$$
, i and j being two individuals, n the number

of observations and H the health status. See chapter 1 for some useful inequality indices.

¹⁶³ Many of the proposed indices have pervasive effects, so economists have dictated a set of axioms or principles to which they must satisfy and that we think it’s useful to recall again. The most well-known example is the variance, which is a summary of dispersion. Simply doubling all incomes would more than double the variance, a property that is not desirable, since in theory, the inequality should have remained unchanged. The first axiom is the Pigou-Dalton transfer principle (Pigou, 1912; Dalton, 1920, Atkinson, 1970; Sen, 1973; Cowell, 1985): a transfer from a poor person to a rich should result in a rise (or at least not a fall) in inequality. The income scale independence axiom states that inequality should remain unchanged when all incomes or any other welfare indicator are scaled up in the same proportion. The population principle axiom is related to the fact that inequality remains unchanged when merging two identical populations. The anonymity or symmetry principle is the axiom that imposes the inequality index to be sensitive only to the welfare measure, not to individual’s other characteristics. The decomposability axiom states that overall inequality should equate sub-groups inequality rates. Any inequality index that satisfies all the above axioms is called a Generalized Entropy (GE) measure (Theil, 1967; Cowell, 1995; Litchfield, 1999).

1.3.1. The Concentration Index (Wagstaff et al., 1989).

The CI has been for more than a decade the traditional tool for assessing inequality in health. This concept has been introduced in the income-related health inequality literature by Wagstaff et al. (1989). The CI is a kind of “health’s Gini coefficient”, in the sense that it provides a measure of socioeconomic inequality in health which is comparable to the traditional Gini index.

In most cases, it is used in its bivariate form involving two variables (the health indicator plus a measure of the socioeconomic status of the unit under study, either a person or a household). The CI is particularly handy when the health variable is dichotomous (such as access to health care, whether the child has had vaccination, etc.) while the pure Gini index is more useful when we have a continuous-like health indicator such as the height or the weight-for-age indicator of the person. However, many authors also computed the CI for continuous variables.

As in the Gini index case, the CI is obtained graphically as twice the area between the concentration curve associated to it and the line of equality, with on the x axis, the cumulative proportion of the population ranked by increasing income (or any proxy of the household’s welfare or socioeconomic status) and on the ordinate axis, the cumulative proportion of health (Wagstaff et van Doorslaer, 2002).

It thus ranges between -1 (all health concentrated in the poorest unit) and 1 (the richest unit captures all health). When the CI is equal to 0, there is a perfect equal distribution of health across the population (everyone has the same health status).

In the case of dichotomous (0/1) variables, Wagstaff (2005) has shown that the bounds are $\mu - 1$ and $1 - \mu$ in the case of large samples, where μ is the mean of the health variable. As μ rises, the feasible intervals shrink.

The author therefore urged strong caution in comparing CI results for such variables across time or countries when the means differ significantly.

Formally, from the concentration curve, one could write the CI as:

$$C = 1 - 2 \int_0^1 L_h(p) dp \quad (1)$$

with $L_h(p)$ the health concentration curve values associated to a proportion p of the population ranked by socioeconomic status.

In the discrete case, the formula is equivalent to:

$$C = \frac{2}{n\mu} \sum_{i=1}^n h_i r_i - 1 - \frac{1}{n} \quad (1a)$$

where h_i is the health of individual i , μ its sample mean and $r_i = i/n$ is the fractional rank of individual i in the welfare indicator distribution from the poorest ($i = 1$) to the richest ($i = N$). n is the total number of observations in the sample.

The CI cannot be computed in the case where the health variable contains negative values or is a categorical variable. It shares some of the properties defined in the axioms above, notably the invariance property in the multiplicative case, but not in the additive case (adding a constant to the health variable will change the CI).

As for the interpretation, a negative CI means that the concentration curve lies above the line of equality (indicating a disproportionate concentration of the health variable among the poor), and vice versa.

On a micro data¹⁶⁴, it is more convenient to use simpler formulas to compute the CI. There are two main methods: the “convenient regression” and the “convenient covariance”.

1.3.1.1. Measuring the CI: The Convenient Covariance Method.

The “convenient covariance” or “formula” method (Jenkins, 1988; Lerman and Yitzhaki, 1989; Wagstaff et al., 2008) is defined as:

$$C = \frac{2}{\mu} \text{cov}(H_i, R_i) \quad (1b)$$

with H the health measure and R the cumulative proportion of the population ranked by the socioeconomic indicator.

¹⁶⁴ Sometimes, many authors find it useful to compute the CI for grouped data (such as quintiles, regions, etc.). This is the case when for example one gets the information from a table in an article. The group data formula for T groups is obtained by:

$$C = (p_1 L_2 - p_2 L_1) + \dots + (p_{T-1} L_T - p_T L_{T-1})$$

The variance is estimated (Kakwani et al., 1997) as:

$$\text{var}(C) = \frac{1}{n} \left[\sum_{t=1}^T f_t a^2 - (1 + C)^2 \right] + \frac{1}{n\mu^2} \sum_{t=1}^T f_t \sigma_t^2 (2R_t - 1 - C)^2$$

with:

$$R_t = \sum_{k=1}^{t-1} f_k + \frac{1}{2} f_t$$

$$a_t = \frac{\mu_t}{\mu} (2R_t - 1 - C) + 2 - q_{t-1} - q_t$$

$$q_t = \frac{1}{\mu} \sum_{k=1}^t \mu_k f_k, \quad q_0 = 0$$

T is the number of groups, f_t is the proportion of the sample in the t th group. R_t is the fractional rank of group t in the overall distribution and thus indicates the cumulative proportion of the population up to the mid-point of each group interval. μ is the mean of the health variable and σ^2 its variance, with the subscript t indicating their corresponding values in a group t . a_t is a simple retransformation. q_t is the ordinate of the concentration curve $L_{h_t}(p)$ and $p_t = \sum_{k=1}^t f_k R_k$ the associated proportion of the population in group t . When the variance of group t is unknown, the second term is assumed zero and n is replaced by T in the first term.

The standard error of the CI is defined as:

$$\text{var}(C) = \frac{1}{n} \left[\frac{1}{n} \sum_{i=1}^n a_i^2 - (1+C)^2 \right] \quad (1c)$$

with:

$$a_i = \frac{H_i}{\mu} (2R_i - 1 - C) + 2 - q_{i-1} - q_i$$

$$q_i = \frac{1}{\mu n} \sum_{y=1}^n H_y, \quad q_0 = 0$$

where q_i is the ordinate of the concentration curve $L_h(p)$.

1.3.1.2. Measuring the CI: The Convenient Regression Method.

In the “convenient regression” case, the CI is obtained via:

$$2\sigma_R^2 \frac{H_i}{\mu} = \alpha + \beta R_i + u_i \quad (1d)$$

The CI is the estimated $\hat{\beta}$. σ_R^2 is the variance of the fractional rank variable of individual i .

The variance is obtained jointly with the CI in the estimation regression. It is the square of the standard error of $\hat{\beta}$. But this variance is inaccurate because of the autocorrelation

induced by σ_R^2 . The solution is to use a Newey-West instead of an OLS to estimate equation (6c). See Wagstaff et al (2008) for further detail¹⁶⁵.

1.3.2. The Gini Income Elasticity (Lerman et Yitzhaki, 1989).

The GIE is a relatively new concept introduced by Lerman and Yitzhaki (1989), Yitzhaki (1999) and further developed in Wodon and Yitzhaki (2001). Loosely speaking, it seeks to foretell how inequality changes at the margin, if the individual or group's welfare variable increases by one percentage point.

Consider a service that provides a benefit to households x^A and assume for simplicity that the level of the benefit, B , is the same for all households with access. If the variable A denotes access, thus one has:

$$\begin{cases} x^A = B & \text{if } A = 1 \\ x^A = 0 & \text{if } A = 0 \end{cases} \quad (2)$$

As shown throughout this dissertation, we need a proxy for the households or individuals' wealth. In this chapter we apply the GIE framework, a factorial analysis is used to obtain such a proxy, denoted by y . The mean level of wealth is \bar{y} and the normalized rank of each household in the distribution of wealth is $F(y)$. This rank takes a value of zero for the poorest household and one for the richest.

The Gini index of wealth inequality G_y is defined as above as:

$$G_y = \frac{2 \text{cov}(y, F(y))}{\bar{y}} \quad (3)$$

¹⁶⁵ We provide in the last Annex, two Stata programs to compute the concentration index both on individual and group data, along with their associated variances and corresponding p-values. The codes give the user the possibility to choose one or all of the methods described above.

Letting $W = \bar{y}(1 - G_y)$ be a measure of social welfare¹⁶⁶, Yitzhaki (1999) shows that an increase in access distributed in the same way as the current distribution of access will generate a gain in social welfare equal to:

$$dW = (\Delta \bar{x}^A)(1 - \eta^A G_y), \quad (4)$$

where $\Delta \bar{x}^A$ denoted the gain in mean access and the GIE parameter η^A is defined as:

$$\eta^A = \frac{\text{cov}(x^A, F(y))}{\text{cov}(y, F(y))} \frac{\bar{y}}{\bar{x}^A}. \quad (5)$$

In (4), \bar{x}^A is the mean benefit from access across the population as a whole, so that $\bar{x}^A = B * p$ if p is the proportion of households with access.

As for the interpretation of (3), a GIE of one means that access is distributed in a similar way as wealth, so that changes in access would not affect the existing level of wealth inequality. A GIE below (above) one means that increases in access will be inequality reducing (increasing). A GIE of zero implies no correlation between new access and wealth, which also implies a reduction in wealth inequality since the poor get as much of the benefits of new access as the better off. A GIE below zero essentially means that in some way, the bottom part of the distribution gains more in access than the top part.

There is no guarantee that the increase in access will be distributed in the same way as current access – it could be distributed in the same way as the distribution of the current lack of access (for example if those who get access are randomly selected among those without access). Then, the GIE for the benefits of new access would be equal to:

¹⁶⁶ Sen (1976) and Yitzhaki (1982) provide different rationales for using this welfare function. Ebert and Moyes (2000) offer an axiomatic characterization of Yitzhaki's interpretation.

$$\eta^{NA} = \frac{\text{cov}(x^{NA}, F(y))}{\text{cov}(y, F(y))} \frac{\bar{y}}{\bar{x}^{NA}}, \text{ with } \begin{cases} x^{NA} = 0 & \text{if } A = 1 \\ x^{NA} = B & \text{if } A = 0 \end{cases} \quad (6)$$

Note that η^A and η^{NA} are related with $\eta^A * p + \eta^{NA} * (1 - p) = 0$.

Finally, the distribution of new access (which can be observed directly if we have two consecutive household surveys) could follow a different pattern, which in practice is likely to be neither as favourable for the poor as the distribution of the current lack of access, nor as unfavourable as the current distribution of access. If η^{MA} denotes the marginal gain in access, the GIE that we are interested in for the marginal benefit incidence analysis is:

$$\eta^{MA} = \frac{\text{cov}(x^{MA}, F(y))}{\text{cov}(y, F(y))} \frac{\bar{y}}{\bar{x}^{MA}} \quad (7)$$

This is what we denote here by MGIE¹⁶⁷.

1.2. Determinants of Health Inequality and Trends.

The causes of health inequalities are often rooted in the causes of health itself. Hofrichter (2004) provided a good literature survey. Usually, we have the so-called socioeconomic determinants (family backgrounds and structure, housing, job, hygiene and sanitation, revenues, self-esteem and social life, community and social networks, education, air quality, transportations, infrastructures and social services, class, race, gender, racism, etc.). These determinants are deeply connected to the foundations of everyday life and have long-term impact on health and inequality in health (Link and Phelan, 1995, 1996; Beaglehole and Bonita, 1997; Hofrichter, 2004).

¹⁶⁷ As for the CI, we also provide two Stata codes in Annex to compute both GIE and MGIE on individual and group datasets.

Other (more short-term) determinants are the performance of the health system itself (organization, quality of health personnel, absenteeism, availability of drugs and vaccines, health campaigns, health funds available to health centers and communities, health fees and out-of-pocket payments, reactivity to epidemiological emergencies, mutual and insurance, corruption, etc.). At the national level, epidemiological diseases (especially AIDS) are also key components of (ill) health and its inequality (Smedley and Syme, 2000). The nature of the political system (democratic or authoritarian) and the economic system (capitalistic, socialist, egalitarian, etc.) adopted, the struggle for power and the fight among classes will also impact inequality in health and health status. As noted above, the deeper the socioeconomic inequality in a society, the sharper the inequality in health. Thus, middle class people in a very unequal society may have worse health status than poor class people in another (more egalitarian) society¹⁶⁸.

It is worth emphasizing once again that all these causes listed above reinforce each other.

Researchers more and more investigate trends of inequality in health over time. For instance, Goesling and Firebaugh (2003), using the four common measures of inequality as outlined above in the Chapter 1 (including the Gini), showed that inequality in life expectancy have steadily declined over the period 1980-1992, then start to rise over the period 1992-2000.

In 2000, inequality in health between world countries was about the same than that of 1980. They attribute this to differential growth rates of life expectancy across countries, and to the worsening inequality situation in Africa coupled with faster population growth in SSA than the Rest of the world. When they take Africa out of their sample, then they retrieve the long-term declining trend in life expectancy inequality. The authors do not provided explanation for the African results, but two factors might have been very important. The first is the AIDS epidemic. The second is more related to the conjectural

¹⁶⁸ We can also add macroeconomic factors such as the effects of exchange rate, aid volatility, macroeconomic and GDP instability, etc.

increase in child mortality as found in the Chapter 3. Indeed, this important result seems to validate our findings above.

As child mortality has not decreased much on average in SSA during the periods 1990-1995 and 1995-2000, the immediate consequence was to shorten life expectancy along with to increase its inequality.

According to United Nation's 2002 projections (UNPD, 2003), life expectancy will continue to decrease in Africa until 2010 when it will start to rise again.

II. Estimates of Inequality in Health in SSA and the Rest of the World: Results using DHS datasets.

Access to network-based health care and sanitation infrastructure services such as electricity and piped water is low in SSA, especially in rural areas and among the poor, as compared to the rest of the world. On the other hand, ill-health remains concentrated in the sub-continent, especially among the poor.

One of the objectives of the PRSs¹⁶⁹ implemented in many countries is to improve health status and access to health care and health-related services.

This is a worthwhile objective, since access to such services is believed to have beneficial impact not only on productivity and growth, but also on a range of social indicators (among others education) that are precisely those that are targeted under many PRSs and more generally under the MDGs.

In addition, in the specific case of sanitation, from a pure distributional point of view, it can be shown that in most cases, policies (such as connection subsidies) that aim to improve access tends to be more pro-poor than policies (such as lifeline or means-tested consumption subsidies) that aim at improving the affordability of consumption for those who already have access, simply because households that already have access tend to be

¹⁶⁹ Poverty Reduction Strategy.

richer than those without access¹⁷⁰. Unfortunately, in the specific case of SSA, it is unclear whether improvement in access, assuming that they are observed, will benefit the poor, unless special efforts are made in order to reach them. As better-off households tend to benefit first from improvements in access (because they are closer to the health facilities and to the existing networks managed by utility services, or because they can more easily afford to pay for the services provided by utilities), improvements will trickle down to the poorer member of a society often only when access rates are already relatively high among the non-poor¹⁷¹. Because access rates remain much lower in SSA than in other regions of the world, it is unclear whether a substantial part of new connections will go to the poor.

For comparability purposes, this chapter, as the previous chapters, relies on DHS implemented during the period 1990-2005 in SSA. Since DHS data do not include information on consumption or income, the now standard approach of relying on an index of wealth was used in order to assess the level of wellbeing of each household.

The method used is very simple. The index of wealth is computed using factorial analysis, with the variables included allowed differing between countries so as to maximize the information used. In practice, the variables used include housing variables, variables on the access to various types of provision for basic infrastructure services, and variables on a range of assets owned. Quintiles are then created to estimate basic statistics on access levels by level of wellbeing within each country.

For the marginal benefit incidence, the paper relies on the countries for which there exist at least two surveys over the period under review, in order to assess which quintiles benefited from the increase (or in some cases, which households suffered from the decrease) in access over time.

¹⁷⁰ For a review of the pros and cons of connection versus consumption subsidies, see Estache et al. (2002).

¹⁷¹ See Ajwad and Wodon (2003, 2004) using data from Latin America and South Asia.

Apart from providing basic statistics, we also estimate as in Diallo and Wodon (2005) summary parameters for the distributional properties of existing levels of access, and changes in access, relying on the GIE framework. The analysis here is based on a simple analytical framework for analyzing the distributional properties for both the incidence of access to services, and the marginal incidence for changes in access over time.

The objective is to use the relatively new concept of the GIE as the overall summary statistics to assess who benefits from access and improvements in access. Results are compared to the more traditional CI.

The GIE and CI frameworks are already presented in detailed sections above. To estimate the various GIEs, we rely as in Diallo and Wodon (2005) on estimates by quintiles, given that as shown by Wodon and Yitzhaki (2001), these estimates tend not to be biased much versus household level estimates (since we do not have panel data, we cannot in fact estimate the GIEs based on household-level data directly).

2.1. Access Rates.

The data employed for all countries are the DHS which are nationally representative household surveys. For reasons of accuracy and comparability, we only include in our sample data covering the period 1990-2005¹⁷². Rates at the national level have been computed using population weights, while the average sample weight is just the simple mean of weighted national rates.

In each survey, the household-level observations are divided into five homogenous assets index intervals, or quintiles. The quintiles groups are computed at the national level, as in Ravallion and Lanjouw (1999). These quintiles are further grouped into two distinct groups: poor (Q1-Q3) and rich (Q4-Q5).

¹⁷² Data before that period are not reliable. More, variables are not standardized as the other waves of surveys. New datasets have been made available since the time we've made our computations. They are not included in our sample.

2.1.1. Access Rates to Health Care and Infrastructures Services.

2.1.1.1. Access to Health Care Services.

In Table A9, we present access rates to health care services. We choose to consider three widely used indicators to assess the performance of the health system and that also are crucial for overall health status: - full vaccination¹⁷³, medical treatment of diarrhoea and medical assistance at delivery. However, due to number of information, below is a short summary table below (Table 12)¹⁷⁴.

As we can see, rates are quite good in the African case. Overall, rates remain low in SSA when set against that of the rest of the world (see below and more in detail in the Table A9). Curiously, out of the three, medical treatment of diarrhoea appears to be lower.

Table 12: Trends in Health Care Services in SSA as Compared to the Rest of the World.

		1990-1995	1995-2000	2000-2005
SSA	Child is fully vaccinated	53.53%	44.45%	44.39%
	Diarrhoea: medical treatment	35.01%	33.29%	26.70%
	Medical delivery	54.80%	52.30%	47.20%
Rest of the World	Child is fully vaccinated	47.04%	51.41%	66.23%
	Diarrhoea: medical treatment	31.12%	37.24%	36.88%
	Medical delivery	59.45%	62.45%	69.92%

Source: Author's Own Calculus Using DHS Data.

Full vaccination coverage overall in the world is low. About half of the children (around 48%) are fully vaccinated in the World. This is far from the universal coverage observed in developed countries. Looking closely at vaccination rates in each period, Africa has been doing better in the first period comparably to the rest of the world (53.5% vs. 47%), but had lost its advantage afterwards in the second and third periods, while the rest of the

¹⁷³ Child received the following vaccines: BCG, measles, 3 doses of DPT, 3 doses of polio (excluding the dose given shortly after birth).

¹⁷⁴ Again, we remind the reader that SSA countries are listed at the beginning of Chapter 1 as well as the poor and middle-income countries that form what we call the "rest of the world". Due to sample problems and under-representativeness, strong caution is due when reading our regional comparisons.

world had managed to extend full vaccination coverage (44% against 51% in 1995-2000 and 44% versus 66% over 2000-2005). Over 1990-2005, SSA has lost almost 10 percentage points of full vaccination. One reason explaining these results is that most vaccination campaigns in Africa are carried out since decades by UNICEF and its satellite agencies, as well as foreign NGOs, while local authorities almost neglect that important services. Indeed, health centers often experience shortages (drugs and vaccines) from central Government. When these are available, there are sometimes stolen and sold on the black market. In fact, UNICEF usually massively intervenes when rates begin to be dangerously low. This explains in large part the teeth-saw evolution.

Medical assistance to delivery is quite high in the full sample with an average of 56%, but still far from the 95% average percentage observed in rich countries. Rates dropped in SSA from 55% to 47% over 1990-2005, while rising in other regions from 59% to 70% on the same period. Once again, looking at country performance, in 1990-1995, worldwide Niger and Haiti had the lowest rates in the first period while Zimbabwe, Malawi and Rwanda championed around 80%. In the second period, Gabon surprisingly had 13% followed by Chad while at the other extreme we have Rwanda, Uzbekistan and Zambia and Egypt (as high as 92%). Over the last period, Nigeria and Chad had the lowest coverage (12% and 13% resp.) while Egypt and Morocco had the highest (around 85%). Overall, Bangladesh and (astonishingly) Morocco were leading behind while the Philippines and the Dominican Republic reached universal coverage with a bursting 93% and 97% respectively. The full sample average coverage was 57% over the full period 1990-2005.

Medical treatment for diarrhoea is even lower (30% on average for the full sample, or one child in three). In SSA, rates continuously dropped from 35% to 33% and 27% over the three periods. The converse is true for the rest of the world (31% to 37% over the last two periods, or a 6 percentage points gain). One possible explanation is that households tend to self-treat diarrheal episodes, especially in Africa, with traditional herbs or pills bought on the black market.

Thus, the drop in vaccination and medical assistance at delivery rates in SSA could be part of the puzzle in explaining why there has been much less progress in child mortality and malnutrition in this part of the world, as observed in the Chapter 3. Taking altogether health status and health care services indicators, rates have been quite staggering, particularly in Africa.

Let's now turn on subgroups inequality...

As said, regarding area of residency, rural areas are the most disadvantaged when set against urban rates. For example, worldwide, 60% of urban children against 47% of rural ones were fully vaccinated between 2000 and 2005. For some indicators, such as medical delivery, urban areas are twice much favoured than urban ones.

The same thing is observed for quintiles groups (Q1 to Q5). For a finer analysis; we decide to observe all the five quintiles. In all regions, the top two quintiles systematically benefit more from health care services. The richest Q5 group had more than twice access to medical delivery than the poorest Q1 group.

However, the gap is shrinking over time, as poor groups and regions have witnessed a slight increase in their rates, and the rich ones being stagnant. For instance in SSA, the poorest groups had 40% of full vaccination in 1990-1995 and 44% in 2000-2005 against 63% and 59% for the rich over the same periods.

The fall or stagnation in the access rates of rich people could mean that they do use much these primary health care services (because of a generally good health status) and that they may have substituted them for other more technical ones (such as heart or cancer diseases treatments).

Another possible explanation could be that African Governments have explicitly targeted poor groups and regions to increase their coverage. In terms of inequality classification, access to medical delivery is more unequal, followed by full vaccination and lastly by medical treatment of diarrhoea.

2.1.1.2. Access to Health-Related (Sanitation) Services.

The rationale for using these indicators has been discussed in the footnote 7 above.

The Table 13 below provides a summary trend while the much bigger Table A10 in Annex presents basic statistics on access to public health-related infrastructures by various characteristics, namely, national, urban/rural and by wealth groups. The outcomes of interest are the access to electricity, to toilet and to water¹⁷⁵.

We observe roughly the same general trends for these indicators. As for the health indicators described above, rates in access to infrastructures are very low in SSA as compared to the rest of the world. But worldwide, it's worth noting also that rates are also very small, as compared to rich countries standards.

Overall on average 28% of the world population had access to water in residence, 41% to tap water, 43% to electricity and only 23% had flush toilet at home. Figures are very different whether we look to SSA or not.

Table 13: Trends in Health-Related Services in SSA as Compared to the Rest of the World.

		1990-1995	1995-2000	2000-2005
SSA	Tap Water (Public & Private)	25.25%	34.02%	30.28%
	Electricity	14.76%	23.92%	20.42%
	Flush Toilet	13.57%	9.65%	6.39%
Rest of the World	Tap Water (Public & Private)	51.08%	57.30%	51.07%
	Electricity	63.08%	75.01%	76.94%
	Flush Toilet	39.02%	38.93%	49.54%

Source: Author's Own Calculus Using DHS Data.

Generally, access to water and sanitation remains a huge problem in African countries, as we are still very far from universal coverage, even in urban areas. The situation is hardly better in the rest of the world as it still does not reach universal coverage as in the

¹⁷⁵ Water in the dwelling or yard/plot and more generally to tap water whether it is privately owned, or publicly supplied. Access to tap water thus is defined here as the access to tap water in the dwelling, in the neighbors compound or to any tap water in general, whether private or public sources.

developed countries. Rates are however far higher than the African ones. The sub-continent had on average an access rate of 14% for tap water in residence (against 42% for the rest of the world), 29% of public and private safe water (against 51%), 16% against 63% for electricity and 9% versus 23% for flush toilet over 1990-2005.

In general, African population has higher access to electricity than to water inside dwellings¹⁷⁶. Electricity (through landline cables) is easier to extend than potable water (which requires digging before installing the pipes). Electricity also has more sources (nuclear plants, natural gas, rivers, etc.) and is more easily accessible than safe water which is dependable of climate, rainfall and the nature of soils).

The average access rate to water in dwelling for the sample is 12%, almost half the mean rate for electricity, which is 20% on average for the period 2000-2005.

However, African countries have made substantial efforts to access to tap water in general. If we compare electricity to all tap water coverage (privately owned in dwelling or yard/plot and public water outside the dwelling), the figures show that access to tap water is higher than to electricity (30% versus 20%) in the late period.

In some countries, the access rate for electricity is twice or three times the access for water in dwelling. This is the case for Nigeria, Indonesia and India, for instance. Looking at socioeconomic and area of residency inequalities, the Table A10 in the Annex indicates mainly that access rates vary widely by income quintiles and area of residency. As expected, a strong positive correlation exists between the levels of access to public services and these socio-economic status. The top two quintiles systematically benefit from access to infrastructures. Alike, urban areas appear to be better-off in terms of access¹⁷⁷.

¹⁷⁶ This is fairly understandable as many “pirate” and illegal connections are made to electrical network. Many households also buy electrical power generators. On the other side, it is more difficult to branch illegally on the water network.

¹⁷⁷ In the late period, urban areas were seven times more privileged than the rural ones in access to electricity (52% against 7% on average) and fifteen times more privileged in terms of access to water in dwelling (34% against 3.5% on average). Considering the fact that the bulk of the population resides in

Comparing SSA to the rest of the world, urban electricity rates were only 1.5 times higher than rural ones in the last period, while for water in dwelling figures are more than the double. Richest groups in the rest of the world had almost universal coverage for electricity against 42% for the poorest. Likewise, richer group had three times higher access coverage than the poor. Thus, urban-rural and Q1-Q5 inequalities appeared more pronounced in Africa than the rest of the world.

Considering the three periods of time corresponding to each phase of the DHS project, our finding is that access to water and electricity has increased between the period 1 (1990-1995) and the second (1996-2000), but has decreased between the second period and the last (2000-2005). Safe water (public and private) varies over the 3 periods respectively from 25% to 34% and 30% in SSA (31%, 57% and 51% for the rest of the world). Figures for electricity are 15%, 24% and 20% for SSA and 63%, 75% and 77% for the rest of the world. For water in dwelling and yard/plot, access rates in SSA have been 14%, 18% and 12% against 42%, 47% and 44% in the rest of the world. Access to toilet sanitation has been falling. On average, access rates in SSA were 14%, 10% and 6% for flush toilet over the three periods of time. In the rest of the world, rates were 39%, 39% and 49.5%, a jump of 10 points over the last period.

The drop between the first and the last periods for water, toilet and electricity is a surprise, especially after the remarkable increase of access in the second period (1995-2000), and call for further investigations¹⁷⁸.

This can be linked on the demand-side to the monetary impoverishment of the SSA households if the findings of Ravallion and Chen (2001) are valid.

rural area, there is no surprise to see such low national rates. For the same period, the richest quintile had sixty-five times higher access to electricity compared to the poorest one (65.5% against 1%), and almost forty times access to water in dwelling (45% against 0.1%). The poor in general have no access to water inside their houses and to electricity. C'est un luxe.

¹⁷⁸ One possible explanation is that electricity and water societies have been privatized during the end of the 1990s and have become more rigorous in their management. Tracking illegal connections, recovering late payments and rising fees could have impacted negatively the demand for these services, especially by the poor.

Another possible and more plausible explanation could be a supply-side deficit and could be found in the rapid urbanization of the African society (Diallo et al., 2007). This fact, coupled with a still-high demographic growth rate (around 3%) could impede countries to develop their coverage to keep-up with its speed. Keeping consistency with the previous paper, there could also be lagged and indirect effects of financial and economic crises on access to sanitation infrastructures, while direct effects will be to increase access coverage during the crisis periods and then devote resources to other sectors afterwards.

Another factor possibly explaining this drawback is the demographic transition that is currently ongoing in the region over the late period (see Chapter 1). As a result of this change, household size is diminishing, resulting in a higher demand for coverage (as the number of households (and thus dwellings) has increased). This also frustrates network expansion. Diallo and Wodon have shown the impact of this demographic transition on economic growth (2007a) and on the accessibility to basic services (2007b) and demonstrated that coverage needed to be expanded by more than 50% to provide universal access in SSA. These general trends are also observed at the sub-groups level.

Finally, the urbanization of these countries poses a great challenge for providing access to services, especially when coupled to the demographic transition above.

Let's now examine urban/rural areas gaps. Contrary to the case of health care services above, overall the gain for urban areas had only been for electricity coverage with a level passing from 50% in the first period to 56% in the second and 52% in the third for the 30 SSA countries-years in our sample. Thus, overall, this is only an increase of 2 percentage point between the first and last periods. Water inside dwelling followed the same trends. Coverage in urban dropped from 42% in the early 1990-1995 to 34% in the late period 2000-2005, or a lost of 8 points. Access to tap water has also been declining, after being stable on the first two periods. Finally, looking at flush toilet inside dwelling, rates have been falling dramatically.

Looking at rural tendencies over the two extreme periods a small increase is observed for rural areas with a gain in coverage only for electricity while water in dwelling coverage slightly increased on average for the sample and tap water from 13.5% to 15% over the first and last periods, or a one point percentage gain. Even access to flush toilet had increased in rural areas overall (1% to 1.7%, almost a double).

As for socioeconomic differences, electricity coverage has increased in the first and last periods for all groups¹⁷⁹. Surprisingly, access to water in dwelling has increased on average only for the middle African classes, while the two top groups are regressing or were stagnant¹⁸⁰.

The Figures A6 summarize clearly the trends and show that the poorest group remains globally stacked to zero while the top quintile captured almost all of the gains, whenever they happen, for virtually all services.

The Table A10 shows that on average, households in the top two richest quintiles benefit more than the average ones from an increase in access to water, even though for some services (public tap water), the poor also benefited a little. However, for electricity, only the last group benefits on average. Among exceptions, we have Cote d'Ivoire where the middle classes benefit also from the increase in access. These gains are summarized in the Table A11 in the Annex.

2.2. Inequality in Health, Health Care and Health-Related Services.

Finally, the CI, GIE and MGIE estimates for the 56 DHS countries are presented in the Tables A12 and A13 to capture the current distribution in access. The MGIE are the GIE

¹⁷⁹ 55% to 65.5% for the highest quintile, against about 0% to 1% for the poorest.

¹⁸⁰ The rates dropped from 20% to 13% for the fourth quintile and remained at 45% for the fifth quintile while the first quintile remained virtually at 0%. Access to tap water in general dropped from 78.5% to 73% for the top quintile, while the poorest quintile slightly improved from 1.5% to 5%. Access to flush toilet for the richest group dropped from 30% to 24% between 1990 and 2005, and remained at zero for the poorest.

computed for a marginal gain in access (Table A13). Once again, we provide below a short table summarizing our results.

Table 14: Trends in Inequality (GIE and CI) in SSA as Compared to the Rest of the World for Various Services.

		SSA			Rest of the World		
		1990-1995	1995-2000	2000-2005	1990-1995	1995-2000	2000-2005
Health Status							
Child Mortality	GIE	-0.16	-0.18	-0.11	-0.33	-0.45	-0.15
	CI	-0.06	-0.08	-0.04	-0.10	-0.13	-0.06
Child Malnutrition (Underweight)	GIE	-0.22	-0.27	-0.33	-0.47	-0.74	-0.13
	CI	-0.09	-0.12	-0.13	-0.16	-0.21	-0.07
Health Care Services							
Child is fully vaccinated	GIE	0.29	0.36	0.29	0.29	0.25	0.02
	CI	0.12	0.16	0.11	0.09	0.08	0.01
Diarrhoea: medical treatment	GIE	0.24	0.17	0.24	0.26	0.27	0.09
	CI	0.10	0.08	0.10	0.09	0.07	0.04
Medical delivery	GIE	0.42	0.45	0.56	0.44	0.45	0.20
	CI	0.17	0.21	0.23	0.15	0.16	0.10
Health-Related Services							
Tap Water in Residence	GIE	1.63	1.42	1.52	1.13	0.95	1.24
	CI	0.68	0.63	0.70	0.40	0.29	0.30
Tap (Public & Private)	GIE	1.43	1.06	1.04	0.88	0.70	0.95
	CI	0.57	0.47	0.47	0.31	0.22	0.22
Electricity	GIE	1.67	1.43	1.49	0.94	0.69	0.58
	CI	0.70	0.65	0.67	0.33	0.24	0.20
Flush Toilet	GIE	1.66	1.44	1.60	1.34	1.72	1.21
	CI	0.69	0.64	0.71	0.47	0.49	0.39

Source: Author's Own Calculus Using DHS Data.

As said before, the CI tells us what is the current average inequality in the whole group or society, while the GIE informs us about the inequality at the margin, if the group's income increases by 1%. The MGIE tells how inequality at the margin evolves over time.

Results are as expected. Five important results need to be outlined.

- Firstly, for health-related infrastructure services (electricity, water and toilet), the GIE and the MGIE tend to be greater than 1 (indicating that inequality between poor and rich is increasing over time) while the CI is also on average superior to zero (indicating that the service is mostly concentrated among rich groups). This is true for SSA and the rest

of the world, but inequality tends to be higher and to be more increasing at the margin in Africa. This could be understandable if as we said, newly privatized companies are stricter and that controls affect mostly poor people (since they are the ones that connect illegally and cheat on bills payment). Note also that a new expansion in coverage favours first the rich before trickling down to the poor, raising marginal inequality. Likewise, with new migration and urbanization, along with the collapse of big families to smaller ones, poor urban areas (the slums) receive much less connection than others and this will increase inequality at the margin.

- Secondly, for access to health care services (medical delivery and diarrhoea treatment, vaccination), the GIE is generally below 1, meaning that inequality is reducing over time (the poor are benefiting more and more of the services). The CI for these indicators however remains positive meaning that the rich are nonetheless the most advantaged group in access to those services. Again, this is true for both regions. This time however, inequality is reducing quicker in SSA according to the table above.

The first and second points tend to show that, from a policy point of view, Governments worldwide, but especially in SSA have made higher efforts to reduce inequality in health care services than in sanitation ones.

- Thirdly, for health status indicators (child death and malnutrition) the GIE and the CI are both negative indicating a disproportional occurrence in poor groups. The CI indicates that inequality is at the disadvantage of poor groups, while the GIE shows that it is increasing at the margin over time (at the disadvantage of the poor). The table above shows that inequality is less pronounced in SSA denoting that children basically face the same risks.

- Fourthly, countries with low access rates have higher GIEs than countries with higher access both for sanitation variables (water, toilet and electricity) and for health care services (vaccination, diarrhoea medical treatment and medical assistance at delivery). This is particularly true once again for SSA. This means that if the mean access rate

increases by one point, it will benefit at the margin more to the poor than the rich, because rich people have already higher access.

- Finally, countries with low access rates also have higher CIs than countries with higher access both for water, toilet and electricity. This indicates that low access tend to be coupled with high inequality.

Thus, comparing globally SSA to the rest of the world, GIE and CI estimates are higher on average in the first, again indicating a worst inequality situation in the sub-continent (except for mortality and malnutrition). Comparing the two kind of services (sanitation and health care), on average, inequality in access to health care services is lower than inequality in access to sanitation infrastructures.

Looking at trend levels, overall in the world and for the full period 1990-2005, sample average of inequality indices (CI) in sanitation services has generally decreased between 1990-1995 and 1995-2000 but again has increased (for water in dwelling) or is stagnant (for the other three indicators) from the second period to the last (2000-2005).

For example, the CI index for water in dwelling and electricity for the whole sample remains stacked at .5 over the 3 periods. In SSA, the CI drops from .7 to .6 and back to .7 (.4, .3 and .3 for the rest of the world). Inequality in access to flush toilet remained unchanged (.6) overall.

Recall here once again that for electricity, and to a lesser extent for water, the unchanged or mild decrease in inequality could be linked at least partly to the privatization of services along with a stronger enforcement of controls and the migration of rural people to towns.

Concerning access to health care services, inequality for full vaccination overall dropped a little bit in absolute between the first and last periods, after a small increase in the second (.11, .13 and .08). The converse is observed for medical delivery which increased

in absolute from .16 in the first period to .19 in the second and .18 in the third (a 2 points percentage increase). For medical treatment of diarrhoea, there has been stagnation over the last 10 years of study, after a small decrease in the first period (.09, .08 and .08). The same general trends are observed for the Africa region and the rest of the world.

As for the GIE, indices for sanitation are also higher than indices for health care. The former are above one (indicating increasing inequality) while the latter are below one (decreasing inequality at margin).

The Table A12 shows that almost all countries have a GIE for electricity above 1, which means that an increase in access to electricity is inequality increasing at the margin. Gabon, Ghana and South Africa are the sole exceptions. Ghana especially passes from a situation of high inequality (2.2) in 1993 to a GIE of 1.6 in 1999 and 0.9 in 2003, which means that inequality in access is decreasing. This implies also that there is almost no correlation between wealth and access. Only South Africa has a GIE for electricity below one before 2000. The figures are the same for GIE of water in dwelling, Comoros and Ghana having a GIE below one. This also implies a reduction in wealth inequality since the poor get as much of the benefits of new access as the better-offs. If we expand access to tap water in general, some countries have GIEs below 1, meaning efforts have been made in the regions to reduce inequality between poor and rich, with especially Comoros having a negative rate. This implies that, at this point, the poorest quintile gains more than the richest one from access.

The same pattern is observed, in a lower extent, for the MGIEs (Table A13)¹⁸¹.

¹⁸¹ We examine also the relationships between our inequality indicators and some macroeconomic variables such as GDP per capita. Figures for the various periods and sub-continent are available upon request. They globally confirm the findings described above. Other graphs (also not shown) demonstrate how GIEs and MGIEs have evolved through for the 56 countries. Graphs for instance for electricity show a reversing trend between the three periods showing that African countries have passed from a situation of increasing inequality to a situation of reducing one. Figures for water in dwelling are more mixed. As for electricity, we have a reversing trend as inequality is increasing between the first two periods and decreasing in the last. Since rich groups have experienced a drop in access, the net result is a reducing trend in equality in access at the margin. Inequality in access to tap water has remained mildly stable between the last two periods, after an increase in the first. However, at the margin, we observe a slight increase in inequality.

Conclusion.

Over the past decades, most of the African countries have made substantial efforts to increase their network coverage in health care (outpatient care, vaccination and delivery) and sanitation (water, toilet and electricity) services since the independence. But comparing the first 1990-1995 period to the last (2000-2005), there has been in general a collapse or stagnation in health care services in the African region, while sanitation services have progressed tremendously between the first two periods in Africa before falling dramatically between the second and last periods. The rest of the world has experienced a continuous improvement in all services (health care and sanitation).

More, the “positive” results (i.e. the gains in access, if any) in health services and health-related sanitation services (water, toilet and electricity) have been hampered by the fact that almost all them are captured by the richest classes of the societies.

This suggests new policies being implemented.

The overall findings suggest that access rates (especially for access to health services) have generally managed to catch up with population growth during the 1990s but not much more. Access remains very low, implying investment levels much lower than needed. This is the lowest level in the world (for instance, 20% on average for electricity against 33% in South Asia, between 60%-90% elsewhere). The biases in access rates continue to favour urban and rich households with on average about two thirds of the population still living in rural areas.

Where to go from here? SSA still has a long way to go before it catches-up with the rest of the developing world in terms of access to, and the quality of, health care, electricity and sanitation services. The need is huge but so is the potential supply, including from renewable sources such as hydro. The efforts have been impressive but not yet all that successful from a social, financial and fiscal viewpoint as well as in terms of getting the International Community to assist in effectively scaling up the investment needed to meet the demand. The emerging policy challenges can be summarized as follows.

From a social viewpoint, the next decade will have to deal with the needs of the poorest. Indeed, the supply gap weights most heavily on them, including the many rural poor. The already “connected” users, most of them urban and mostly from middle and upper income classes, do benefit from the performance improvements associated with the reforms of the health and utilities sector. The drama is that even the poor urban residents who could have benefited from these reforms have been reluctant to use the health care services or to connect to utility ones in view of the high charges and overall average tariffs associated with the reforms.

From a fiscal viewpoint, the reforms will require a much stronger pragmatism in the financing approaches. Minimizing costs and aiming at cost recovery should continue to be central concerns but subsidies will be hard to avoid. Direct subsidies would be ideal but in many of the countries they are not likely to be realistic options. Some degree of redistribution, by which existing users pay for future connections, and a redesign of some of the life line schemes in place may be necessary to meet the social agenda in a fiscally responsible way.

GENERAL CONCLUSION

The major goal in conducting this thesis research is to analyze inequality in health status, health care and health-related services using DHS data. These surveys are comparable, unique and rich datasets that provide useful information on child and mother's health, on household's assets and structure, on access to health care and sanitation, on mortality and malnutrition, etc. The period of analysis is 1990-2005.

The major constraint in achieving that goal is the unavailability of information on households' welfare indicator, along with a suitable indicator of the overall health of the population.

To reach our objective, we follow two intermediate steps:

- First we find a proxy for welfare using household's assets, dwelling characteristics and access to utilities to construct the so-called "assets index". The first two papers deal with it and how to use it to analyze poverty over time and across regions. Results show that assets poverty and inequality are decreasing in every region of the world, including Sub-Saharan Africa. This tends to support our hypothesis that, contrary to common beliefs, African households use assets and building ownerships as saving tools and buffer to economic shocks. The first paper shows however that the demographic transition actually occurring in developing countries could impede on economic growth and trigger a bullet on policies aiming at combating poverty.

- Second, we assess the overall population's health using child mortality and malnutrition. Our third paper shows that child mortality is decreasing in all parts the world. However, the 1990s and early 2000s have been a lost decade for the African continent where many countries have witnessed an increase in rates that is mostly attributable among other factors to the economic and financial turmoils of the 1990s and early 2000s and the HIV epidemic. Our hypothesis is that these phenomena have destabilized the organization of the health care system, cut its funding and hampered its performance. High levels of health inequality can also be part of the puzzle. Coming back to the particular case of HIV/AIDS, the reader should observe that it affects more

and more the less poor so that it can also lead to a decline in assets inequality (richer people are dying) along with an increase in child mortality and thus explain in great part our paradox.

This setback (the rise in mortality over recent periods despite poverty reduction) will make impossible for these countries to reach the millennium development goals, at least for child mortality. The conclusion to this is that African population's health has been stagnant over the period 1990-2005. Regression analysis reveals no strong correlation between our measure of welfare (assets index) and child mortality. More important are mothers' education and access to health care and sanitation services.

- Finally, we realize the true objective of this dissertation in the fourth and last chapter: assessing inequality in health and health-related services. We use three tools: the Concentration Index CI (which informs on the current level of average inequality), the Gini Income Elasticity GIE (which tells how much inequality varies at a margin if welfare indicator varies by 1% percentage point) and the Marginal Gini Income Elasticity MGIE which tells how inequality at the margin evolves over time. Results show that inequality is pronounced for all indicators considered.

For ill-health indicators (child malnutrition and death), rates are excessively concentrated in poor and rural groups.

Concerning access to health care services, rich and urban groups tend to be more favoured than poor and urban ones. But the high level of inequality tends to be reducing at the margin over time, as the poor have increasing access.

Finally for access to sanitation services, results show that while the majority of countries have made substantial efforts to increase coverage on the first two periods, the rich and urban classes have benefited more and inequality (which is at high levels) tends to rise at the margin over time, especially for the poor. More preoccupying is the fact that rates are falling between 1995-2000 and 2000-2005, probably because of the privatization of these services and the new costs they impose on households.

Overall, inequality in all variables considered is more pronounced in SSA than the rest of the world (except for death and malnutrition). The sub-continent is still disadvantaged in terms of access to services or ill-health.

Where to go from here? In the African sub-continent, we have the following picture: a decreasing (material) poverty and inequality but coupled with a stagnant child mortality situation, a stagnant or increasing malnutrition. This is mostly due to high levels of, and an increasing inequality at the margin in access to sanitation and electricity services coupled with a decreasing access to these services. Thus, despite the fact that we observe a decreasing inequality at the margin in access to health care (even though the average level of inequality is still high) the missing link in health-related services coupled with an overall high inequality in these two types of services hugely impact child health and survival.

Therefore, as access to health care services and health-related sanitation services is essential to child survival, our findings call for vigorous policies to promote access of the poor groups and rural areas to these services. African Governments should continue to favour access of the poor to health care and reverse the inequality trends in access to water, sanitation and electricity. This is vital for the health of the population and for the development of Africa.

Funding can come from various sources: the Government Budget, International Assistance but also from households themselves (since the first part of our thesis has demonstrated that they are getting richer (and various surveys show that they are willing to pay for quality health care), an adequate fees policy could benefit to the health care system). Measures should be put in place to strengthen the performance of the health system and to mitigate the negative effects of macroeconomic imbalances, economic crises and HIV/AIDS.

Only on these conditions the Sub-Continent could hope to eradicate poverty and promote health for all.

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ANNEXES

Chapter 1.

Annex 1: The Factor Analysis Methodology.

Factor Analysis and the Assets Index.

Factor analysis is a branch of statistical analysis aimed to reduce a set of numerous variables linearly ¹ in terms of usually a smaller number of categories or “factors”. This is often called a dimension-reduction technique. The principal objective is thus to reach the most parsimonious description of observed data.

The classical factor analysis assumes that each of the n observed variables could be expressed as the sum of m ($m \leq n$) *common* factors and a *unique* factor. The common factors account for the correlations among assets variables, while each unique factor accounts for the remaining variance (including error) of that variable. It allows for assets-specific influences to explain variances. Contrary to the principal-components analysis, all of the common factors are not forced to explain the entire covariance matrix. The common factors explain the variance in the ownership of the set of assets and could be assimilated to a measure of economic status or wellbeing. Usually, a linear structure is assumed, although other forms exist in the literature.

For each variable x , the model could be written as (Harman, 1976):

$$x_{ji} = \sum_{p=1}^m a_{jp} F_{pi} + u_j Y_{ji} \quad (i = 1, 2, \dots, N; j = 1, 2, \dots, n). \quad (1)$$

where j represents the number of observed variables, i , the number of individuals, x_{ji} , the value of variable j for individual j . x thus is the correlation matrix of and thus represents effectively the unique correlations between variables x_{ji} . The coefficients a_{jp} are called “loadings”. F_{pi} is the value of a common factor p . $a_{jp} F_{pi}$ represents the contribution of the corresponding factor to the linear composite, while $u_j Y_{ji} = e_j$ is the residual term (the “unique” factors, assumed uncorrelated between each other and with the common factors: $E(e_j) = 0$ and $V(e_j) = \sigma_j^2$). This residual or error term expresses the fact that the hypothesis that our observed variables x being represented by F_{pi} may not be exact. Unlike traditional OLS regressions, where the variables are given or observed, here, all the four term in the right of the equation must be estimated. We essentially follow below a methodology described in Sahn et Stifel (2000).

The loadings a could be view in our case as the “propensity” to hold an asset.

Equation 1 could be rewritten as:

$$x_{ji} = a_j F_i + u_{ji} \quad (2)$$

In a matricial format:

$$\begin{aligned} x_i &= aF_i + u_i \\ a &= (a_1, a_2, \dots, a_N) \\ u_i &= (u_{1i}, u_{2i}, \dots, u_{ni}) \end{aligned} \quad (3)$$

for each household i . x is usually assumed standardized (with mean 0 and variance 1). It is also assumed that F and u are uncorrelated. u is a vector of errors with diagonal covariance equal to the uniqueness matrix φ .

The variance-covariance matrix of the error or disturbance term is then:

$$E(u_i u_i') = \text{Diag}\{\sigma_1^2, \dots, \sigma_n^2\} = \varphi \quad (4)$$

Technically, estimating the loadings a on the unique factor p is achieved through extracting the maximum possible variance that exists across the assets. This is done by estimating the eigenvalues (or unit roots) and the eigenvectors of the correlation matrix x (Cattell, 1965).

It is assumed that the mean of the common factors (“welfare”) is zero. Thus:

$$E(F_i F_i') = \sigma_F^2 \quad (5)$$

The fact that F is orthogonal and that the unique factors are i.i.d. permit to rewrite the variance-covariance matrix of the assets variables as:

$$\begin{aligned} E(x_i x_i') &= E[(aF_i + u_i)(aF_i + u_i)'] \\ &= aa' \sigma_F^2 + \varphi \\ &= \Omega \end{aligned} \quad (6)$$

where σ_F^2 represents the factor loading matrix while φ represents the diagonal matrix of uniqueness.

Identification requires the normalization of one of the parameters. Typically, it is the variance of the unobserved factors¹:

$$\sigma_F^2 = 1 \quad (7)$$

Assuming multivariate normal distribution of the common and unique factors, the assets index is computed in 3 steps:

Step 1. Estimate a and φ using maximum likelihood techniques.

Step 2. Estimate the common factors F for each household as the orthogonal projection of the unobserved household's welfare (F) on the space of the observed household's assets variables:

$$E^*(F_i / x_i) = \gamma_1 x_{1i} + \dots + \gamma_n x_{ni} \quad (8)$$

where :

$$\gamma = v(x_i)^{-1} \text{cov}(x_i, F_i) \quad (9)$$

But:

$$\sigma_F^2 = 1 \quad \Leftrightarrow \quad \left\{ \begin{array}{l} \text{cov}(x_i, F_i) = a \\ \text{and} \\ \gamma = \Omega^{-1} a \end{array} \right\} \quad (10)$$

Step 3. Finally, construct the assets index for each household i as:

$$I_i = \hat{\gamma}_i x_{1i} + \dots + \hat{\gamma}_n x_{1n} \quad (11)$$

where:

$$\hat{\gamma} = \hat{\Omega}^{-1} \hat{a} \hat{\sigma}_F^2 \quad (12)$$

$\hat{\gamma}_i$ is the estimated weight of each asset owned by the household.

Once computed the assets index, we could construct our measures of poverty based on the FGT general formula (13).

$$P_\alpha = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - \hat{I}_i}{z} \right)^\alpha \quad (13)$$

where \hat{I}_i is the estimated assets index for household i .

Annex 2: Asset-Based Poverty Comparisons.

Table A1: Assets Poverty, Inequality and Welfare for Countries in Sample.

Country	Year	Head – count (60% Line)	Poverty Gap (60% Line)	Average Annual ΔP0 (60% Line)	Average Annual Δgini (60% Line)	Head-Count Standard Errors (60% Line)	Poverty Gap Standard Errors (60% Line)	Head – count (50% Line)	Poverty Gap (50% Line)	Gini Index	Sen's Welfare Index	Sen' Head - count (60% Line)	Median Head-Count
Armenia	2000	0.11%	0.02%			3.27%	0.71%	49.40%	9.52%	10.00	2.14	0.06%	43.15%
Bangladesh	1994	85.86%	61.04%			34.84%	32.75%	98.13%	82.86%	57.90	0.18	71.47%	27.45%
Bangladesh	1997	83.13%	56.19%			37.45%	33.75%	97.48%	80.37%	56.19	0.22	67.51%	23.49%
Bangladesh	2000	76.29%	50.20%			42.53%	35.24%	97.25%	76.41%	54.60	0.27	61.16%	50.86%
Bangladesh	2004	72.24%	44.75%	-1.36%	-0.76%	44.78%	34.85%	97.39%	74.77%	50.33	0.32	56.30%	47.95%
Benin	1996	60.36%	35.80%			48.92%	39.07%	96.69%	68.47%	48.69	0.41	46.12%	45.52%
Benin	2001	48.93%	26.11%	-2.29%	-1.13%	49.99%	35.29%	94.31%	60.49%	43.03	0.58	35.70%	46.61%
Bolivia	1994	29.34%	16.53%			45.53%	29.56%	76.19%	40.74%	35.26	1.00	21.91%	49.00%
Bolivia	1998	22.82%	12.47%			41.97%	26.39%	74.09%	33.59%	30.26	1.22	16.82%	43.34%
Bolivia	2003	21.24%	10.29%	-0.90%	-0.56%	40.90%	23.63%	72.30%	33.04%	30.25	1.25	14.89%	49.93%
Brazil	1991	22.18%	11.74%			41.55%	27.55%	64.25%	32.24%	31.08	1.26	16.12%	56.45%
Brazil	1996	6.02%	2.77%	-3.23%	-2.78%	23.79%	13.94%	55.39%	15.68%	17.19	1.89	4.14%	44.21%
Burkina Faso	1993	75.59%	56.71%			42.96%	40.45%	97.39%	79.73%	63.07	0.19	64.64%	65.10%
Burkina Faso	1999	79.84%	58.03%			40.12%	37.80%	97.38%	80.75%	61.74	0.19	67.19%	54.19%
Burkina Faso	2003	71.30%	45.84%	-0.43%	-0.74%	45.24%	39.00%	95.62%	73.62%	55.64	0.30	56.53%	46.55%
CAR	1995	74.77%	47.04%			43.44%	33.42%	98.42%	77.31%	49.00	0.29	58.69%	32.97%
Cameroon	1991	52.81%	29.57%			49.93%	32.86%	91.83%	60.41%	45.94	0.56	39.33%	57.52%
Cameroon	1998	51.01%	27.11%			50.00%	32.50%	93.22%	58.95%	43.68	0.60	37.15%	58.96%
Cameroon	2004	45.31%	24.11%	-0.58%	-0.31%	49.78%	31.47%	91.91%	54.98%	41.87	0.68	33.01%	50.04%
Chad	1997	92.12%	74.04%			26.95%	30.64%	99.26%	89.91%	66.66	0.09	81.63%	57.03%
Chad	2004	89.09%	70.28%	-0.43%	-0.22%	31.18%	32.35%	98.94%	87.91%	65.12	0.11	78.18%	59.14%
Colombia	1990	6.38%	3.23%			24.44%	14.80%	43.10%	14.89%	17.15	1.94	4.56%	55.55%
Colombia	1995	7.45%	3.33%			26.26%	14.24%	39.39%	13.98%	16.75	1.99	5.06%	48.39%
Colombia	2000	4.12%	1.78%			19.88%	10.41%	33.52%	10.39%	12.40	2.14	2.77%	47.30%
Colombia	2005	2.87%	1.28%	-0.23%	-0.34%	16.71%	8.97%	32.69%	8.92%	11.98	2.21	1.95%	41.60%
Comoros	1996	41.17%	13.63%			49.22%	22.12%	97.42%	57.90%	30.93	0.74	25.20%	47.01%
Congo (Brazza)	2005	40.04%	20.75%			49.00%	29.48%	95.24%	53.70%	37.86	0.73	28.85%	52.26%
Cote d'Ivoire	1994	37.26%	18.53%			48.35%	32.45%	88.72%	51.55%	38.73	0.77	26.40%	49.41%
Cote d'Ivoire	1999	29.76%	12.09%	-1.50%	-0.94%	45.73%	26.42%	86.83%	45.10%	34.03	0.94	19.51%	63.60%
Dominican Rep	1991	9.95%	5.04%			29.93%	17.76%	66.51%	24.36%	22.74	1.56	7.10%	38.10%
Dominican Rep	1996	7.11%	3.21%			25.69%	13.96%	72.04%	22.72%	20.27	1.62	4.85%	39.94%
Dominican Rep	1999	3.14%	1.36%			17.45%	9.08%	66.74%	15.92%	15.20	1.88	2.11%	36.13%
Dominican Rep	2002	2.58%	1.10%	-0.67%	-0.78%	15.84%	8.23%	68.30%	15.05%	14.10	1.91	1.72%	35.36%
Egypt	1992	7.80%	3.35%			26.82%	13.85%	57.64%	22.09%	19.88	1.63	5.22%	52.34%
Egypt	1995	5.24%	2.34%			22.29%	11.80%	52.65%	18.33%	18.05	1.79	3.56%	50.64%
Egypt	2000	2.04%	0.87%			14.12%	7.33%	38.22%	10.87%	13.02	2.12	1.36%	51.20%
Egypt	2003	0.69%	0.28%			8.26%	4.01%	29.79%	6.76%	9.56	2.35	0.45%	41.59%
Egypt	2005	0.29%	0.11%	-0.58%	-0.96%	5.37%	2.51%	23.76%	4.70%	7.42	2.47	0.19%	45.20%
Ethiopia	2000	88.77%	68.61%			31.57%	30.61%	99.84%	87.11%	56.34	0.14	77.08%	4.29%
Ethiopia	2005	85.80%	58.64%	-0.60%	-0.52%	34.91%	31.94%	99.29%	82.63%	53.77	0.20	70.05%	55.77%
Gabon	2000	16.51%	7.41%			37.13%	19.09%	73.75%	27.17%	25.86	1.44	11.24%	32.97%
Ghana	1993	37.77%	13.47%			48.49%	26.15%	95.72%	56.68%	32.81	0.74	23.68%	51.80%
Ghana	1998	32.90%	12.49%			46.99%	26.37%	94.01%	51.99%	33.28	0.82	21.07%	47.78%

Ghana	2003	27.34%	8.93%	-1.04%	-0.18%	44.57%	21.25%	91.20%	48.51%	30.97	0.92	16.66%	48.00%
Guatemala	1995	27.74%	12.06%			44.77%	24.06%	79.27%	41.70%	34.58	1.01	18.65%	42.84%
Guatemala	1999	21.54%	9.61%	-1.55%	-0.86%	41.11%	22.25%	75.08%	35.73%	31.14	1.17	14.62%	40.18%
Guinea	1999	61.65%	37.25%			48.63%	36.48%	96.01%	68.53%	49.45	0.41	47.50%	47.86%
Guinea	2005	58.67%	34.04%	-0.50%	-0.37%	49.25%	34.64%	95.97%	66.10%	47.24	0.46	44.39%	45.74%
Haiti	1995	50.63%	31.30%			50.00%	37.24%	96.08%	62.50%	45.94	0.52	39.42%	51.02%
Haiti	2000	47.35%	25.91%	-0.66%	-0.64%	49.93%	34.08%	96.14%	58.07%	42.74	0.61	34.92%	46.50%
Honduras	2005	10.95%	3.67%			31.23%	12.73%	74.85%	26.79%	23.27	1.48	6.73%	43.53%
India	1993	64.62%	46.00%			47.81%	41.25%	96.46%	72.01%	57.10	0.31	53.82%	59.09%
India	1999	55.82%	38.19%	-1.47%	-0.74%	49.66%	40.92%	94.20%	66.31%	52.64	0.41	45.59%	55.82%
Indonesia	1991	30.18%	10.92%			45.90%	21.26%	89.06%	47.08%	32.93	0.92	19.01%	49.84%
Indonesia	1994	25.26%	8.62%			43.45%	19.64%	90.30%	44.74%	29.96	1.00	15.61%	47.12%
Indonesia	1997	19.16%	6.31%			39.36%	17.31%	93.62%	43.39%	25.28	1.08	11.71%	46.85%
Indonesia	2003	12.82%	4.54%	-1.45%	-0.69%	33.43%	14.87%	83.78%	33.80%	24.69	1.29	8.02%	47.00%
Kazakhstan	1995	0.16%	0.03%			3.98%	0.98%	65.44%	14.08%	11.94	1.98	0.09%	58.27%
Kazakhstan	1999	2.48%	0.80%	0.58%	0.90%	15.56%	6.21%	64.49%	18.78%	15.55	1.79	1.50%	64.49%
Kenya	1993	67.50%	38.79%			46.84%	32.41%	96.95%	72.33%	45.69	0.38	50.85%	50.48%
Kenya	1998	62.00%	33.91%			48.54%	31.70%	94.97%	67.88%	45.41	0.45	45.71%	43.32%
Kenya	2003	60.28%	31.71%	-0.72%	-0.14%	48.94%	31.07%	94.56%	66.32%	44.30	0.48	43.71%	58.07%
Kyrgyz Republic	1997	1.62%	0.41%			12.63%	3.90%	81.16%	21.37%	14.13	1.73	0.92%	49.56%
Lesotho	2004	47.19%	24.39%			49.92%	34.12%	97.77%	62.90%	39.03	0.58	33.97%	47.43%
Madagascar	1992	78.21%	44.08%			41.29%	34.36%	98.79%	77.18%	46.69	0.31	58.41%	52.02%
Madagascar	1997	69.40%	21.35%			46.08%	21.14%	98.89%	68.27%	28.95	0.57	41.54%	49.85%
Madagascar	2004	57.08%	20.29%	-1.76%	-0.99%	49.50%	25.66%	98.41%	63.48%	34.85	0.60	35.74%	72.98%
Malawi	1992	80.66%	52.63%			39.50%	34.13%	99.58%	80.68%	50.95	0.24	64.40%	52.34%
Malawi	2000	74.65%	46.33%			43.50%	32.88%	98.48%	77.29%	47.25	0.30	58.23%	39.03%
Malawi	2004	74.78%	45.22%	-0.49%	-0.30%	43.43%	31.58%	97.42%	76.16%	47.36	0.32	57.64%	34.45%
Mali	1996	74.75%	48.24%			43.44%	34.46%	97.00%	76.00%	52.85	0.29	59.38%	42.70%
Mali	2001	65.93%	36.37%	-1.76%	-1.14%	47.40%	32.70%	94.86%	70.05%	47.13	0.41	48.79%	40.80%
Mauritania	2001	59.01%	37.95%			49.19%	39.71%	96.02%	67.45%	51.50	0.40	46.80%	53.27%
Moldova	2005	2.80%	0.67%			16.50%	4.94%	74.10%	23.24%	17.32	1.65	1.56%	57.02%
Morocco	1992	29.83%	16.22%			45.76%	29.52%	65.16%	38.06%	36.15	1.08	21.94%	52.23%
Morocco	2004	12.31%	5.37%	-1.46%	-1.12%	32.86%	18.24%	47.94%	21.16%	22.66	1.69	8.29%	46.98%
Mozambique	1997	76.26%	54.93%			42.55%	38.61%	97.26%	78.78%	60.44	0.22	63.89%	50.43%
Mozambique	2003	72.37%	49.06%	-0.65%	-0.60%	44.72%	37.16%	96.67%	74.61%	56.82	0.28	58.86%	49.66%
Namibia	1992	59.64%	35.97%			49.07%	36.80%	83.95%	61.16%	52.42	0.50	45.92%	52.57%
Namibia	2000	52.12%	30.03%	-0.94%	-0.47%	49.96%	35.75%	76.06%	54.38%	48.63	0.64	39.31%	60.68%
Nepal	1996	82.80%	56.73%			37.74%	36.49%	99.55%	82.56%	56.48	0.19	67.68%	48.94%
Nepal	2001	76.60%	48.17%	-1.24%	-0.37%	42.34%	38.07%	98.54%	76.87%	54.64	0.27	60.12%	51.63%
Nicaragua	1998	27.09%	13.81%			44.44%	26.57%	79.49%	40.65%	34.22	1.03	19.39%	44.95%
Nicaragua	2001	24.36%	11.83%	-0.91%	-0.54%	42.93%	24.49%	81.15%	39.52%	32.60	1.07	17.09%	44.38%
Niger	1992	85.09%	69.73%			35.62%	36.10%	98.24%	85.58%	70.87	0.11	76.18%	51.72%
Niger	1998	84.41%	67.70%	-0.11%	-0.16%	36.28%	36.69%	97.80%	84.43%	69.93	0.12	74.72%	50.83%
Nigeria	1990	44.10%	25.87%			49.65%	34.79%	92.77%	59.64%	43.43	0.59	33.53%	58.63%
Nigeria	1999	39.96%	22.48%			48.99%	33.19%	91.44%	54.69%	40.95	0.69	29.82%	50.00%
Nigeria	2003	36.41%	19.40%	-0.59%	-0.43%	48.12%	31.05%	92.83%	53.02%	37.86	0.75	26.54%	50.12%
Pakistan	1991	58.00%	39.13%			49.36%	39.43%	93.80%	65.56%	52.72	0.42	47.05%	63.64%
Paraguay	1990	29.77%	13.01%			45.73%	23.54%	79.92%	41.82%	34.88	1.01	20.05%	45.85%
Peru	1992	23.70%	12.04%			42.53%	25.31%	61.30%	32.56%	31.47	1.26	16.94%	43.82%
Peru	1996	25.58%	12.42%			43.63%	25.02%	65.92%	34.60%	32.44	1.19	17.94%	41.38%
Peru	2000	22.40%	10.00%			41.69%	22.25%	62.36%	32.10%	30.44	1.28	15.21%	39.45%
Peru	2004	19.68%	8.89%	-0.34%	-0.31%	39.76%	20.94%	57.08%	28.28%	27.74	1.40	13.42%	38.98%
Philippines	1993	11.82%	2.68%			32.29%	9.61%	78.75%	32.06%	24.97	1.34	6.52%	45.48%
Philippines	1998	11.99%	3.49%			32.48%	12.23%	66.71%	26.28%	24.30	1.50	7.06%	41.10%
Philippines	2003	9.98%	3.28%	-0.18%	-0.25%	29.97%	12.71%	66.07%	24.20%	22.43	1.57	6.09%	47.16%
Rwanda	1992	82.12%	42.69%			38.32%	26.44%	99.39%	78.86%	33.72	0.35	59.26%	50.08%

Rwanda	2000	76.20%	37.48%			42.59%	27.91%	98.87%	74.80%	38.15	0.40	53.74%	46.41%
Rwanda	2005	76.90%	39.02%	-0.40%	0.25%	42.15%	27.38%	99.02%	76.24%	36.92	0.38	54.93%	44.74%
Senegal	1993	46.29%	27.99%			49.87%	36.63%	93.27%	59.36%	44.69	0.58	35.68%	47.71%
Senegal	1997	44.06%	26.22%			49.65%	35.70%	91.87%	56.09%	43.64	0.64	33.72%	40.31%
Senegal	2005	29.78%	14.99%	-1.38%	-0.76%	45.73%	27.53%	75.96%	41.01%	35.54	1.00	21.20%	41.93%
South Africa	1998	13.48%	6.50%			34.16%	19.18%	61.71%	26.61%	25.62	1.48	9.43%	46.19%
Tanzania	1992	75.96%	44.44%			42.74%	32.66%	99.25%	77.21%	44.92	0.32	57.68%	32.35%
Tanzania	1996	72.50%	40.74%			44.66%	32.76%	98.82%	74.80%	44.84	0.35	54.08%	54.26%
Tanzania	1999	71.98%	42.40%			44.92%	33.28%	98.95%	75.60%	45.73	0.34	54.83%	61.14%
Tanzania	2003	65.06%	36.55%			47.68%	32.36%	97.60%	71.40%	44.44	0.41	48.52%	46.19%
Tanzania	2004	67.21%	38.08%	-0.73%	0.03%	46.95%	32.33%	97.72%	72.07%	45.30	0.39	50.32%	54.07%
Togo	1998	52.03%	23.05%			49.96%	33.50%	96.66%	62.58%	39.06	0.58	35.22%	48.54%
Turkey	1993	0.92%	0.18%			9.55%	2.59%	52.24%	11.17%	12.66	2.09	0.49%	49.36%
Turkey	1998	0.08%	0.01%	-0.17%	-0.71%	2.90%	0.53%	39.49%	5.83%	9.08	2.35	0.04%	46.07%
Uganda	1995	85.18%	54.05%			35.54%	28.95%	99.37%	81.59%	46.11	0.25	67.12%	55.63%
Uganda	2001	80.32%	50.24%	-0.81%	0.23%	39.76%	30.79%	98.84%	79.22%	47.50	0.28	62.87%	43.37%
Uzbekistan	1996	2.11%	0.75%			14.37%	5.73%	76.52%	19.74%	14.79	1.76	1.32%	60.07%
Vietnam	1997	32.44%	13.18%			46.82%	24.88%	91.13%	50.65%	33.50	0.85	21.27%	51.80%
Vietnam	2002	15.35%	5.84%	-3.42%	-1.34%	36.05%	16.93%	85.81%	40.15%	26.82	1.14	9.83%	51.13%
Yemen	1992	40.20%	23.06%			49.03%	34.06%	87.57%	53.39%	42.50	0.70	30.26%	51.49%
Zambia	1992	48.82%	33.61%			49.99%	38.98%	90.05%	58.74%	48.66	0.55	40.00%	41.38%
Zambia	1996	58.70%	40.00%			49.24%	38.80%	87.49%	63.49%	53.73	0.44	47.86%	37.00%
Zambia	2002	61.26%	41.76%	1.24%	0.64%	48.72%	38.76%	89.04%	65.00%	55.10	0.41	49.95%	38.58%
Zimbabwe	1994	59.42%	35.99%			49.11%	40.34%	87.68%	62.32%	52.69	0.47	45.83%	52.23%
Zimbabwe	1999	47.88%	24.77%	-2.31%	-1.51%	49.96%	36.57%	82.00%	53.11%	45.15	0.68	34.48%	48.71%
Sample Unweighted Average		41.77%	25.22%	-0.95%	-0.57%	49.32%	35.27%	82.09%	50.92%	38.21	0.89	32.17%	48.12%

Source: Author's own calculations using DHS data.

Table A2: Relative Risk and Contribution to Overall Assets Poverty.

	Level			Contribution			Relative Risk			
	Pop. share	P0	P1	P2	P0	P1	P2	P0	P1	P2
World	100%	41.77%	25.22%	18.80%	100%	100%	100%	1.00	1.00	1.00
Country-Year										
Armenia 2000	0.38%	0.11%	0.02%	0.01%	0.00%	0.00%	0.00%	0.00	0.00	0.00
Bangladesh 1994	0.73%	85.86%	61.04%	47.99%	1.50%	1.76%	1.86%	2.06	2.42	2.55
Bangladesh 1997	0.67%	83.13%	56.19%	42.96%	1.33%	1.49%	1.53%	1.99	2.23	2.29
Bangladesh 2000	0.74%	76.29%	50.20%	37.62%	1.36%	1.48%	1.49%	1.83	1.99	2.00
Bangladesh 2004	0.76%	72.24%	44.75%	32.17%	1.32%	1.35%	1.30%	1.73	1.77	1.71
Benin 1996	0.39%	60.36%	35.80%	28.07%	0.57%	0.56%	0.59%	1.45	1.42	1.49
Benin 2001	0.44%	48.93%	26.11%	19.27%	0.51%	0.45%	0.45%	1.17	1.04	1.02
Bolivia 1994	0.60%	29.34%	16.53%	11.47%	0.42%	0.39%	0.37%	0.70	0.66	0.61
Bolivia 1998	0.77%	22.82%	12.47%	8.52%	0.42%	0.38%	0.35%	0.55	0.49	0.45
Bolivia 2003	1.18%	21.25%	10.29%	6.64%	0.60%	0.48%	0.42%	0.51	0.41	0.35
Brazil 1991	0.42%	22.18%	11.74%	8.97%	0.22%	0.20%	0.20%	0.53	0.47	0.48
Brazil 1996	0.79%	6.02%	2.77%	2.02%	0.11%	0.09%	0.09%	0.14	0.11	0.11
Burkina Faso 1993	0.50%	75.59%	56.71%	48.52%	0.90%	1.12%	1.29%	1.81	2.25	2.58
Burkina Faso 1999	0.47%	79.84%	58.03%	47.96%	0.90%	1.09%	1.21%	1.91	2.30	2.55
Burkina Faso 2003	0.86%	71.30%	45.84%	36.22%	1.47%	1.56%	1.65%	1.71	1.82	1.93
CAR 1995	0.40%	74.77%	47.04%	33.29%	0.71%	0.74%	0.70%	1.79	1.87	1.77
Cameroon 1991	0.29%	52.81%	29.57%	19.54%	0.37%	0.34%	0.30%	1.26	1.17	1.04
Cameroon 1998	0.38%	51.01%	27.11%	17.91%	0.46%	0.40%	0.36%	1.22	1.07	0.95
Cameroon 2004	0.73%	45.31%	24.11%	15.72%	0.79%	0.70%	0.61%	1.08	0.96	0.84
Chad 1997	0.53%	92.12%	74.04%	64.20%	1.17%	1.56%	1.82%	2.21	2.94	3.41
Chad 2004	0.42%	89.09%	70.28%	59.86%	0.90%	1.17%	1.34%	2.13	2.79	3.18
Colombia 1990	0.46%	6.38%	3.24%	2.29%	0.07%	0.06%	0.06%	0.15	0.13	0.12
Colombia 1995	0.66%	7.45%	3.33%	2.14%	0.12%	0.09%	0.07%	0.18	0.13	0.11
Colombia 2000	0.67%	4.12%	1.79%	1.12%	0.07%	0.05%	0.04%	0.10	0.07	0.06
Colombia 2005	2.23%	2.88%	1.28%	0.82%	0.15%	0.11%	0.10%	0.07	0.05	0.04
Comoros 1996	0.21%	41.17%	13.64%	6.75%	0.20%	0.11%	0.07%	0.99	0.54	0.36
Congo (Brazza) 2005	0.44%	40.04%	20.75%	13.00%	0.42%	0.36%	0.31%	0.96	0.82	0.69
Cote d'Ivoire 1994	0.54%	37.26%	18.53%	13.96%	0.48%	0.40%	0.40%	0.89	0.73	0.74
Cote d'Ivoire 1999	0.19%	29.76%	12.09%	8.44%	0.14%	0.09%	0.09%	0.71	0.48	0.45
Dominican Rep 1991	0.48%	9.95%	5.04%	3.41%	0.11%	0.10%	0.09%	0.24	0.20	0.18
Dominican Rep 1996	0.55%	7.11%	3.21%	2.05%	0.09%	0.07%	0.06%	0.17	0.13	0.11
Dominican Rep 1999	0.09%	3.14%	1.36%	0.84%	0.01%	0.01%	0.00%	0.08	0.05	0.04
Dominican Rep 2002	1.55%	2.58%	1.10%	0.69%	0.10%	0.07%	0.06%	0.06	0.04	0.04
Egypt 1992	0.89%	7.80%	3.35%	2.03%	0.17%	0.12%	0.10%	0.19	0.13	0.11
Egypt 1995	1.21%	5.24%	2.34%	1.45%	0.15%	0.11%	0.09%	0.13	0.09	0.08
Egypt 2000	1.30%	2.04%	0.87%	0.54%	0.06%	0.05%	0.04%	0.05	0.03	0.03
Egypt 2003	0.74%	0.69%	0.28%	0.16%	0.01%	0.01%	0.01%	0.02	0.01	0.01
Egypt 2005	1.57%	0.29%	0.11%	0.06%	0.01%	0.01%	0.01%	0.01	0.00	0.00
Ethiopia 2000	0.99%	88.78%	68.61%	56.44%	2.11%	2.69%	2.97%	2.13	2.72	3.00
Ethiopia 2005	1.01%	85.80%	58.64%	44.59%	2.07%	2.34%	2.39%	2.05	2.33	2.37
Gabon 2000	0.45%	16.51%	7.42%	4.19%	0.18%	0.13%	0.10%	0.40	0.29	0.22
Ghana 1993	0.32%	37.77%	13.47%	8.65%	0.29%	0.17%	0.15%	0.90	0.53	0.46
Ghana 1998	0.32%	32.90%	12.49%	8.51%	0.25%	0.16%	0.14%	0.79	0.50	0.45
Ghana 2003	0.37%	27.34%	8.93%	5.31%	0.24%	0.13%	0.10%	0.65	0.35	0.28
Guatemala 1995	0.87%	27.74%	12.06%	7.24%	0.58%	0.41%	0.33%	0.66	0.48	0.39
Guatemala 1999	0.43%	21.54%	9.61%	5.87%	0.22%	0.16%	0.13%	0.52	0.38	0.31
Guinea 1999	0.49%	61.65%	37.25%	27.18%	0.73%	0.73%	0.71%	1.48	1.48	1.45
Guinea 2005	0.56%	58.67%	34.04%	23.59%	0.78%	0.75%	0.70%	1.40	1.35	1.25
Haiti 1995	0.35%	50.63%	31.30%	23.66%	0.43%	0.44%	0.44%	1.21	1.24	1.26
Haiti 2000	0.66%	47.35%	25.91%	18.32%	0.75%	0.68%	0.64%	1.13	1.03	0.97
Honduras 2005	1.31%	10.95%	3.67%	1.75%	0.34%	0.19%	0.12%	0.26	0.15	0.09

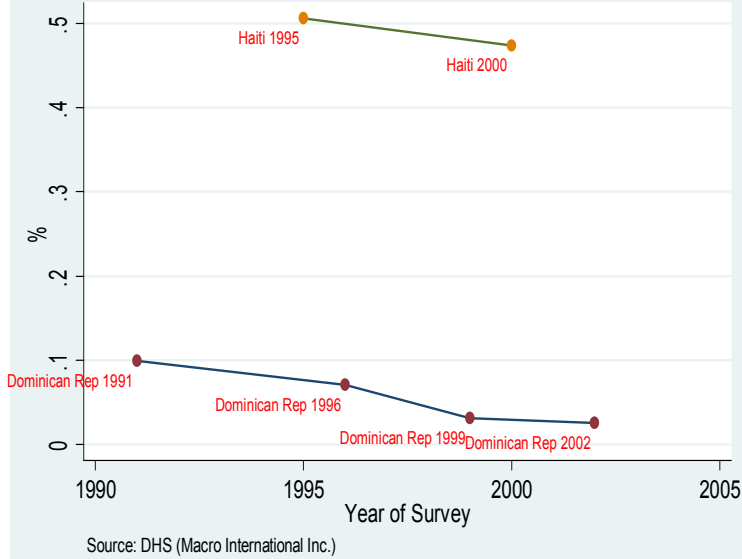
India 1993	7.31%	64.63%	46.00%	38.18%	11.31%	13.33%	14.84%	1.55	1.82	2.03
India 1999	7.27%	55.82%	38.19%	31.32%	9.71%	11.00%	12.11%	1.34	1.51	1.67
Indonesia 1991	1.82%	30.18%	10.93%	5.71%	1.31%	0.79%	0.55%	0.72	0.43	0.30
Indonesia 1994	2.20%	25.26%	8.62%	4.60%	1.33%	0.75%	0.54%	0.60	0.34	0.24
Indonesia 1997	2.16%	19.16%	6.31%	3.40%	0.99%	0.54%	0.39%	0.46	0.25	0.18
Indonesia 2003	2.09%	12.82%	4.54%	2.42%	0.64%	0.38%	0.27%	0.31	0.18	0.13
Kazakhstan 1995	0.23%	0.16%	0.03%	0.01%	0.00%	0.00%	0.00%	0.00	0.00	0.00
Kazakhstan 1999	0.31%	2.48%	0.80%	0.39%	0.02%	0.01%	0.01%	0.06	0.03	0.02
Kenya 1993	0.56%	67.50%	38.79%	25.55%	0.90%	0.86%	0.76%	1.62	1.54	1.36
Kenya 1998	0.52%	62.00%	33.91%	21.54%	0.78%	0.71%	0.60%	1.48	1.34	1.15
Kenya 2003	0.54%	60.28%	31.71%	19.71%	0.79%	0.68%	0.57%	1.44	1.26	1.05
Kyrgyz Republic 1997	0.25%	1.62%	0.41%	0.15%	0.01%	0.00%	0.00%	0.04	0.02	0.01
Lesotho 2004	0.49%	47.19%	24.39%	17.59%	0.55%	0.47%	0.46%	1.13	0.97	0.94
Madagascar 1992	0.45%	78.21%	44.08%	31.23%	0.84%	0.78%	0.75%	1.87	1.75	1.66
Madagascar 1997	0.51%	69.40%	21.35%	9.03%	0.85%	0.44%	0.25%	1.66	0.85	0.48
Madagascar 2004	0.57%	57.08%	20.29%	10.70%	0.78%	0.46%	0.32%	1.37	0.80	0.57
Malawi 1992	0.35%	80.66%	52.63%	39.34%	0.67%	0.72%	0.73%	1.93	2.09	2.09
Malawi 2000	0.91%	74.65%	46.33%	32.28%	1.63%	1.67%	1.56%	1.79	1.84	1.72
Malawi 2004	0.87%	74.78%	45.22%	30.42%	1.56%	1.57%	1.41%	1.79	1.79	1.62
Mali 1996	0.71%	74.75%	48.24%	35.14%	1.27%	1.36%	1.33%	1.79	1.91	1.87
Mali 2001	0.96%	65.93%	36.37%	23.93%	1.51%	1.38%	1.22%	1.58	1.44	1.27
Mauritania 2001	0.52%	59.01%	37.95%	30.17%	0.74%	0.78%	0.84%	1.41	1.50	1.60
Moldova 2005	0.46%	2.80%	0.67%	0.25%	0.03%	0.01%	0.01%	0.07	0.03	0.01
Morocco 1992	0.58%	29.84%	16.22%	11.34%	0.41%	0.37%	0.35%	0.71	0.64	0.60
Morocco 2004	0.90%	12.31%	5.37%	3.61%	0.27%	0.19%	0.17%	0.29	0.21	0.19
Mozambique 1997	0.63%	76.26%	54.93%	45.08%	1.14%	1.36%	1.50%	1.83	2.18	2.40
Mozambique 2003	0.87%	72.38%	49.06%	37.88%	1.51%	1.70%	1.76%	1.73	1.95	2.01
Namibia 1992	0.36%	59.64%	35.97%	26.48%	0.51%	0.51%	0.51%	1.43	1.43	1.41
Namibia 2000	0.47%	52.12%	30.03%	21.80%	0.59%	0.56%	0.55%	1.25	1.19	1.16
Nepal 1992	0.65%	82.80%	56.73%	45.49%	1.29%	1.46%	1.57%	1.98	2.25	2.42
Nepal 2001	0.66%	76.60%	48.17%	37.70%	1.22%	1.27%	1.33%	1.83	1.91	2.00
Nicaragua 1998	0.93%	27.09%	13.81%	8.97%	0.60%	0.51%	0.44%	0.65	0.55	0.48
Nicaragua 2001	0.87%	24.36%	11.83%	7.40%	0.51%	0.41%	0.34%	0.58	0.47	0.39
Niger 1992	0.48%	85.09%	69.73%	61.65%	0.98%	1.33%	1.57%	2.04	2.76	3.28
Niger 1998	0.51%	84.41%	67.70%	59.30%	1.04%	1.38%	1.62%	2.02	2.68	3.15
Nigeria 1990	0.60%	44.10%	25.87%	18.79%	0.63%	0.61%	0.59%	1.06	1.03	1.00
Nigeria 1999	0.56%	39.96%	22.48%	16.07%	0.53%	0.50%	0.48%	0.96	0.89	0.85
Nigeria 2003	0.53%	36.41%	19.40%	13.40%	0.46%	0.40%	0.37%	0.87	0.77	0.71
Pakistan 1991	0.71%	58.00%	39.13%	30.86%	0.98%	1.10%	1.16%	1.39	1.55	1.64
Paraguay 1990	0.42%	29.77%	13.01%	7.24%	0.30%	0.22%	0.16%	0.71	0.52	0.38
Peru 1992	1.03%	23.70%	12.04%	7.86%	0.59%	0.49%	0.43%	0.57	0.48	0.42
Peru 1996	1.99%	25.58%	12.42%	7.80%	1.22%	0.98%	0.83%	0.61	0.49	0.41
Peru 2000	1.90%	22.40%	10.00%	5.95%	1.02%	0.75%	0.60%	0.54	0.40	0.32
Peru 2004	0.35%	19.68%	8.89%	5.17%	0.17%	0.13%	0.10%	0.47	0.35	0.28
Philippines 1993	1.01%	11.82%	2.68%	1.00%	0.29%	0.11%	0.05%	0.28	0.11	0.05
Philippines 1998	0.92%	11.99%	3.49%	1.62%	0.26%	0.13%	0.08%	0.29	0.14	0.09
Philippines 2003	0.88%	9.98%	3.28%	1.72%	0.21%	0.12%	0.08%	0.24	0.13	0.09
Rwanda 1992	0.45%	82.13%	42.69%	25.22%	0.89%	0.77%	0.61%	1.97	1.69	1.34
Rwanda 2000	0.65%	76.20%	37.48%	21.84%	1.18%	0.96%	0.75%	1.82	1.49	1.16
Rwanda 2005	0.69%	76.91%	39.02%	22.72%	1.26%	1.06%	0.83%	1.84	1.55	1.21
Senegal 1993	0.46%	46.29%	27.99%	21.25%	0.50%	0.51%	0.51%	1.11	1.11	1.13
Senegal 1997	0.63%	44.06%	26.22%	19.62%	0.66%	0.65%	0.65%	1.05	1.04	1.04
Senegal 2005	0.94%	29.78%	14.99%	9.82%	0.67%	0.56%	0.49%	0.71	0.59	0.52
South Africa 1998	0.76%	13.48%	6.50%	4.10%	0.25%	0.20%	0.17%	0.32	0.26	0.22
Tanzania 1992	0.65%	75.96%	44.44%	30.42%	1.17%	1.14%	1.04%	1.82	1.76	1.62
Tanzania 1996	0.57%	72.50%	40.74%	27.33%	0.99%	0.92%	0.83%	1.74	1.62	1.45
Tanzania 1999	0.27%	71.98%	42.40%	29.05%	0.46%	0.45%	0.41%	1.72	1.68	1.55

Tanzania 2003	0.47%	65.06%	36.55%	23.82%	0.73%	0.68%	0.60%	1.56	1.45	1.27
Tanzania 2004	0.69%	67.21%	38.08%	24.95%	1.11%	1.04%	0.92%	1.61	1.51	1.33
Togo 1998	0.59%	52.03%	23.05%	16.53%	0.74%	0.54%	0.52%	1.25	0.91	0.88
Turkey 1993	0.57%	0.92%	0.18%	0.07%	0.01%	0.00%	0.00%	0.02	0.01	0.00
Turkey 1998	0.51%	0.08%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00	0.00	0.00
Uganda 1995	0.52%	85.18%	54.05%	37.59%	1.07%	1.12%	1.05%	2.04	2.14	2.00
Uganda 2001	0.55%	80.32%	50.24%	34.72%	1.06%	1.10%	1.02%	1.92	1.99	1.85
Uzbekistan 1996	0.28%	2.11%	0.76%	0.33%	0.01%	0.01%	0.01%	0.05	0.03	0.02
Vietnam 1997	0.48%	32.44%	13.19%	7.93%	0.37%	0.25%	0.20%	0.78	0.52	0.42
Vietnam 2002	0.45%	15.35%	5.84%	3.21%	0.17%	0.11%	0.08%	0.37	0.23	0.17
Yemen 1992	1.25%	40.20%	23.06%	16.92%	1.21%	1.15%	1.13%	0.96	0.91	0.90
Zambia 1992	0.51%	48.82%	33.61%	26.49%	0.59%	0.68%	0.72%	1.17	1.33	1.41
Zambia 1996	0.57%	58.70%	40.00%	31.05%	0.80%	0.91%	0.94%	1.41	1.59	1.65
Zambia 2002	0.55%	61.26%	41.76%	32.46%	0.80%	0.90%	0.94%	1.47	1.66	1.73
Zimbabwe 1994	0.41%	59.42%	35.99%	29.22%	0.58%	0.58%	0.63%	1.42	1.43	1.55
Zimbabwe 1999	0.39%	47.88%	24.77%	19.51%	0.45%	0.38%	0.40%	1.15	0.98	1.04
Language										
Arabic	8.95%	14.11%	7.84%	5.72%	3.02%	2.78%	2.72%	0.34	0.31	0.30
English	43.91%	50.39%	31.09%	23.50%	52.97%	54.13%	54.88%	1.21	1.23	1.25
French	18.81%	58.97%	34.72%	25.45%	26.56%	25.89%	25.46%	1.41	1.38	1.35
Other	4.39%	63.76%	44.69%	35.45%	6.69%	7.77%	8.27%	1.53	1.77	1.89
Portuguese	2.71%	46.11%	31.11%	24.59%	2.99%	3.34%	3.54%	1.10	1.23	1.31
Russia	0.46%	2.80%	0.67%	0.25%	0.03%	0.01%	0.01%	0.07	0.03	0.01
Russian	1.45%	1.27%	0.40%	0.18%	0.04%	0.02%	0.01%	0.03	0.02	0.01
Spanish	19.33%	16.63%	7.90%	4.96%	7.70%	6.05%	5.10%	0.40	0.31	0.26
Zone										
Central Asia	1.07%	1.68%	0.53%	0.24%	0.04%	0.02%	0.01%	0.04	0.02	0.01
Latin America & Caribbean	21.56%	17.84%	8.71%	5.64%	9.21%	7.45%	6.47%	0.43	0.35	0.30
North Africa/West										
Asia/Europe	10.34%	9.42%	4.92%	3.45%	2.33%	2.02%	1.90%	0.23	0.19	0.18
South & Southeast Asia		47.18%	29.94%	23.53%	35.58%	37.40%	39.43%	1.13	1.19	1.25
Sub-Saharan Africa	35.53%	62.11%	37.70%	27.62%	52.84%	53.12%	52.19%	1.49	1.49	1.47
Sub-Zone										
Africa - Centre	3.63%	57.43%	37.54%	28.62%	4.99%	5.41%	5.53%	1.37	1.49	1.52
Africa - East	9.33%	75.05%	44.95%	31.05%	16.76%	16.63%	15.41%	1.80	1.78	1.65
Africa - North	7.18%	6.29%	3.00%	1.99%	1.08%	0.85%	0.76%	0.15	0.12	0.11
Africa - South		61.00%	36.27%	26.45%	14.10%	13.89%	13.59%	1.46	1.44	1.41
Africa - West	12.91%	54.92%	33.59%	25.73%	16.98%	17.20%	17.67%	1.31	1.33	1.37
Caribbean	3.68%	16.83%	9.26%	6.60%	1.48%	1.35%	1.29%	0.40	0.37	0.35
Central Asia	1.07%	1.68%	0.53%	0.24%	0.04%	0.02%	0.01%	0.04	0.02	0.01
Europe	1.91%	0.99%	0.22%	0.08%	0.05%	0.02%	0.01%	0.02	0.01	0.00
Latin America	17.88%	18.05%	8.60%	5.45%	7.73%	6.10%	5.18%	0.43	0.34	0.29
South Asia	19.50%	64.29%	44.29%	35.86%	30.01%	34.24%	37.19%	1.54	1.76	1.91
Southeast Asia	12.01%	19.39%	6.64%	3.51%	5.57%	3.16%	2.24%	0.46	0.26	0.19
West Asia	1.25%	40.20%	23.06%	16.92%	1.21%	1.15%	1.13%	0.96	0.91	0.90
Time Period										
1990-1995	31.60%	44.39%	27.41%	20.90%	33.58%	34.34%	35.12%	1.06	1.09	1.11
1995-2000	38.34%	43.55%	26.70%	20.21%	39.97%	40.58%	41.21%	1.04	1.06	1.07
2000-2005	30.06%	36.75%	21.04%	14.80%	26.45%	25.08%	23.67%	0.88	0.83	0.79
Area of residency										
Rural	62.94%	61.82%	38.10%	28.64%	93.14%	95.07%	95.88%	1.48	1.51	1.52
Urban	37.06%	7.74%	3.35%	2.09%	6.86%	4.93%	4.12%	0.19	0.13	0.11
Development Level										
Low Income	58.53%	60.94%	38.57%	29.35%	85.38%	89.50%	91.35%	1.46	1.53	1.56
Low-Middle Income	39.19%	15.12%	6.54%	4.02%	14.19%	10.17%	8.38%	0.36	0.26	0.21
Upper-Middle Income	2.28%	7.98%	3.67%	2.21%	0.44%	0.33%	0.27%	0.19	0.15	0.12

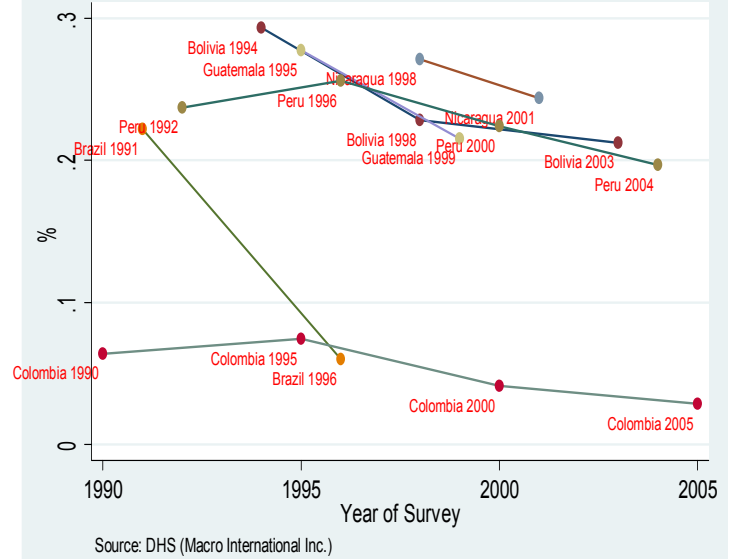
Source: Author's own calculations using DHS data.

Figure A1: Assets Poverty Trends in the Rest of the World.

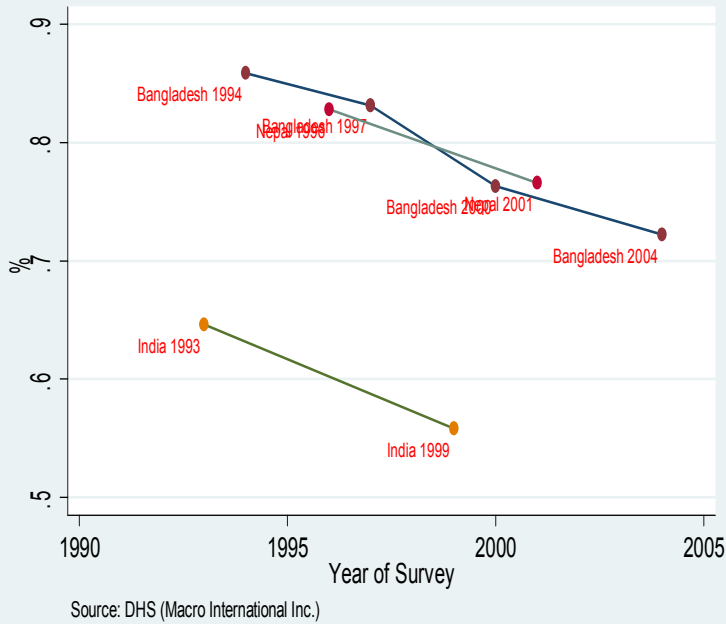
Assets Poverty Trends
Latin America & Caribbean
Caribbean



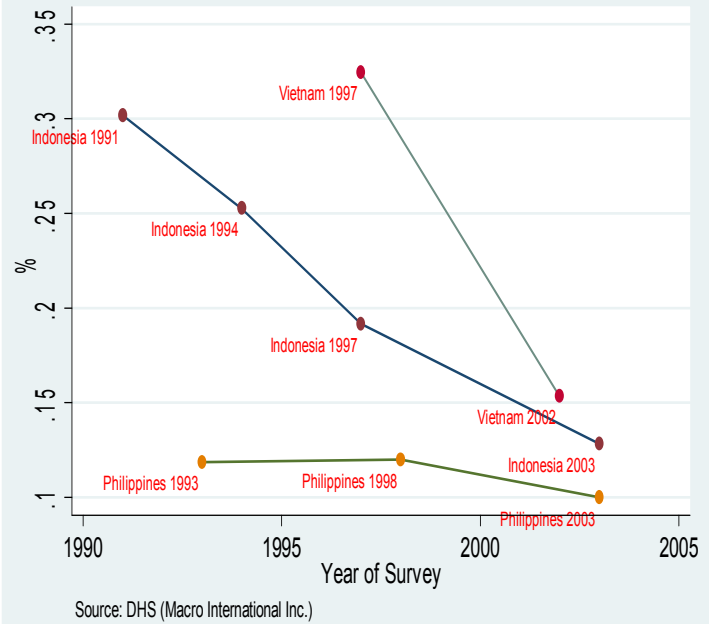
Assets Poverty Trends
Latin America & Caribbean
Latin America



Assets Poverty Trends
South & Southeast Asia
South Asia

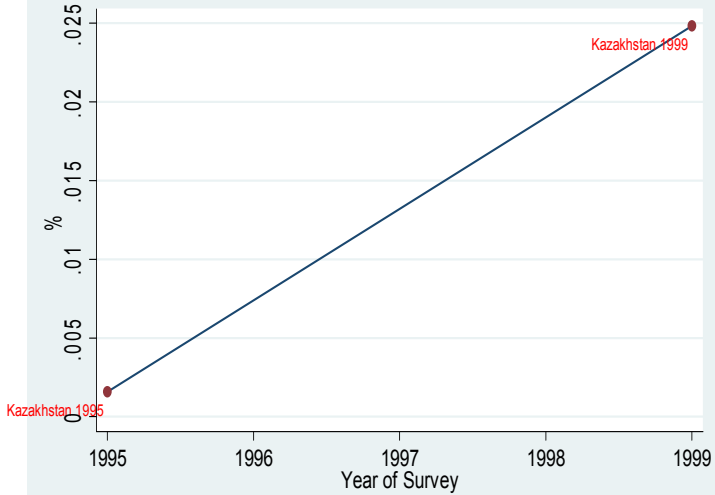


Assets Poverty Trends
South & Southeast Asia
Southeast Asia



Assets Poverty Trends

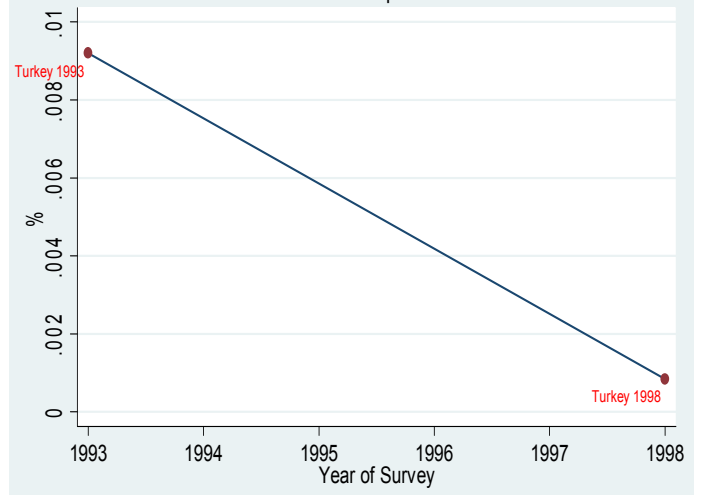
Central Asia
Central Asia



Source: DHS (Macro International Inc.)

Assets Poverty Trends

North Africa/West Asia/Europe
Europe



Source: DHS (Macro International Inc.)

Source: Author's calculations using DHS datasets.

Table A3: Required GDP Growth Needed to Offset the Impact of Change in Household Size.

	Beta values										
	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Burkina Faso											
Required GDP per equivalent adult, t1	15.03	18.17	21.96	26.54	32.08	38.77	46.86	56.64	68.46	82.74	100.00
Required GDP per equivalent adult, t2	15.46	18.64	22.46	27.07	32.63	39.32	47.40	57.12	68.84	82.97	100.00
Cumulative GDP growth required w/o pop. growth	2.86	2.57	2.28	1.99	1.71	1.42	1.13	0.85	0.57	0.28	0.00
Cumulative GDP growth required with pop. growth	3.82	3.43	3.04	2.66	2.28	1.89	1.51	1.13	0.75	0.38	0.00
Annual growth rate required w/o pop. Growth	0.28	0.25	0.23	0.20	0.17	0.14	0.11	0.08	0.06	0.03	0.00
Annual growth rate required with pop. growth	0.38	0.34	0.30	0.26	0.23	0.19	0.15	0.11	0.08	0.04	0.00
Benin											
Required GDP per equivalent adult, t1	16.69	19.96	23.87	28.55	34.15	40.85	48.86	58.44	69.90	83.61	100.00
Required GDP per equivalent adult, t2	19.29	22.74	26.81	31.60	37.26	43.92	51.78	61.04	71.96	84.83	100.00
Cumulative GDP growth required w/o pop. growth	15.60	13.93	12.29	10.68	9.09	7.52	5.97	4.44	2.94	1.46	0.00
Cumulative GDP growth required with pop. growth	18.10	16.17	14.27	12.39	10.54	8.72	6.93	5.16	3.41	1.69	0.00
Annual growth rate required w/o pop. Growth	2.94	2.64	2.35	2.05	1.75	1.46	1.17	0.87	0.58	0.29	0.00
Annual growth rate required with pop. growth	3.38	3.04	2.70	2.36	2.03	1.69	1.35	1.01	0.67	0.34	0.00
Cote d'Ivoire											
Required GDP per equivalent adult, t1	16.09	19.32	23.19	27.84	33.41	40.11	48.15	57.81	69.39	83.30	100.00
Required GDP per equivalent adult, t2	16.22	19.45	23.33	27.99	33.57	40.27	48.30	57.94	69.50	83.37	100.00
Cumulative GDP growth required w/o pop. growth	0.78	0.70	0.63	0.55	0.47	0.39	0.31	0.23	0.16	0.08	0.00
Cumulative GDP growth required with pop. growth	0.89	0.80	0.71	0.62	0.54	0.45	0.36	0.27	0.18	0.09	0.00
Annual growth rate required w/o pop. Growth	0.16	0.14	0.12	0.11	0.09	0.08	0.06	0.05	0.03	0.02	0.00
Annual growth rate required with pop. growth	0.18	0.16	0.14	0.12	0.11	0.09	0.07	0.05	0.04	0.02	0.00
Cameroon											
Required GDP per equivalent adult, t1	17.87	21.23	25.22	29.96	35.59	42.28	50.22	59.66	70.87	84.18	100.00
Required GDP per equivalent adult, t2	20.99	24.54	28.69	33.53	39.20	45.82	53.56	62.61	73.18	85.55	100.00
Cumulative GDP growth required w/o pop. growth	17.45	15.58	13.73	11.92	10.13	8.38	6.65	4.94	3.27	1.62	0.00
Cumulative GDP growth required with pop. growth	23.36	20.85	18.38	15.95	13.56	11.21	8.90	6.62	4.38	2.17	0.00
Annual growth rate required w/o pop. Growth	1.25	1.12	0.99	0.87	0.75	0.62	0.50	0.37	0.25	0.12	0.00
Annual growth rate required with pop. growth	1.63	1.47	1.31	1.15	0.98	0.82	0.66	0.49	0.33	0.17	0.00
Ethiopia											
Required GDP per equivalent adult, t1	20.74	24.27	28.41	33.25	38.91	45.54	53.30	62.38	73.01	85.44	100.00
Required GDP per equivalent adult, t2	19.89	23.38	27.47	32.29	37.95	44.60	52.41	61.60	72.40	85.09	100.00
Cumulative GDP growth required w/o pop. growth	-4.09	-3.69	-3.29	-2.88	-2.48	-2.07	-1.66	-1.25	-0.83	-0.42	0.00
Cumulative GDP growth required with pop. growth	-4.54	-4.09	-3.65	-3.20	-2.75	-2.29	-1.84	-1.38	-0.92	-0.46	0.00
Annual growth rate required w/o pop. Growth	-0.83	-0.75	-0.67	-0.58	-0.50	-0.42	-0.33	-0.25	-0.17	-0.08	0.00
Annual growth rate required with pop. growth	-0.92	-0.83	-0.74	-0.65	-0.56	-0.46	-0.37	-0.28	-0.19	-0.09	0.00

	Ghana										
Required GDP per equivalent adult, t1	26.58	30.34	34.64	39.55	45.15	51.55	58.86	67.20	76.72	87.59	100.00
Required GDP per equivalent adult, t2	24.84	28.55	32.82	37.73	43.36	49.84	57.29	65.85	75.69	87.00	100.00
Cumulative GDP growth required w/o pop. growth	-6.52	-5.89	-5.25	-4.61	-3.97	-3.32	-2.66	-2.00	-1.34	-0.67	0.00
Cumulative GDP growth required with pop. growth	-8.22	-7.42	-6.62	-5.81	-5.00	-4.18	-3.36	-2.52	-1.69	-0.85	0.00
Annual growth rate required w/o pop. growth	-0.67	-0.61	-0.54	-0.47	-0.40	-0.34	-0.27	-0.20	-0.13	-0.07	0.00
Annual growth rate required with pop. growth	-0.85	-0.77	-0.68	-0.60	-0.51	-0.43	-0.34	-0.26	-0.17	-0.09	0.00
	Guinea										
Required GDP per equivalent adult, t1	15.11	18.25	22.05	26.63	32.17	38.87	46.95	56.72	68.52	82.78	100.00
Required GDP per equivalent adult, t2	16.42	19.68	23.57	28.24	33.83	40.53	48.55	58.16	69.68	83.47	100.00
Cumulative GDP growth required w/o pop. growth	8.72	7.81	6.92	6.03	5.14	4.27	3.40	2.54	1.69	0.84	0.00
Cumulative GDP growth required with pop. growth	9.92	8.89	7.87	6.86	5.85	4.86	3.87	2.89	1.92	0.96	0.00
Annual growth rate required w/o pop. Growth	1.40	1.26	1.12	0.98	0.84	0.70	0.56	0.42	0.28	0.14	0.00
Annual growth rate required with pop. growth	1.59	1.43	1.27	1.11	0.95	0.79	0.63	0.48	0.32	0.16	0.00
	Kenya										
Required GDP per equivalent adult, t1	20.87	24.41	28.55	33.39	39.05	45.68	53.43	62.49	73.10	85.50	100.00
Required GDP per equivalent adult, t2	22.98	26.62	30.84	35.72	41.38	47.94	55.53	64.33	74.52	86.32	100.00
Cumulative GDP growth required w/o pop. growth	10.12	9.06	8.02	6.98	5.96	4.94	3.93	2.93	1.95	0.97	0.00
Cumulative GDP growth required with pop. growth	12.87	11.53	10.20	8.88	7.57	6.28	5.00	3.73	2.48	1.23	0.00
Annual growth rate required w/o pop. Growth	0.97	0.87	0.77	0.68	0.58	0.48	0.39	0.29	0.19	0.10	0.00
Annual growth rate required with pop. growth	1.22	1.10	0.98	0.85	0.73	0.61	0.49	0.37	0.24	0.12	0.00
	Madagascar										
Required GDP per equivalent adult, t1	19.33	22.79	26.86	31.65	37.31	43.97	51.82	61.08	71.99	84.85	100.00
Required GDP per equivalent adult, t2	21.64	25.21	29.39	34.25	39.91	46.51	54.21	63.18	73.63	85.81	100.00
Cumulative GDP growth required w/o pop. growth	11.91	10.65	9.42	8.19	6.98	5.79	4.60	3.43	2.28	1.13	0.00
Cumulative GDP growth required with pop. growth	16.90	15.12	13.36	11.63	9.91	8.21	6.53	4.87	3.23	1.61	0.00
Annual growth rate required w/o pop. Growth	0.94	0.85	0.75	0.66	0.56	0.47	0.38	0.28	0.19	0.09	0.00
Annual growth rate required with pop. growth	1.31	1.18	1.05	0.92	0.79	0.66	0.53	0.40	0.27	0.13	0.00
	Mali										
Required GDP per equivalent adult, t1	17.87	21.23	25.22	29.96	35.59	42.27	50.22	59.65	70.86	84.18	100.00
Required GDP per equivalent adult, t2	18.78	22.20	26.24	31.02	36.67	43.34	51.23	60.55	71.57	84.60	100.00
Cumulative GDP growth required w/o pop. growth	5.11	4.59	4.07	3.55	3.04	2.52	2.01	1.51	1.00	0.50	0.00
Cumulative GDP growth required with pop. growth	5.88	5.28	4.68	4.09	3.49	2.90	2.32	1.73	1.15	0.57	0.00
Annual growth rate required w/o pop. Growth	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.00
Annual growth rate required with pop. growth	1.15	1.03	0.92	0.80	0.69	0.57	0.46	0.34	0.23	0.11	0.00
	Malawi										
Required GDP per equivalent adult, t1	22.41	26.02	30.22	35.10	40.76	47.34	54.97	63.84	74.14	86.11	100.00
Required GDP per equivalent adult, t2	22.84	26.47	30.68	35.57	41.23	47.79	55.39	64.21	74.43	86.27	100.00
Cumulative GDP growth required w/o pop. growth	1.92	1.73	1.53	1.34	1.15	0.96	0.76	0.57	0.38	0.19	0.00
Cumulative GDP growth required with pop. growth	2.47	2.22	1.97	1.72	1.47	1.23	0.98	0.73	0.49	0.24	0.00

Annual growth rate required w/o pop. Growth	0.16	0.14	0.13	0.11	0.10	0.08	0.06	0.05	0.03	0.02	0.00
Annual growth rate required with pop. growth	0.20	0.18	0.16	0.14	0.12	0.10	0.08	0.06	0.04	0.02	0.00
Mozambique											
Required GDP per equivalent adult, t1	21.64	25.22	29.39	34.25	39.92	46.52	54.21	63.18	73.63	85.81	100.00
Required GDP per equivalent adult, t2	20.60	24.13	28.26	33.09	38.76	45.39	53.16	62.25	72.91	85.39	100.00
Cumulative GDP growth required w/o pop. growth	-4.80	-4.33	-3.86	-3.38	-2.91	-2.43	-1.95	-1.46	-0.98	-0.49	0.00
Cumulative GDP growth required with pop. growth	-5.46	-4.93	-4.39	-3.85	-3.31	-2.76	-2.22	-1.67	-1.11	-0.56	0.00
Annual growth rate required w/o pop. Growth	-0.82	-0.73	-0.65	-0.57	-0.49	-0.41	-0.33	-0.25	-0.16	-0.08	0.00
Annual growth rate required with pop. growth	-0.93	-0.84	-0.75	-0.65	-0.56	-0.47	-0.37	-0.28	-0.19	-0.09	0.00
Nigeria											
Required GDP per equivalent adult, t1	15.93	19.14	23.00	27.64	33.22	39.91	47.96	57.63	69.25	83.22	100.00
Required GDP per equivalent adult, t2	20.10	23.60	27.71	32.53	38.19	44.84	52.64	61.80	72.55	85.18	100.00
Cumulative GDP growth required w/o pop. growth	26.18	23.28	20.45	17.68	14.97	12.33	9.75	7.23	4.76	2.35	0.00
Cumulative GDP growth required with pop. growth	36.41	32.37	28.43	24.58	20.82	17.15	13.56	10.05	6.62	3.27	0.00
Annual growth rate required w/o pop. Growth	1.81	1.62	1.44	1.26	1.08	0.90	0.72	0.54	0.36	0.18	0.00
Annual growth rate required with pop. growth	2.42	2.18	1.94	1.71	1.47	1.22	0.98	0.74	0.49	0.25	0.00
Niger											
Required GDP per equivalent adult, t1	15.96	19.17	23.03	27.67	33.25	39.94	47.99	57.66	69.28	83.23	100.00
Required GDP per equivalent adult, t2	16.87	20.15	24.08	28.77	34.37	41.07	49.07	58.63	70.05	83.70	100.00
Cumulative GDP growth required w/o pop. growth	5.71	5.13	4.54	3.97	3.39	2.82	2.25	1.68	1.12	0.56	0.00
Cumulative GDP growth required with pop. growth	6.97	6.25	5.54	4.84	4.13	3.43	2.74	2.05	1.36	0.68	0.00
Annual growth rate required w/o pop. Growth	0.93	0.84	0.74	0.65	0.56	0.46	0.37	0.28	0.19	0.09	0.00
Annual growth rate required with pop. growth	1.13	1.02	0.90	0.79	0.68	0.56	0.45	0.34	0.23	0.11	0.00
Namibia											
Required GDP per equivalent adult, t1	16.67	19.94	23.85	28.53	34.13	40.83	48.84	58.42	69.89	83.60	100.00
Required GDP per equivalent adult, t2	19.79	23.27	27.36	32.17	37.83	44.48	52.31	61.51	72.32	85.04	100.00
Cumulative GDP growth required w/o pop. growth	18.70	16.68	14.70	12.75	10.83	8.95	7.10	5.28	3.49	1.73	0.00
Cumulative GDP growth required with pop. growth	23.57	21.03	18.53	16.07	13.66	11.28	8.95	6.65	4.40	2.18	0.00
Annual growth rate required w/o pop. Growth	2.17	1.95	1.73	1.51	1.29	1.08	0.86	0.65	0.43	0.21	0.00
Annual growth rate required with pop. growth	2.68	2.41	2.15	1.88	1.61	1.35	1.08	0.81	0.54	0.27	0.00
Rwanda											
Required GDP per equivalent adult, t1	20.12	23.62	27.73	32.55	38.21	44.85	52.65	61.81	72.56	85.18	100.00
Required GDP per equivalent adult, t2	21.88	25.47	29.65	34.52	40.18	46.77	54.45	63.39	73.79	85.90	100.00
Cumulative GDP growth required w/o pop. growth	8.75	7.84	6.94	6.05	5.16	4.28	3.41	2.55	1.69	0.84	0.00
Cumulative GDP growth required with pop. growth	12.37	11.09	9.81	8.55	7.30	6.06	4.82	3.60	2.39	1.19	0.00
Annual growth rate required w/o pop. Growth	0.65	0.58	0.52	0.45	0.39	0.32	0.26	0.19	0.13	0.06	0.00
Annual growth rate required with pop. growth	0.90	0.81	0.72	0.63	0.54	0.45	0.36	0.27	0.18	0.09	0.00
Senegal											
Required GDP per equivalent adult, t1	11.32	14.07	17.50	21.76	27.06	33.64	41.83	52.02	64.68	80.42	100.00
Required GDP per equivalent adult, t2	11.51	14.29	17.74	22.02	27.33	33.93	42.12	52.28	64.90	80.56	100.00

Cumulative GDP growth required w/o pop. growth	1.71	1.54	1.37	1.19	1.02	0.85	0.68	0.51	0.34	0.17	0.00
Cumulative GDP growth required with pop. growth	2.30	2.07	1.84	1.61	1.38	1.15	0.92	0.69	0.46	0.23	0.00
Annual growth rate required w/o pop. Growth	0.14	0.13	0.11	0.10	0.08	0.07	0.06	0.04	0.03	0.01	0.00
Annual growth rate required with pop. growth	0.19	0.17	0.15	0.13	0.11	0.10	0.08	0.06	0.04	0.02	0.00
Chad											
Required GDP per equivalent adult, t1	18.75	22.17	26.21	30.99	36.63	43.31	51.20	60.52	71.55	84.59	100.00
Required GDP per equivalent adult, t2	18.68	22.09	26.12	30.90	36.54	43.22	51.11	60.45	71.49	84.55	100.00
Cumulative GDP growth required w/o pop. growth	-0.41	-0.37	-0.33	-0.29	-0.25	-0.21	-0.17	-0.12	-0.08	-0.04	0.00
Cumulative GDP growth required with pop. growth	-0.52	-0.47	-0.42	-0.37	-0.32	-0.26	-0.21	-0.16	-0.11	-0.05	0.00
Annual growth rate required w/o pop. Growth	-0.06	-0.05	-0.05	-0.04	-0.04	-0.03	-0.02	-0.02	-0.01	-0.01	0.00
Annual growth rate required with pop. growth	-0.08	-0.07	-0.06	-0.05	-0.05	-0.04	-0.03	-0.02	-0.02	-0.01	0.00
Tanzania											
Required GDP per equivalent adult, t1	18.83	22.26	26.30	31.08	36.73	43.40	51.28	60.60	71.61	84.62	100.00
Required GDP per equivalent adult, t2	20.55	24.08	28.21	33.04	38.70	45.34	53.11	62.21	72.88	85.37	100.00
Cumulative GDP growth required w/o pop. growth	9.14%	8.19%	7.24%	6.31%	5.38%	4.47%	3.56%	2.66%	1.76%	0.88%	0.00%
Cumulative GDP growth required with pop. growth	12.23%	10.96%	9.70%	8.45%	7.21%	5.98%	4.76%	3.56%	2.36%	1.18%	0.00%
Annual growth rate required w/o pop. Growth	0.73%	0.66%	0.58%	0.51%	0.44%	0.36%	0.29%	0.22%	0.15%	0.07%	0.00%
Annual growth rate required with pop. growth	0.97%	0.87%	0.77%	0.68%	0.58%	0.49%	0.39%	0.29%	0.19%	0.10%	0.00%
Uganda											
Required GDP per equivalent adult, t1	21.05	24.59	28.74	33.59	39.26	45.88	53.61	62.65	73.22	85.57	100.00
Required GDP per equivalent adult, t2	20.84	24.37	28.51	33.36	39.02	45.65	53.40	62.47	73.07	85.48	100.00
Cumulative GDP growth required w/o pop. growth	-1.00	-0.90	-0.80	-0.70	-0.60	-0.50	-0.40	-0.30	-0.20	-0.10	0.00
Cumulative GDP growth required with pop. growth	-1.20	-1.08	-0.96	-0.84	-0.72	-0.60	-0.48	-0.36	-0.24	-0.12	0.00
Annual growth rate required w/o pop. Growth	-0.17	-0.15	-0.13	-0.12	-0.10	-0.08	-0.07	-0.05	-0.03	-0.02	0.00
Annual growth rate required with pop. growth	-0.20	-0.18	-0.16	-0.14	-0.12	-0.10	-0.08	-0.06	-0.04	-0.02	0.00
Zambia											
Required GDP per equivalent adult, t1	17.84	21.19	25.18	29.92	35.55	42.23	50.18	59.62	70.84	84.16	100.00
Required GDP per equivalent adult, t2	19.09	22.53	26.58	31.37	37.02	43.69	51.56	60.85	71.81	84.74	100.00
Cumulative GDP growth required w/o pop. growth	7.02	6.30	5.58	4.87	4.16	3.45	2.75	2.06	1.37	0.68	0.00
Cumulative GDP growth required with pop. growth	8.80	7.90	7.00	6.10	5.21	4.33	3.45	2.58	1.71	0.85	0.00
Annual growth rate required w/o pop. Growth	0.68	0.61	0.54	0.48	0.41	0.34	0.27	0.20	0.14	0.07	0.00
Annual growth rate required with pop. growth	0.85	0.76	0.68	0.59	0.51	0.42	0.34	0.25	0.17	0.09	0.00
Zimbabwe											
Required GDP per equivalent adult, t1	21.41	24.97	29.14	33.99	39.66	46.27	53.98	62.97	73.47	85.71	100.00
Required GDP per equivalent adult, t2	23.88	27.56	31.80	36.70	42.35	48.87	56.39	65.08	75.10	86.66	100.00
Cumulative GDP growth required w/o pop. growth	11.57	10.36	9.16	7.97	6.79	5.63	4.48	3.34	2.21	1.10	0.00
Cumulative GDP growth required with pop. growth	12.44	11.13	9.84	8.56	7.30	6.05	4.81	3.59	2.38	1.18	0.00
Annual growth rate required w/o pop. Growth	2.21	1.99	1.77	1.55	1.32	1.10	0.88	0.66	0.44	0.22	0.00
Annual growth rate required with pop. growth	2.37	2.13	1.90	1.66	1.42	1.18	0.94	0.71	0.47	0.24	0.00
Egypt											

Required GDP per equivalent adult, t1	17.75	21.10	25.08	29.81	35.44	42.13	50.08	59.53	70.77	84.12	100.00
Required GDP per equivalent adult, t2	20.48	24.00	28.12	32.95	38.62	45.25	53.03	62.14	72.82	85.33	100.00
Cumulative GDP growth required w/o pop. growth	15.38	13.74	12.13	10.54	8.97	7.42	5.89	4.39	2.90	1.44	0.00
Cumulative GDP growth required with pop. growth	19.67	17.57	15.50	13.47	11.46	9.48	7.53	5.61	3.71	1.84	0.00
Annual growth rate required w/o pop. Growth	1.11	1.00	0.88	0.77	0.66	0.55	0.44	0.33	0.22	0.11	0.00
Annual growth rate required with pop. growth	1.39	1.25	1.11	0.98	0.84	0.70	0.56	0.42	0.28	0.14	0.00
Morocco											
Required GDP per equivalent adult, t1	16.61	19.88	23.78	28.46	34.06	40.75	48.77	58.36	69.83	83.57	100.00
Required GDP per equivalent adult, t2	18.68	22.09	26.12	30.90	36.54	43.22	51.11	60.45	71.49	84.55	100.00
Cumulative GDP growth required w/o pop. growth	12.44	11.13	9.84	8.56	7.29	6.04	4.80	3.58	2.37	1.18	0.00
Cumulative GDP growth required with pop. growth	14.89	13.32	11.77	10.24	8.72	7.22	5.75	4.28	2.84	1.41	0.00
Annual growth rate required w/o pop. Growth	0.98	0.88	0.78	0.69	0.59	0.49	0.39	0.29	0.20	0.10	0.00
Annual growth rate required with pop. growth	1.16	1.05	0.93	0.82	0.70	0.58	0.47	0.35	0.23	0.12	0.00
Indonesia											
Required GDP per equivalent adult, t1	21.58	25.15	29.32	34.18	39.84	46.45	54.15	63.12	73.59	85.78	100.00
Required GDP per equivalent adult, t2	23.16	26.81	31.03	35.92	41.58	48.13	55.71	64.48	74.64	86.39	100.00
Cumulative GDP growth required w/o pop. growth	7.35	6.59	5.84	5.09	4.35	3.61	2.88	2.15	1.43	0.71	0.00
Cumulative GDP growth required with pop. growth	8.70	7.80	6.91	6.02	5.15	4.27	3.41	2.55	1.69	0.84	0.00
Annual growth rate required w/o pop. Growth	0.59	0.53	0.47	0.41	0.36	0.30	0.24	0.18	0.12	0.06	0.00
Annual growth rate required with pop. growth	0.70	0.63	0.56	0.49	0.42	0.35	0.28	0.21	0.14	0.07	0.00
Philippines											
Required GDP per equivalent adult, t1	18.78	22.19	26.23	31.01	36.66	43.33	51.22	60.55	71.57	84.60	100.00
Required GDP per equivalent adult, t2	20.77	24.30	28.44	33.28	38.94	45.57	53.33	62.41	73.03	85.46	100.00
Cumulative GDP growth required w/o pop. growth	10.62	9.50	8.41	7.32	6.24	5.17	4.12	3.07	2.04	1.01	0.00
Cumulative GDP growth required with pop. growth	13.00	11.64	10.30	8.96	7.64	6.34	5.04	3.76	2.50	1.24	0.00
Annual growth rate required w/o pop. Growth	1.01	0.91	0.81	0.71	0.61	0.51	0.40	0.30	0.20	0.10	0.00
Annual growth rate required with pop. growth	1.23	1.11	0.98	0.86	0.74	0.62	0.49	0.37	0.25	0.12	0.00
Vietnam											
Required GDP per equivalent adult, t1	21.21	24.77	28.92	33.77	39.44	46.05	53.78	62.80	73.33	85.63	100.00
Required GDP per equivalent adult, t2	22.71	26.34	30.55	35.43	41.09	47.66	55.27	64.10	74.34	86.22	100.00
Cumulative GDP growth required w/o pop. growth	7.08	6.35	5.63	4.91	4.19	3.48	2.78	2.07	1.38	0.69	0.00
Cumulative GDP growth required with pop. growth	7.55	6.77	6.00	5.23	4.47	3.71	2.96	2.21	1.47	0.73	0.00
Annual growth rate required w/o pop. Growth	1.38	1.24	1.10	0.96	0.82	0.69	0.55	0.41	0.27	0.14	0.00
Annual growth rate required with pop. growth	1.47	1.32	1.17	1.02	0.88	0.73	0.58	0.44	0.29	0.15	0.00
Bolivia											
Required GDP per equivalent adult, t1	22.23	25.84	30.03	34.91	40.57	47.15	54.80	63.69	74.03	86.04	100.00
Required GDP per equivalent adult, t2	23.68	27.35	31.58	36.48	42.13	48.66	56.20	64.91	74.97	86.58	100.00
Cumulative GDP growth required w/o pop. growth	6.49	5.82	5.16	4.50	3.84	3.19	2.55	1.90	1.27	0.63	0.00
Cumulative GDP growth required with pop. growth	7.84	7.03	6.23	5.43	4.64	3.86	3.08	2.30	1.53	0.76	0.00
Annual growth rate required w/o pop. Growth	0.70	0.63	0.56	0.49	0.42	0.35	0.28	0.21	0.14	0.07	0.00

Annual growth rate required with pop. growth	0.84	0.76	0.67	0.59	0.51	0.42	0.34	0.25	0.17	0.08	0.00
	Brazil										
Required GDP per equivalent adult, t1	21.07	24.62	28.77	33.62	39.29	45.91	53.64	62.68	73.24	85.58	100.00
Required GDP per equivalent adult, t2	24.49	28.19	32.45	37.35	42.99	49.49	56.96	65.57	75.47	86.88	100.00
Cumulative GDP growth required w/o pop. growth	16.21	14.48	12.77	11.09	9.43	7.80	6.19	4.61	3.05	1.51	0.00
Cumulative GDP growth required with pop. growth	17.49	15.62	13.78	11.96	10.18	8.42	6.68	4.97	3.29	1.63	0.00
Annual growth rate required w/o pop. Growth	3.05	2.74	2.43	2.13	1.82	1.51	1.21	0.91	0.60	0.30	0.00
Annual growth rate required with pop. growth	3.28	2.95	2.62	2.29	1.96	1.63	1.30	0.98	0.65	0.32	0.00
	Colombia										
Required GDP per equivalent adult, t1	21.66	25.24	29.42	34.28	39.94	46.55	54.24	63.20	73.65	85.82	100.00
Required GDP per equivalent adult, t2	24.35	28.04	32.30	37.20	42.85	49.35	56.83	65.46	75.39	86.83	100.00
Cumulative GDP growth required w/o pop. growth	12.40	11.09	9.80	8.52	7.26	6.02	4.79	3.57	2.36	1.18	0.00
Cumulative GDP growth required with pop. growth	16.17	14.46	12.78	11.12	9.47	7.85	6.24	4.65	3.08	1.53	0.00
Annual growth rate required w/o pop. Growth	0.78	0.70	0.63	0.55	0.47	0.39	0.31	0.23	0.16	0.08	0.00
Annual growth rate required with pop. growth	1.00	0.90	0.80	0.71	0.61	0.50	0.40	0.30	0.20	0.10	0.00
	Dominican Republic										
Required GDP per equivalent adult, t1	21.75	25.33	29.51	34.37	40.04	46.64	54.32	63.27	73.70	85.85	100.00
Required GDP per equivalent adult, t2	25.51	29.25	33.53	38.44	44.06	50.51	57.90	66.38	76.10	87.23	100.00
Cumulative GDP growth required w/o pop. growth	17.32	15.46	13.63	11.83	10.06	8.31	6.60	4.91	3.25	1.61	0.00
Cumulative GDP growth required with pop. growth	20.45	18.25	16.09	13.97	11.88	9.82	7.79	5.80	3.83	1.90	0.00
Annual growth rate required w/o pop. Growth	1.46	1.32	1.17	1.02	0.87	0.73	0.58	0.44	0.29	0.15	0.00
Annual growth rate required with pop. growth	1.71	1.54	1.37	1.20	1.03	0.85	0.68	0.51	0.34	0.17	0.00
	Guatemala										
Required GDP per equivalent adult, t1	19.06	22.50	26.55	31.34	36.99	43.66	51.53	60.82	71.78	84.72	100.00
Required GDP per equivalent adult, t2	18.97	22.40	26.45	31.23	36.88	43.55	51.43	60.73	71.71	84.68	100.00
Cumulative GDP growth required w/o pop. growth	-0.49	-0.44	-0.39	-0.34	-0.29	-0.24	-0.20	-0.15	-0.10	-0.05	0.00
Cumulative GDP growth required with pop. growth	-0.53	-0.48	-0.43	-0.37	-0.32	-0.27	-0.21	-0.16	-0.11	-0.05	0.00
Annual growth rate required w/o pop. Growth	-0.12	-0.11	-0.10	-0.09	-0.07	-0.06	-0.05	-0.04	-0.02	-0.01	0.00
Annual growth rate required with pop. growth	-0.13	-0.12	-0.11	-0.09	-0.08	-0.07	-0.05	-0.04	-0.03	-0.01	0.00
	Haiti										
Required GDP per equivalent adult, t1	19.95	23.44	27.54	32.36	38.02	44.67	52.48	61.66	72.44	85.11	100.00
Required GDP per equivalent adult, t2	21.30	24.87	29.03	33.88	39.54	46.16	53.88	62.88	73.40	85.67	100.00
Cumulative GDP growth required w/o pop. growth	6.78	6.08	5.39	4.70	4.01	3.33	2.66	1.99	1.32	0.66	0.00
Cumulative GDP growth required with pop. growth	7.28	6.53	5.78	5.04	4.31	3.58	2.85	2.13	1.42	0.71	0.00
Annual growth rate required w/o pop. Growth	1.32	1.19	1.05	0.92	0.79	0.66	0.53	0.39	0.26	0.13	0.00
Annual growth rate required with pop. growth	1.42	1.27	1.13	0.99	0.85	0.71	0.56	0.42	0.28	0.14	0.00
	Nicaragua										
Required GDP per equivalent adult, t1	18.10	21.48	25.48	30.23	35.87	42.55	50.48	59.89	71.05	84.29	100.00
Required GDP per equivalent adult, t2	18.91	22.34	26.39	31.17	36.82	43.49	51.37	60.68	71.67	84.66	100.00
Cumulative GDP growth required w/o pop. growth	4.45	4.00	3.55	3.10	2.65	2.20	1.76	1.32	0.88	0.44	0.00

Cumulative GDP growth required with pop. growth	4.73	4.25	3.77	3.29	2.81	2.34	1.87	1.40	0.93	0.46	0.00
Annual growth rate required w/o pop. Growth	1.46	1.32	1.17	1.02	0.88	0.73	0.58	0.44	0.29	0.15	0.00
Annual growth rate required with pop. growth	1.55	1.40	1.24	1.08	0.93	0.77	0.62	0.46	0.31	0.15	0.00
Peru											
Required GDP per equivalent adult, t1	19.04	22.47	26.53	31.31	36.96	43.63	51.50	60.80	71.77	84.71	100.00
Required GDP per equivalent adult, t2	23.09	26.74	30.96	35.84	41.50	48.05	55.64	64.42	74.59	86.37	100.00
Cumulative GDP growth required w/o pop. growth	21.31	18.99	16.71	14.48	12.29	10.14	8.03	5.97	3.94	1.95	0.00
Cumulative GDP growth required with pop. growth	25.99	23.16	20.38	17.66	14.99	12.37	9.80	7.28	4.80	2.38	0.00
Annual growth rate required w/o pop. Growth	1.62	1.46	1.30	1.13	0.97	0.81	0.65	0.48	0.32	0.16	0.00
Annual growth rate required with pop. growth	1.94	1.75	1.56	1.36	1.17	0.98	0.78	0.59	0.39	0.20	0.00
Kazakhstan											
Required GDP per equivalent adult, t1	26.28	30.04	34.33	39.24	44.85	51.26	58.59	66.97	76.55	87.49	100.00
Required GDP per equivalent adult, t2	27.77	31.56	35.88	40.78	46.36	52.69	59.90	68.09	77.39	87.97	100.00
Cumulative GDP growth required w/o pop. growth	5.66	5.08	4.50	3.93	3.36	2.79	2.23	1.67	1.11	0.55	0.00
Cumulative GDP growth required with pop. growth	5.34	4.79	4.25	3.71	3.17	2.63	2.10	1.57	1.05	0.52	0.00
Annual growth rate required w/o pop. Growth	1.39	1.25	1.11	0.97	0.83	0.69	0.55	0.41	0.28	0.14	0.00
Annual growth rate required with pop. growth	1.31	1.18	1.05	0.91	0.78	0.65	0.52	0.39	0.26	0.13	0.00
Turkey											
Required GDP per equivalent adult, t1	22.18	25.79	29.98	34.85	40.51	47.10	54.75	63.65	73.99	86.02	100.00
Required GDP per equivalent adult, t2	23.22	26.87	31.10	35.98	41.64	48.19	55.76	64.53	74.68	86.41	100.00
Cumulative GDP growth required w/o pop. growth	4.69	4.21	3.74	3.26	2.79	2.32	1.85	1.38	0.92	0.46	0.00
Cumulative GDP growth required with pop. growth	5.14	4.61	4.09	3.57	3.05	2.54	2.03	1.52	1.01	0.50	0.00
Annual growth rate required w/o pop. Growth	0.92	0.83	0.74	0.64	0.55	0.46	0.37	0.28	0.18	0.09	0.00
Annual growth rate required with pop. growth	1.01	0.91	0.81	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.00
Bangladesh											
Required GDP per equivalent adult, t1	18.39	21.78	25.80	30.56	36.20	42.88	50.79	60.17	71.27	84.42	100.00
Required GDP per equivalent adult, t2	20.14	23.64	27.75	32.57	38.24	44.88	52.68	61.83	72.58	85.19	100.00
Cumulative GDP growth required w/o pop. growth	9.55	8.56	7.57	6.59	5.63	4.67	3.72	2.77	1.84	0.92	0.00
Cumulative GDP growth required with pop. growth	11.67	10.45	9.25	8.06	6.87	5.70	4.54	3.39	2.25	1.12	0.00
Annual growth rate required w/o pop. Growth	0.92	0.82	0.73	0.64	0.55	0.46	0.37	0.27	0.18	0.09	0.00
Annual growth rate required with pop. growth	1.11	1.00	0.89	0.78	0.67	0.56	0.45	0.33	0.22	0.11	0.00
Nepal											
Required GDP per equivalent adult, t1	18.14	21.51	25.52	30.27	35.90	42.59	50.52	59.92	71.07	84.31	100.00
Required GDP per equivalent adult, t2	18.90	22.33	26.37	31.15	36.80	43.47	51.35	60.66	71.66	84.65	100.00
Cumulative GDP growth required w/o pop. growth	4.20	3.77	3.35	2.92	2.50	2.08	1.66	1.24	0.83	0.41	0.00
Cumulative GDP growth required with pop. growth	4.72	4.24	3.76	3.28	2.81	2.34	1.86	1.40	0.93	0.46	0.00
Annual growth rate required w/o pop. Growth	0.83	0.74	0.66	0.58	0.49	0.41	0.33	0.25	0.16	0.08	0.00
Annual growth rate required with pop. growth	0.93	0.83	0.74	0.65	0.56	0.46	0.37	0.28	0.18	0.09	0.00
India											
Required GDP per equivalent adult, t1	17.68	21.03	25.01	29.74	35.36	42.05	50.01	59.47	70.72	84.09	100.00

Required GDP per equivalent adult, t2	18.58	21.98	26.01	30.78	36.42	43.10	51.00	60.35	71.42	84.51	100.00
Cumulative GDP growth required w/o pop. growth	5.05	4.54	4.02	3.51	3.00	2.50	1.99	1.49	0.99	0.49	0.00
Cumulative GDP growth required with pop. growth	5.61	5.04	4.47	3.90	3.33	2.77	2.21	1.65	1.10	0.55	0.00
Annual growth rate required w/o pop. Growth	0.82	0.74	0.66	0.58	0.49	0.41	0.33	0.25	0.16	0.08	0.00
Annual growth rate required with pop. growth	0.91	0.82	0.73	0.64	0.55	0.46	0.37	0.27	0.18	0.09	0.00

Source: Authors' estimation using DHS data.

Chapter 2.

Table A4: Results of the PCA.

	Principal components/correlation					Principal components (Eigenvectors)			Scoring coefficients(Assets Weights)	
	Component	Eigenvalue	Difference	Proportion	Cumulative	Comp1	Comp2	Unexplained	Comp1	Comp2
Equipment : Iron	Comp1	8.52	5.65	0.15	0.15	0.26	0.10	0.38	0.26	0.10
Refrigerator	Comp2	2.87	0.78	0.05	0.20	0.25	0.14	0.40	0.25	0.14
Television	Comp3	2.09	0.42	0.04	0.24	0.25	0.09	0.44	0.25	0.09
Video deck	Comp4	1.67	0.18	0.03	0.27	0.18	0.22	0.58	0.18	0.22
Cassette player/radio	Comp5	1.49	0.19	0.03	0.29	0.10	0.05	0.91	0.10	0.05
Stereo system	Comp6	1.30	0.07	0.02	0.31	0.15	0.17	0.72	0.15	0.17
Mattress or bed	Comp7	1.23	0.03	0.02	0.34	0.12	-0.16	0.80	0.12	-0.16
Watch or clock	Comp8	1.20	0.05	0.02	0.36	0.15	-0.02	0.82	0.15	-0.02
Sewing machine	Comp9	1.15	0.02	0.02	0.38	0.10	0.02	0.91	0.10	0.02
Electric/gas stove	Comp10	1.13	0.02	0.02	0.40	0.20	0.27	0.45	0.20	0.27
Bicycle	Comp11	1.11	0.03	0.02	0.42	-0.07	0.20	0.84	-0.07	0.20
Motorcycle	Comp12	1.08	0.01	0.02	0.44	0.02	0.07	0.98	0.02	0.07
Vehicle	Comp13	1.07	0.00	0.02	0.45	0.11	0.18	0.79	0.11	0.18
Material for roof of dwelling :										
Mud	Comp14	1.07	0.02	0.02	0.47	-0.06	0.12	0.93	-0.06	0.12
Thatch	Comp15	1.05	0.01	0.02	0.49	-0.15	0.26	0.62	-0.15	0.26
Wood	Comp16	1.04	0.01	0.02	0.51	-0.02	0.01	1.00	-0.02	0.01
Metal sheets	Comp17	1.03	0.00	0.02	0.53	0.03	-0.31	0.72	0.03	-0.31
Cement/concrete	Comp18	1.03	0.01	0.02	0.55	0.07	0.07	0.95	0.07	0.07
Roofing tiles	Comp19	1.02	0.01	0.02	0.56	0.02	0.03	0.99	0.02	0.03
Asbestos	Comp20	1.01	0.00	0.02	0.58	0.14	0.06	0.81	0.14	0.06
Other	Comp21	1.01	0.00	0.02	0.60	-0.02	0.02	0.99	-0.02	0.02
Material for walls of dwelling :										
Mud or Mud bricks	Comp22	1.01	0.00	0.02	0.62	-0.25	0.12	0.44	-0.25	0.12
Stone	Comp23	1.00	0.00	0.02	0.64	0.00	0.00	1.00	0.00	0.00
Burnt bricks	Comp24	1.00	0.01	0.02	0.65	0.00	-0.04	1.00	0.00	-0.04
Cement or sandcrete	Comp25	0.99	0.00	0.02	0.67	0.25	-0.11	0.44	0.25	-0.11
Wood or bamboo	Comp26	0.99	0.00	0.02	0.69	0.00	-0.02	1.00	0.00	-0.02
Iron sheets	Comp27	0.98	0.00	0.02	0.70	0.01	-0.03	1.00	0.01	-0.03
Cardboard	Comp28	0.98	0.02	0.02	0.72	0.00	-0.01	1.00	0.00	-0.01
Other	Comp29	0.96	0.00	0.02	0.74	-0.01	0.01	1.00	-0.01	0.01
Source of drinking water :										
Piped in dwelling/compound	Comp30	0.96	0.01	0.02	0.76	0.22	0.13	0.54	0.22	0.13
Public outdoor tap/borehole	Comp31	0.95	0.01	0.02	0.77	0.07	-0.25	0.77	0.07	-0.25
Borehole	Comp32	0.94	0.01	0.02	0.79	-0.11	0.06	0.89	-0.11	0.06
Protected well	Comp33	0.93	0.01	0.02	0.80	-0.01	-0.05	0.99	-0.01	-0.05
Unprotected well	Comp34	0.92	0.04	0.02	0.82	-0.05	0.03	0.98	-0.05	0.03
River, lake, pond	Comp35	0.88	0.02	0.02	0.84	-0.13	0.10	0.82	-0.13	0.10
Vendor, truck	Comp36	0.86	0.03	0.02	0.85	0.05	-0.05	0.98	0.05	-0.05
Other	Comp37	0.82	0.05	0.01	0.87	-0.01	-0.02	1.00	-0.01	-0.02
Type of toilet facility : None										
(bush)	Comp38	0.77	0.02	0.01	0.88	-0.14	0.23	0.68	-0.14	0.23
Flush toilet to sewer	Comp39	0.76	0.03	0.01	0.89	0.20	0.25	0.50	0.20	0.25
Pan or bucket	Comp40	0.73	0.02	0.01	0.91	0.06	-0.06	0.96	0.06	-0.06
Covered pit latrine	Comp41	0.71	0.07	0.01	0.92	0.02	-0.13	0.94	0.02	-0.13
Uncovered pit latrine	Comp42	0.64	0.04	0.01	0.93	-0.11	0.00	0.90	-0.11	0.00
Improved pit latrine	Comp43	0.60	0.02	0.01	0.94	0.08	-0.25	0.77	0.08	-0.25
Other	Comp44	0.58	0.03	0.01	0.95	0.00	-0.02	1.00	0.00	-0.02
Main fuel used for cooking :										
Firewood	Comp45	0.55	0.05	0.01	0.96	-0.27	0.07	0.37	-0.27	0.07
Charcoal	Comp46	0.50	0.01	0.01	0.97	0.19	-0.26	0.52	0.19	-0.26
Kerosene/Oil	Comp47	0.49	0.11	0.01	0.98	0.03	0.01	0.99	0.03	0.01
Gas	Comp48	0.38	0.04	0.01	0.98	0.18	0.29	0.47	0.18	0.29
Electricity	Comp49	0.35	0.01	0.01	0.99	0.04	0.07	0.97	0.04	0.07
Crop residue/Sawdust	Comp50	0.33	0.07	0.01	1.00	-0.02	0.06	0.98	-0.02	0.06
Other	Comp51	0.26	0.26	0.00	1.00	0.00	-0.01	1.00	0.00	-0.01
Main fuel used for lighting :										
Kerosene/Paraffin	Comp52	0.00	0.00	0.00	1.00	-0.27	0.11	0.36	-0.27	0.11
Gas	Comp53	0.00	0.00	0.00	1.00	0.02	0.05	0.99	0.02	0.05
Mains electricity	Comp54	0.00	0.00	0.00	1.00	0.27	-0.12	0.35	0.27	-0.12
Generator	Comp55	0.00	0.00	0.00	1.00	0.00	-0.03	1.00	0.00	-0.03
Battery	Comp56	0.00	0.00	0.00	1.00	-0.02	0.03	1.00	-0.02	0.03
Candles	Comp57	0.00		0.00	1.00	-0.01	0.04	0.99	-0.01	0.04

Source: Authors' estimations based on 1997 and 2003 CWIQ surveys.

Table A5: Profile of Asset Poverty According to Selected Household Characteristics, Ghana 1997-2003.

	Year	Rural				Urban				National			
		Share	P0	P1	P2	Share	P0	P1	P2	Share	P0	P1	P2
Population as a whole													
	1997	68.56%	55.21%	24.52%	14.93%	31.44%	25.00%	8.97%	4.70%	100	45.71%	19.63%	11.72%
	(S.E.)		49.73%	29.87%	23.95%		43.31%	19.75%	13.17%		49.82%	28.04%	21.68%
	2003	57.89%	51.83%	20.70%	11.83%	42.11%	21.07%	7.09%	3.49%	100	38.88%	14.97%	8.32%
	(S.E.)		49.97%	27.48%	20.87%		40.78%	17.30%	11.03%		48.75%	24.66%	17.90%
	Δ	-10.67%	-3.38%	-3.82%	-3.10%	10.67%	-3.93%	-1.88%	-1.21%	0	-6.83%	-4.66%	-3.39%
Educational attainment of the household head													
Not educated	1997	47.36%	71.59%	36.70%	24.16%	31.32%	41.41%	15.71%	8.65%	42.32%	64.57%	31.82%	20.55%
	(S.E.)		45.10%	32.69%	28.53%		49.27%	24.87%	17.76%		47.84%	32.29%	27.22%
	2003	49.42%	68.35%	31.50%	19.28%	25.03%	43.25%	16.27%	8.68%	39.15%	61.59%	27.40%	16.42%
	(S.E.)		46.51%	30.58%	25.08%		49.55%	24.57%	17.24%		48.64%	29.86%	23.70%
	Δ	2.06%	-3.24%	-5.20%	-4.88%	-6.28%	1.84%	0.56%	0.03%	-3.17%	-2.97%	-4.42%	-4.12%
Primary	1997	10.18%	52.13%	20.64%	11.17%	6.08%	47.83%	17.52%	9.17%	8.89%	51.20%	19.97%	10.74%
	(S.E.)		49.98%	26.31%	18.79%		50.02%	24.72%	17.34%		50.01%	26.00%	18.50%
	2003	9.30%	51.16%	17.15%	8.63%	6.05%	31.36%	10.63%	5.17%	7.93%	44.80%	15.05%	7.52%
	(S.E.)		50.00%	23.86%	16.53%		46.42%	20.11%	12.39%		49.74%	22.92%	15.40%
	Δ	-0.88%	-0.96%	-3.49%	-2.54%	-0.03%	-16.47%	-6.89%	-3.99%	-0.96%	-6.40%	-4.91%	-3.22%
College	1997	34.22%	41.33%	13.04%	6.13%	39.28%	18.47%	6.33%	3.14%	35.81%	33.45%	10.73%	5.10%
	(S.E.)		49.25%	21.05%	13.71%		38.81%	16.55%	9.94%		47.18%	19.87%	12.62%
	2003	33.74%	35.07%	9.38%	4.02%	42.74%	16.71%	4.79%	2.04%	37.53%	26.26%	7.18%	3.07%
	(S.E.)		47.72%	17.72%	10.71%		37.31%	13.45%	7.47%		44.01%	15.98%	9.35%
	Δ	-0.48%	-6.26%	-3.66%	-2.11%	3.46%	-1.76%	-1.54%	-1.10%	1.72%	-7.18%	-3.55%	-2.03%
Secondary/Technical	1997	7.16%	24.34%	7.50%	3.34%	18.80%	9.42%	2.47%	1.04%	10.82%	16.19%	4.75%	2.09%
	(S.E.)		42.95%	16.68%	10.14%		29.23%	9.92%	6.06%		36.85%	13.64%	8.25%
	2003	6.65%	20.97%	5.33%	2.20%	18.80%	5.54%	1.56%	0.67%	11.77%	10.59%	2.79%	1.17%
	(S.E.)		40.72%	13.83%	7.90%		22.88%	8.01%	4.48%		30.77%	10.43%	5.87%
	Δ	-0.51%	-3.37%	-2.16%	-1.14%	0.01%	-3.88%	-0.91%	-0.38%	0.95%	-5.61%	-1.96%	-0.92%
Post Secondary/higher	1997	1.08%	10.20%	3.53%	1.64%	4.53%	2.27%	0.62%	0.21%	2.17%	4.99%	1.62%	0.70%
	(S.E.)		30.41%	12.38%	7.18%		14.92%	4.59%	1.79%		21.80%	8.24%	4.49%
	2003	0.90%	7.91%	1.70%	0.55%	7.37%	2.27%	0.41%	0.15%	3.62%	3.08%	0.60%	0.21%
	(S.E.)		27.04%	7.24%	4.08%		14.90%	3.85%	1.89%		17.28%	4.52%	2.33%
	Δ	-0.18%	-2.30%	-1.83%	-1.09%	2.84%	0.00%	-0.20%	-0.06%	1.46%	-1.91%	-1.02%	-0.50%
Occupation of the household head													
Unemployed	1997	4.07%	41.43%	14.24%	7.21%	10.56%	24.39%	7.55%	3.54%	6.11%	32.18%	10.61%	5.22%
	(S.E.)		49.31%	22.78%	16.07%		42.98%	17.24%	11.03%		46.74%	20.23%	13.68%

	2003	7.54%	73.18%	38.92%	25.64%	7.28%	20.19%	7.81%	4.47%	7.43%	51.33%	26.09%	16.91%
	(S.E.)		44.31%	32.41%	27.64%		40.16%	19.66%	14.28%		49.99%	31.79%	25.33%
	Δ	3.47%	31.75%	24.68%	18.43%	-3.28%	-4.20%	0.26%	0.93%	1.32%	19.15%	15.48%	11.70%
Employer/Owner	1997	84.25%	59.80%	27.24%	16.80%	59.43%	31.96%	12.12%	6.54%	76.45%	53.00%	23.54%	14.29%
	(S.E.)		49.03%	30.64%	24.99%		46.64%	22.52%	15.33%		49.91%	29.59%	23.43%
	2003	73.32%	52.86%	20.02%	11.09%	52.62%	27.17%	9.35%	4.65%	64.61%	44.05%	16.36%	8.88%
	(S.E.)		49.92%	26.60%	19.95%		44.48%	19.43%	12.45%		49.65%	24.90%	18.00%
	Δ	-10.93%	-6.94%	-7.21%	-5.72%	-6.80%	-4.80%	-2.76%	-1.89%	-11.84%	-8.95%	-7.18%	-5.42%
Unpaid/Casual Work	1997	1.73%	50.97%	18.44%	10.09%	2.67%	29.16%	6.31%	2.21%	2.02%	41.93%	13.41%	6.82%
	(S.E.)		50.10%	25.92%	19.23%		45.58%	13.51%	6.65%		49.41%	22.45%	15.79%
	2003	4.10%	60.15%	30.10%	18.92%	4.05%	26.63%	8.57%	3.83%	4.08%	46.13%	21.10%	12.61%
	(S.E.)		48.98%	31.41%	24.98%		44.23%	17.59%	10.29%		49.86%	28.57%	21.51%
	Δ	2.37%	9.18%	11.67%	8.83%	1.38%	-2.53%	2.27%	1.61%	2.05%	4.20%	7.69%	5.79%
Regular employee	1997	9.67%	22.46%	6.71%	3.06%	26.81%	9.41%	2.85%	1.37%	15.06%	15.16%	4.55%	2.12%
	(S.E.)		41.76%	16.16%	10.34%		29.21%	11.38%	7.16%		35.87%	13.82%	8.74%
	2003	7.28%	19.61%	4.85%	1.95%	24.47%	6.87%	1.87%	0.83%	14.52%	10.57%	2.74%	1.16%
	(S.E.)		39.71%	13.08%	7.62%		25.30%	8.93%	5.27%		30.75%	10.40%	6.06%
	Δ	-2.38%	-2.85%	-1.85%	-1.11%	-2.35%	-2.54%	-0.98%	-0.54%	-0.54%	-4.58%	-1.81%	-0.96%
Student/Apprentice/Other	1997	0.28%	29.35%	8.88%	3.71%	0.53%	24.20%	6.63%	3.32%	0.35%	26.95%	7.83%	3.53%
	(S.E.)		45.96%	17.24%	9.42%		43.18%	17.12%	11.35%		44.56%	17.14%	10.32%
	2003	7.76%	47.21%	19.23%	11.01%	11.58%	21.98%	6.84%	3.14%	9.37%	34.08%	12.78%	6.92%
	(S.E.)		49.93%	27.05%	20.42%		41.42%	16.36%	10.06%		47.40%	22.99%	16.37%
	Δ	7.48%	17.86%	10.35%	7.31%	11.06%	-2.21%	0.21%	-0.18%	9.01%	7.13%	4.95%	3.39%
Sector of employment of the household head													
Public	1997	6.86%	22.62%	7.43%	3.86%	16.00%	9.99%	3.30%	1.65%	9.73%	16.09%	5.30%	2.72%
	(S.E.)		41.87%	18.19%	13.30%		30.01%	12.44%	7.77%		36.76%	15.62%	10.86%
	2003	4.96%	16.11%	4.42%	1.91%	14.88%	7.54%	2.12%	0.94%	9.14%	10.24%	2.84%	1.24%
	(S.E.)		36.77%	13.11%	7.98%		26.41%	9.44%	5.39%		30.32%	10.78%	6.34%
	Δ	-1.90%	-6.51%	-3.02%	-1.94%	-1.12%	-2.45%	-1.18%	-0.72%	-0.60%	-5.86%	-2.46%	-1.48%
Private/Parastatal	1997	86.76%	59.07%	26.69%	16.37%	68.27%	28.93%	10.84%	5.82%	80.94%	51.08%	22.49%	13.58%
	(S.E.)		49.17%	30.42%	24.69%		45.35%	21.57%	14.61%		49.99%	29.19%	22.94%
	2003	80.05%	52.43%	20.10%	11.22%	67.06%	23.94%	8.13%	4.01%	74.58%	41.64%	15.57%	8.49%
	(S.E.)		49.94%	26.80%	20.17%		42.67%	18.29%	11.63%		49.30%	24.63%	17.79%
	Δ	-6.71%	-6.64%	-6.59%	-5.15%	-1.21%	-5.00%	-2.70%	-1.82%	-6.37%	-9.43%	-6.92%	-5.09%
Unstated/Unemployed	1997	6.38%	37.74%	13.40%	7.22%	15.74%	23.20%	6.61%	2.95%	9.32%	30.03%	9.80%	4.95%
	(S.E.)		48.50%	23.30%	17.03%		42.23%	15.86%	9.79%		45.85%	19.99%	13.83%
	2003	14.99%	60.45%	29.27%	18.39%	18.07%	21.59%	7.31%	3.70%	16.28%	42.29%	19.01%	11.53%
	(S.E.)		48.90%	31.35%	25.17%		41.15%	17.79%	11.87%		49.41%	28.13%	21.38%
	Δ	8.61%	22.71%	15.87%	11.18%	2.33%	-1.61%	0.70%	0.75%	6.96%	12.27%	9.21%	6.57%

Type of Industry for the employment of the household head													
Agriculture	1997	72.94%	64.38%	29.86%	18.59%	18.30%	62.04%	26.31%	14.92%	55.76%	64.14%	29.49%	18.21%
	(S.E.)		47.89%	31.11%	25.85%		48.56%	28.30%	21.35%		47.96%	30.85%	25.45%
	2003	63.22%	58.15%	22.43%	12.59%	16.59%	54.28%	20.53%	10.65%	43.58%	57.53%	22.12%	12.28%
	(S.E.)		49.33%	27.49%	21.08%		49.82%	25.38%	17.48%		49.43%	27.17%	20.56%
	Δ	-9.72%	-6.23%	-7.43%	-6.00%	-1.71%	-7.77%	-5.78%	-4.27%	-12.17%	-6.61%	-7.37%	-5.93%
Mines/Transport/Manufactures	1997	5.37%	29.84%	10.23%	5.22%	16.41%	15.80%	5.76%	2.95%	8.84%	21.65%	7.62%	3.90%
	(S.E.)		45.79%	20.43%	13.69%		36.50%	16.20%	10.20%		41.20%	18.21%	11.83%
	2003	7.69%	36.13%	14.55%	8.16%	16.75%	14.86%	4.33%	1.92%	11.51%	23.09%	8.28%	4.33%
	(S.E.)		48.05%	24.59%	17.61%		35.57%	13.15%	7.65%		42.14%	19.10%	12.85%
	Δ	2.32%	6.28%	4.31%	2.95%	0.35%	-0.94%	-1.43%	-1.04%	2.66%	1.43%	0.66%	0.44%
Services/Finances/Commerce	1997	15.39%	27.91%	8.94%	4.32%	49.63%	14.92%	4.36%	2.06%	26.16%	20.16%	6.21%	2.97%
	(S.E.)		44.87%	18.77%	12.34%		35.64%	13.69%	8.31%		40.13%	16.09%	10.19%
	2003	14.46%	23.54%	7.44%	3.63%	48.82%	11.83%	3.38%	1.53%	28.93%	15.22%	4.56%	2.13%
	(S.E.)		42.43%	17.53%	11.49%		32.30%	11.89%	7.17%		35.92%	13.88%	8.70%
	Δ	-0.93%	-4.36%	-1.49%	-0.69%	-0.80%	-3.10%	-0.98%	-0.54%	2.77%	-4.94%	-1.65%	-0.84%
Unstated/Unemployed	1997	6.30%	37.36%	12.97%	6.78%	15.67%	23.30%	6.65%	2.97%	9.24%	29.87%	9.60%	4.75%
	(S.E.)		48.41%	22.60%	16.06%		42.30%	15.92%	9.85%		45.78%	19.58%	13.25%
	2003	14.63%	60.75%	29.54%	18.62%	17.83%	21.33%	7.31%	3.70%	15.98%	42.23%	19.10%	11.61%
	(S.E.)		48.84%	31.45%	25.32%		40.97%	17.80%	11.90%		49.40%	28.22%	21.49%
	Δ	8.34%	23.38%	16.57%	11.84%	2.16%	-1.97%	0.66%	0.73%	6.74%	12.36%	9.50%	6.86%
Regional location of the household													
Western	1997	12.69%	50.47%	18.11%	8.99%	7.08%	14.70%	3.96%	1.53%	10.93%	43.18%	15.22%	7.47%
	(S.E.)		50.02%	23.91%	15.88%		35.47%	11.75%	5.39%		49.55%	22.71%	14.68%
	2003	11.54%	43.05%	11.32%	4.48%	8.08%	22.06%	7.27%	3.40%	10.08%	35.97%	9.95%	4.12%
	(S.E.)		49.52%	17.90%	9.74%		41.48%	16.95%	9.96%		48.00%	17.69%	9.83%
	Δ	-1.15%	-7.42%	-6.79%	-4.51%	1.00%	7.36%	3.31%	1.87%	-0.84%	-7.21%	-5.27%	-3.35%
Central	1997	9.23%	40.41%	12.95%	6.03%	8.57%	49.03%	18.96%	9.77%	9.02%	42.99%	14.74%	7.15%
	(S.E.)		49.10%	20.87%	13.32%		50.04%	24.87%	16.26%		49.52%	22.30%	14.36%
	2003	9.95%	29.96%	7.24%	2.83%	7.76%	25.98%	6.94%	2.81%	9.02%	28.52%	7.13%	2.82%
	(S.E.)		45.82%	15.20%	8.38%		43.86%	15.26%	8.07%		45.15%	15.22%	8.27%
	Δ	0.72%	-10.45%	-5.71%	-3.20%	-0.81%	-23.05%	-12.02%	-6.96%	0.00%	-14.47%	-7.62%	-4.32%
Greater	1997	1.39%	36.87%	15.07%	7.98%	34.94%	3.50%	0.45%	0.12%	11.94%	6.17%	1.62%	0.75%
	(S.E.)		48.35%	23.94%	15.07%		18.38%	3.39%	1.31%		24.07%	8.49%	4.92%
	2003	3.40%	21.12%	5.04%	1.84%	28.77%	2.83%	0.33%	0.07%	14.08%	5.38%	0.99%	0.32%
	(S.E.)		40.84%	12.61%	6.00%		16.57%	2.61%	0.80%		22.57%	5.54%	2.44%
	Δ	2.00%	-15.75%	-10.02%	-6.13%	-6.17%	-0.67%	-0.12%	-0.05%	2.14%	-0.79%	-0.63%	-0.43%
Volta	1997	12.66%	50.29%	18.93%	9.28%	4.76%	40.84%	10.70%	4.45%	10.18%	48.90%	17.72%	8.57%
	(S.E.)		50.02%	23.87%	15.05%		49.24%	18.21%	10.05%		50.00%	23.30%	14.52%

Female	1997	26.29%	46.67%	16.42%	8.15%	35.25%	29.63%	10.03%	4.95%	29.11%	40.18%	13.99%	6.93%
	(S.E.)		49.90%	23.36%	15.96%		45.67%	19.86%	12.38%		49.03%	22.31%	14.78%
	2003	21.77%	39.23%	13.45%	6.93%	31.31%	25.40%	8.08%	3.80%	25.79%	32.16%	10.71%	5.33%
	(S.E.)		48.83%	22.63%	15.62%		43.54%	17.73%	10.86%		46.71%	20.45%	13.49%
	Δ	-4.51%	-7.44%	-2.97%	-1.22%	-3.95%	-4.23%	-1.96%	-1.15%	-3.32%	-8.02%	-3.28%	-1.60%
Age category of the head													
0-25 years	1997	3.66%	56.82%	23.96%	13.63%	3.84%	36.50%	12.36%	6.38%	3.72%	50.22%	20.19%	11.27%
	(S.E.)		49.57%	28.11%	20.98%		48.20%	22.05%	14.41%		50.02%	26.84%	19.39%
	2003	3.57%	52.00%	20.09%	11.10%	3.71%	25.64%	8.78%	4.24%	3.63%	40.65%	15.22%	8.14%
	(S.E.)		49.97%	26.58%	19.75%		43.68%	18.64%	11.59%		49.12%	24.15%	17.07%
	Δ	-0.09%	-4.81%	-3.87%	-2.53%	-0.13%	-10.86%	-3.58%	-2.13%	-0.09%	-9.57%	-4.97%	-3.13%
25-45 years	1997	47.41%	55.20%	24.24%	14.54%	48.65%	22.56%	8.30%	4.44%	47.80%	44.76%	19.14%	11.31%
	(S.E.)		49.73%	29.44%	23.04%		41.81%	19.38%	13.01%		49.73%	27.65%	20.91%
	2003	46.92%	51.16%	19.95%	11.24%	49.58%	18.84%	6.04%	2.91%	48.04%	37.12%	13.91%	7.62%
	(S.E.)		49.99%	26.95%	20.33%		39.10%	15.96%	10.06%		48.31%	23.85%	17.17%
	Δ	-0.49%	-4.04%	-4.30%	-3.30%	0.93%	-3.72%	-2.26%	-1.53%	0.24%	-7.64%	-5.24%	-3.69%
45-65 years	1997	36.86%	55.42%	25.42%	15.85%	37.20%	24.04%	8.29%	4.21%	36.97%	45.49%	20.00%	12.17%
	(S.E.)		49.71%	30.65%	25.26%		42.75%	18.78%	12.38%		49.80%	28.58%	22.67%
	2003	36.70%	52.59%	21.43%	12.42%	36.30%	20.96%	7.26%	3.64%	36.53%	39.36%	15.50%	8.75%
	(S.E.)		49.94%	27.98%	21.41%		40.71%	17.66%	11.36%		48.86%	25.19%	18.42%
	Δ	-0.16%	-2.83%	-3.98%	-3.43%	-0.90%	-3.08%	-1.03%	-0.57%	-0.44%	-6.13%	-4.49%	-3.42%
65 + years	1997	12.07%	54.08%	23.04%	14.05%	10.31%	35.71%	13.28%	7.09%	11.52%	48.91%	20.29%	12.09%
	(S.E.)		49.85%	29.58%	24.13%		47.96%	23.11%	15.66%		50.00%	28.25%	22.30%
	2003	12.81%	52.04%	21.49%	12.52%	10.41%	30.48%	10.87%	5.48%	11.80%	44.03%	17.54%	9.91%
	(S.E.)		49.96%	28.12%	21.46%		46.04%	20.73%	13.52%		49.65%	26.13%	19.21%
	Δ	0.74%	-2.04%	-1.55%	-1.53%	0.10%	-5.23%	-2.41%	-1.62%	0.28%	-4.88%	-2.75%	-2.19%
Head ownership of land													
No land	1997	51.11%	56.48%	25.26%	15.35%	22.92%	35.11%	13.45%	7.19%	42.25%	52.84%	23.24%	13.96%
	(S.E.)		49.58%	29.96%	23.88%		47.75%	23.21%	15.38%		49.92%	29.25%	22.86%
	2003	53.87%	55.85%	23.09%	13.46%	25.89%	33.11%	12.46%	6.49%	42.09%	49.96%	20.33%	11.66%
	(S.E.)		49.66%	28.52%	21.97%		47.07%	22.22%	14.89%		50.00%	27.43%	20.60%
	Δ	2.76%	-0.63%	-2.17%	-1.89%	2.97%	-2.00%	-0.99%	-0.70%	-0.16%	-2.87%	-2.91%	-2.30%
Has Land	1997	48.89%	53.87%	23.75%	14.49%	77.08%	22.00%	7.63%	3.97%	57.75%	40.50%	16.99%	10.08%
	(S.E.)		49.86%	29.76%	24.01%		41.43%	18.40%	12.34%		49.09%	26.82%	20.63%
	2003	46.13%	47.13%	17.90%	9.93%	74.11%	16.87%	5.21%	2.45%	57.91%	30.83%	11.06%	5.90%
	(S.E.)		49.92%	25.94%	19.33%		37.45%	14.75%	9.08%		46.18%	21.62%	15.19%
	Δ	-2.76%	-6.74%	-5.85%	-4.56%	-2.97%	-5.13%	-2.42%	-1.52%	0.16%	-9.67%	-5.92%	-4.18%
Household size													
1-5 members	1997	48.02%	53.16%	22.23%	12.85%	55.19%	23.51%	8.14%	4.15%	50.27%	42.92%	17.37%	9.84%

Table A6: Correlates of the Logarithm of the Asset Index, Ghana 1997-2003.

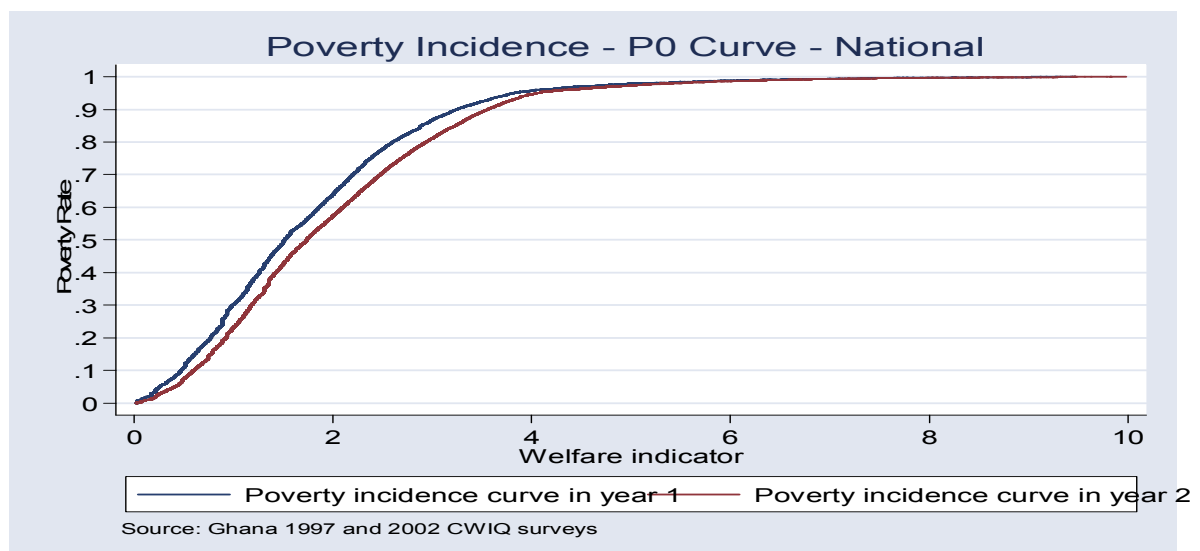
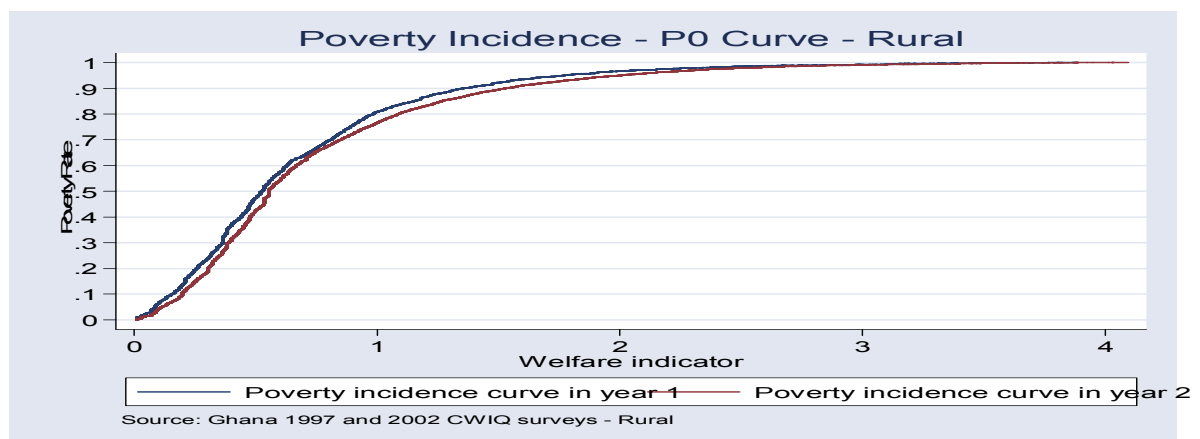
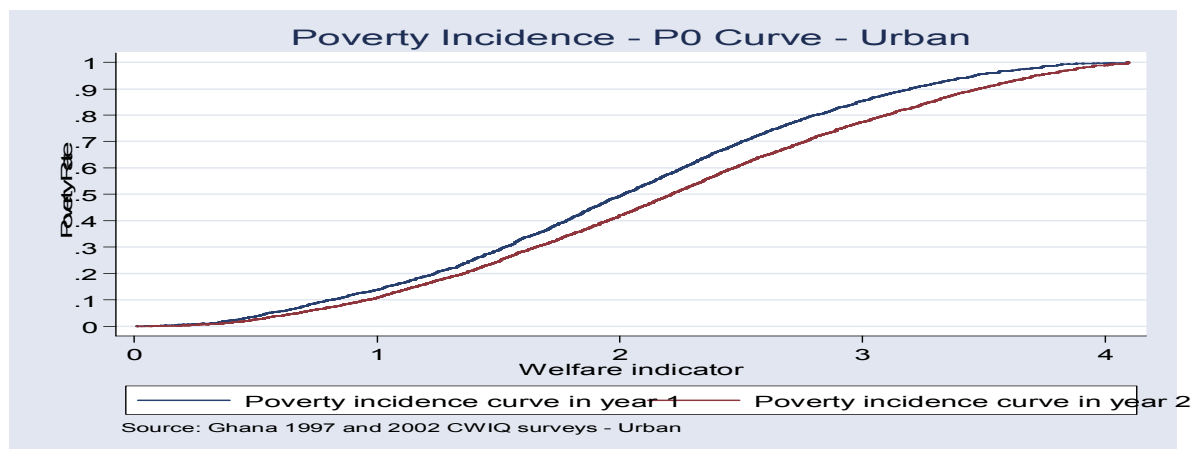
	1997			2003		
	National	Rural	Urban	National	Rural	Urban
Demographic structure						
Number of infants (under 5)	-0.02*** (5.05)	-0.02*** (3.33)	-0.01 (0.62)	-0.01*** (3.30)	-0.02*** (4.32)	0 (0.79)
Square of number of infants	0 (1.03)	0 (1.49)	-0.01 (1.55)	0 (0.09)	0.00* (1.96)	-0.01*** (3.19)
Number of children (5-14)	-0.01 (0.97)	0 (0.44)	-0.01 (1.00)	-0.01*** (6.80)	-0.01** (2.32)	-0.01*** (6.04)
Square of number of children	0 (1.34)	0 (1.13)	0 (0.14)	0.00*** (4.87)	0 (1.18)	0.00*** (5.07)
Number of adults	0.02*** (3.09)	0.02** (2.18)	0.02** (2.14)	0.02*** (4.10)	0.01*** (3.97)	0.02*** (5.12)
Square of number of adults	0 (1.16)	0 (1.19)	0 (0.28)	0 (1.23)	0 (0.49)	-0.00* (1.81)
Number of seniors	0.02 (1.10)	0.02 (0.92)	-0.02 (0.56)	0.02 (1.64)	0.02** (2.28)	0.02 (0.86)
Square of number of seniors	0 (0.24)	0 (0.52)	0.02 (1.33)	0 (0.25)	0 (0.17)	-0.01 (0.64)
Education of head (ref.: no educ.)						
Primary	0.03 (1.36)	0.04** (2.17)	-0.03 (1.63)	0.02*** (4.06)	0.02*** (2.90)	0.02** (2.17)
Junior/Middle/Senior School	0.06*** (5.41)	0.06*** (2.61)	0.08*** (4.20)	0.07*** (11.35)	0.07*** (9.64)	0.06*** (6.24)
Secondary/Technical	0.15*** (8.98)	0.13*** (4.33)	0.18*** (7.98)	0.17*** (20.51)	0.15*** (12.23)	0.17*** (14.97)
Postsecondary/Higher	0.33*** (10.66)	0.34*** (6.47)	0.31*** (11.99)	0.31*** (25.67)	0.37*** (12.13)	0.29*** (19.27)
Head is literate	0.06*** (4.96)	0.07*** (3.10)	0.03 (1.57)	0.05*** (9.72)	0.05*** (6.73)	0.06*** (7.00)
Other characteristics of head						
Mentally or physically disabled	-0.06** (2.37)	-0.06** (2.04)	-0.01 (0.23)	-0.01 (1.16)	-0.01 (1.59)	0 (0.22)
Female	0.04*** (4.46)	0.07*** (3.20)	-0.02 (1.50)	0.02*** (4.66)	0.05*** (7.96)	-0.02** (2.42)
Age of head	0 (0.53)	0 (0.42)	0.00* (1.73)	0 (0.71)	0 (1.57)	0 (1.14)
Age of head squared	0 (0.22)	0 (1.10)	0 (1.35)	0 (0.84)	0 (1.63)	0 (1.14)
Marital status of head (ref.: single)						
Head is in a union	0.04*** (2.63)	0.03 (1.54)	0.03* (1.65)	0.01* (1.80)	0 (0.02)	0.02** (2.10)
Head is widowed/divorced/separated	0.01 (0.60)	0 (0.06)	0 (0.21)	0 (0.18)	0 (0.36)	-0.01 (0.82)
Employment of head (ref.: unemployed)						
Employer/Owner/Investor/Self-employed	0 (0.02)	-0.03 (0.22)	0.09 (1.09)	0.01 (0.87)	0.04* (1.87)	-0.02 (0.83)
Unpaid/Casual/Domestic employee	-0.04 (0.45)	-0.06 (0.46)	0.05 (0.60)	-0.03* (1.71)	0.02 (0.70)	-0.08*** (2.88)
Regular employee	0.08 (0.97)	0.08 (0.58)	0.13 (1.58)	0.05*** (3.01)	0.09*** (3.62)	0.01 (0.26)
Other	0.01 (0.10)	-0.01 (0.04)	0.09 (0.93)	-0.04 (1.42)	0.03 (0.70)	-0.09*** (2.81)
Sector of head (ref.: public sector)						
Private/Parastatal sector	0.03 (1.63)	0.08*** (3.09)	-0.01 (0.74)	-0.01 (1.58)	0 (0.11)	-0.01 (1.61)
Sector of activity of head (ref.: agriculture)						
Mineral/Const/Manufacture/Transport	0.19*** (11.20)	0.19*** (11.25)	0.20*** (10.88)	0.16*** (22.26)	0.16*** (15.03)	0.15*** (15.69)
Head in Services/Finance/Commerce	0.18*** (10.83)	0.16*** (11.77)	0.22*** (14.08)	0.16*** (28.99)	0.15*** (18.71)	0.17*** (21.48)
Urban areas	0.37*** (15.78)	0	0	0.31*** (41.22)	0	0
Geographic location (ref.: Western)						
Central	0.02 (0.47)	0.08*** (5.13)	-0.18*** (7.03)	0.03** (2.53)	0.05*** (2.95)	-0.01 (0.38)
Greater Accra	0.20***	0.10***	0.10***	0.10***	0.10***	0.09***

	(6.17)	(3.90)	(5.43)	(7.94)	(2.88)	(6.07)
Volta	-0.05	-0.02*	-0.15***	-0.09***	-0.08***	-0.14***
	(1.46)	(1.68)	(5.89)	(6.81)	(4.83)	(6.50)
Eastern	0.01	0.05**	-0.19***	-0.04***	-0.02	-0.07***
	(0.13)	(2.32)	(7.56)	(2.94)	(1.33)	(3.58)
Ashanti	0.06**	0.08***	-0.02	0.06***	0.06***	0.05***
	(2.06)	(5.65)	(1.07)	(4.80)	(3.47)	(3.26)
Brong Ahafo	-0.06*	-0.03**	-0.16***	-0.07***	-0.07***	-0.07***
	(1.96)	(2.11)	(6.16)	(5.34)	(4.26)	(3.53)
Northern	-0.23***	-0.22***	-0.27***	-0.17***	-0.19***	-0.12***
	(7.09)	(15.91)	(7.64)	(12.39)	(12.28)	(4.95)
Upper East	-0.19***	-0.16***	-0.35***	-0.24***	-0.28***	-0.11**
	(6.66)	(11.02)	(7.03)	(12.55)	(16.13)	(2.42)
Upper West	-0.16***	-0.16***	-0.13***	-0.19***	-0.22***	-0.09**
	(4.00)	(9.02)	(2.96)	(11.01)	(13.40)	(2.28)
Constant	-0.12	0.24*	0.60***	0.25***	0.54***	0.86***
	(1.30)	(1.75)	(5.85)	(8.77)	(15.62)	(20.50)
Observations	12760	8360	4400	40448	25595	14853
R-squared	0.69	0.39	0.54	0.7	0.4	0.48

Source: Authors' estimations based on 1997 and 2003 CWIQ surveys

Note: Robust t statistics in parenthesis. * significant at 10%; ** at 5%; *** at 1%.

Figure A2: Stochastic Dominance Tests: Changes in Poverty Over Time.



Source: Authors' estimations based on 1997 and 2003 CWIQ surveys.

Chapter 3.

Annex 1: Theoretical Framework.

Duration Models: A General Formulation.

The Problem of Duration Data.

What are the main determinants of the time elapsed before an event X ?

The traditional reflex of an econometrician will be to estimate by OLS the (log of) time against a set of covariates X . This however would produce inefficient estimates since time is a non-normal process. Also, in many cases, censoring and truncation are commonly encountered, that are not well handled by OLS. This censored observation result in missing values for the survival time.

Instead, in many occasions, time is viewed as an instantaneous process, leading to seek a more comprehensive method.

Survival analysis is a young branch of econometrics that is interested in the analysis of the time to an event. It is a growing area of research. The reader should be aware that alternative notations exist in the literature.

Let t be a random variable, which summarizes the time elapsing. We are interested in the elapsed time to the occurrence of an event called failure; t is the length spell of the subject. We assume t is a continuous variable (the discrete case being not considered in this dissertation), twice derivable with a probability density function $f(t)$ and a cumulative distribution function $F(t)$, which is also known as failure function. It is the probability that the subject fails (or “dies”) at time t , given that he has survived until t .

$$F(t) = \Pr(T \leq t) \quad (1)$$

The survivor function is defined as the probability that the subject under observation survives beyond t , given that he has survived until that date. This implies that there is no failure event prior to t .

$$\begin{aligned} S(t) &= 1 - F(t) \\ &= \Pr(T > t) \end{aligned} \quad (2)$$

The density function is the slope of the failure function and summarizes, for sake of simplicity, the occurrence of the failure in a small, tiny interval Δt .

$$\begin{aligned} f(t) &= \frac{\partial F(t)}{\partial t} \\ &= \lim_{\Delta t \rightarrow 0} \frac{\Pr(t \leq T \leq t + \Delta t \mid T \geq t)}{\Delta t} \end{aligned} \quad (3)$$

The density function is positive, continuous and twice derivable.

$$f(t) \geq 0$$

Since the survivor function is the complement of the failure function, we could rewrite $f(t)$ as:

$$f(t) = -\frac{\partial S(t)}{\partial t} \quad (3a)$$

Since $F(t)$ and $S(t)$ are probabilities, we have the following properties:

$$0 \leq S(t) \leq 1, \quad S(0) = 1, \quad \lim_{t \rightarrow \infty} S(t) = 0, \quad \frac{\partial S(t)}{\partial t} < 0, \quad \frac{\partial^2 S(t)}{\partial t^2} >> 0.$$

$$0 \leq F(t) \leq 1, \quad F(0) = 0, \quad \lim_{t \rightarrow \infty} F(t) = 1, \quad \frac{\partial F(t)}{\partial t} > 0, \quad \frac{\partial^2 F(t)}{\partial t^2} >> 0$$

With these tools in hand, we can now define the hazard function, which is a measure of the risk of failure (also sometimes referred to as the conditional failure rate, or the intensity function, or the age-specific failure rate, or the mortality force, or the inverse of the Mills' ratio). Although very useful, it is not easy to understand that concept. Formally, we can write the hazard rate function as:

$$h(t) = \frac{f(t)}{1 - F(t)}$$

$$= \frac{f(t)}{S(t)} \tag{4}$$

The hazard rate function measures the instantaneous transition intensity between each state t . It is not a probability but it can be viewed as the conditional probability of having a spell of length exactly t . It has units $1/t$. Since $f(t)$ and $S(t)$ are positive functions, it yields:

$$h(t) \geq 0$$

The probability density function $f(t)$ “summarizes the concentration of spell lengths (exit times) at each instant of time along the time axis, (while) the hazard (rate) function summarizes the same concentration at each point of time, but conditions the expression on survival in the state up to that instant” Jenkins (2003). Said more simply, the hazard rate is the limiting probability that the failure event occurs in a tiny interval, given that the subject has survived to the beginning of that interval, divided by the width of the interval. It tells us the risk an individual, who has not yet experienced a failure, experiences it at time t .

It can be shown that the hazard rate and the survivor functions share a one-to-one relationship:

$$h(t) = \frac{f(t)}{S(t)}$$

$$= \frac{\partial \{-\ln[S(t)]\}}{\partial t} \tag{5}$$

By integrating both sides from 0 to t , and given the fact that $F(0) = 0$ and yields:

$$S(t) = \exp\left(-\int_0^t h(x)dx\right)$$

$$= \exp(-H(t)) \tag{6}$$

where $H(t)$ is the cumulative or integrated hazard function (Hougaard, 1999; Andersen et al., 1993).

$$H(t) \geq 0, \quad \frac{\partial H(t)}{\partial t} = h(t).$$

It is assumed that the hazard function is separable (Frees et Valdez, 1998; Cox, 1972). It can be decomposed into two parts: the first component is known as the *baseline* hazard which is assumed common to all individuals (depends on t but does not depend on covariates X), and the second component which is a positive function assumed to be influenced by a set of person-specific covariates X .

Cox particularly emphasizes what is later related to as the proportional hazard functions as:

$$h(t) = h_0(t) \cdot \exp(\beta^T X(t)) \quad (7)$$

where X is a set of covariates that can depend of time or not. β is a parameter that measures the effect of the explanatory variables. Since this specification has a parametric ($\exp(\beta^T X(t))$) and a non parametric ($h_0(t)$) components, it is sometimes misleadingly referred to as the semi-parametric proportional hazard model. But that term is now mostly devoted to a particular functional form due to Cox and is true if and only if $h_0(t)$ is let unspecified.

Other cases are the Accelerated Failure-Time (AFT) models and the Additive Hazard Rate models. Under this specification, we have after manipulations:

$$\begin{aligned} H(t / X) &= H_0(t) \exp(\beta^T X(t)) \\ S(t / X) &= S_0(t)^{\exp(\beta^T X(t))} \end{aligned} \quad (8)$$

To see why this is called proportional hazard, assume two subjects i and j with characteristics X_i and X_j at time \bar{t} . The ratio of the respective hazards yields:

$$\begin{aligned} \frac{h(\bar{t}, X_i)}{h(\bar{t}, X_j)} &= \frac{h_0(\bar{t}) \exp(\beta^T X_i(\bar{t}))}{h_0(\bar{t}) \exp(\beta^T X_j(\bar{t}))} \\ &= \exp[\beta^T (X_i(\bar{t}) - X_j(\bar{t}))] \end{aligned} \quad (9)$$

This tells us that absolute differences in X imply proportionate differences in the hazard at each time.

In the case i and j are identical in all characteristics but k , we have: $\frac{h(\bar{t}, X_i)}{h(\bar{t}, X_j)} = \exp[\beta_k^T (X_{ik} - X_{jk})] = \exp(\beta_k)$ for one unit change

$X_{ik} - X_{jk} = 1$. $\exp(\beta_k)$ is usually referred to as the hazard ratio.

In the remaining of the modeling, we will suppose that the covariates are fixed to simplify notation. This means the hazard rates are proportional

$\frac{h(\bar{t}, X_i)}{h(\bar{t}, X_j)} = \exp[\beta^T (X_i - X_j)]$. The ratio does not depend on time. If subjects share the same characteristics, then we have:

$$\frac{h(t, \bar{X})}{h(v, \bar{X})} = \frac{h_0(t)}{h_0(v)} \quad (10)$$

which depends only on respective elapsed times.

The cumulative and survival functions thus become:

$$\begin{aligned} S(t) &= S_0(t)^{\exp(\beta^T X)} \\ H(t) &= H_0(t) \exp(\beta^T X) \end{aligned} \tag{11}$$

Differences in characteristics imply therefore a scaling of the common baseline survival and cumulative functions.

The estimation procedure consist of finding BLUE estimators for parameters β and p . This is usually done via maximum likelihood method (MLE) i.e. estimates of the covariates parameters and the ancillary parameter (shape parameter). Another method is the rank regression, not discussed in this paper.

The likelihood function is of the form:

$$L = \left\{ \prod_{i \in U} f(t_i) \right\}^{d_i} \left\{ \prod_{i \in C} S(t_i) \right\}^{1-d_i} \tag{12}$$

i.e. the combination of those who experienced the failure and those who exit (right-censored). d_i is an indicator dummy which evaluate to 1 if the subject experiences the failure and to 0 if not.

Linearizing this expression yields the log-likelihood function that is given by:

$$\ln L = \sum_{j=1}^n \left\{ d_j \ln f_j(t_j) + (1 - d_j) \ln S_j(t_j) - \ln S_j(t_{0j}) \right\} \tag{13}$$

Equation (13) tells us that a subject experiencing a failure contributes to the log-likelihood function the value of his density at time t_j conditional on entry time t_{0j} : $f_j(t_j) / S_j(t_{0j})$. When the individual is censored, the only information available is that he has survived up to time t_j . Thus, his contribution to the likelihood is: $S_j(t_j) / S_j(t_{0j})$ i.e. the probability of surviving beyond t_j , conditional on the entry time t_{0j} (StataCorp, 2003).

The rest of the estimation is done as usual by differentiating $\ln L$ against β and p .

Table A7: Predicted Mortality Rates (x 1000).

	Official DHS Macro Inc. Estimates (Non Parametric - ICMR)		Own Non Parametric Fictive Cohort Estimates (ICMR)		Own Non Parametric Estimates (Kaplan-Meier)		Own Parametric Estimates (Weibull)		Assets Poverty (Head - count - 60% Line)	
	Obs.	IMR	U5M	IMR	U5M	IMR	U5M	IMR		U5M
Country-Year survey										
Armenia 2000	1726	36	39	38	39	38	38	34	***	0.11%
Bangladesh 1993/94	3874	88	134	77	.NE	80	NE	78	.NE	85.86%
Bangladesh 1996/97	6189	82	116	81	113	83	105	87	221	83.13%
Bangladesh 1999/2000	6832	66	94	65	85	66	81	67	182	76.29%
Bangladesh 2004	6908	65	88	65	82	66	79	68	188	72.24%
Benin 1996	3011	94	167	81	NE	81	NE	78	NE	60.36%
Benin 2001	5349	89	160	89	153	98	142	99	198	48.93%
Bolivia 1994	3654	75	116	72	NE	70	NE	68	NE	29.34%
Bolivia 1998	7304	67	92	66	89	69	84	69	186	22.82%
Bolivia 2003	10448	54	75	52	73	53	68	55	155	21.24%
Brazil 1991	3159	75	85	72	81	75	79	64	199	22.18%
Brazil 1996	5045	39	49	39	45	40	44	35	118	6.02%
Burkina Faso 1992/93	5828	94	187	92	181	107	162	109	235	75.59%
Burkina Faso 1998/99	5953	105	219	106	218	118	193	131	258	79.84%
Burkina Faso 2003	10645	81	184	81	185	95	164	111	209	71.30%
Cameroon 1991	3350	64	125	61	122	62	108	76	173	52.81%
Cameroon 1998	2317	77	151	71	NE	78	NE	74	NE	51.01%
Cameroon 2004	8125	74	144	75	146	83	134	94	189	45.31%
CAR 1994/95	2816	97	158	86	NE	87	NE	85	NE	74.77%
Chad 1996/97	7408	103	194	103	205	118	178	126	251	92.12%
Chad 2004	5635	102	191	101	195	110	174	115	222	89.09%
Colombia 1990	3751	17	23	16	23	18	22	20	69	6.38%
Colombia 1995	5141	28	36	28	37	30	35	28	99	7.45%
Colombia 2000	4670	21	25	22	24	21	24	21	73	4.12%
Colombia 2005	14621	19	22	19	22	19	21	21	78	2.87%
Comoros 1996	1145	77	104	77	NE	77	NE	66	NE	41.17%
Congo (Brazzaville) 2005	4835	76	117	75	110	78	104	70	161	40.04%
Cote d'Ivoire 1994	3998	89	150	78	NE	76	NE	79	NE	37.26%
Cote d'Ivoire 1998/99	1992	112	181	112	186	119	171	118	254	29.76%
Dominican Republic 1991	4164	43	59	43	57	45	54	49	142	9.95%
Dominican Republic 1996	4643	47	57	45	53	46	52	45	141	7.11%
Dominican Republic 1999	597	22	30	23	27	25	26	***	52	3.14%
Dominican Republic 2002	11362	31	38	32	38	32	36	29	86	2.58%
Egypt 1992	8764	62	85	62	81	66	77	66	198	7.80%
Egypt 1995	12135	63	81	63	77	64	73	62	186	5.24%
Egypt 2000	11467	44	54	43	56	43	51	41	126	2.04%
Egypt 2003	6661	NA	NA	38	45	39	44	40	132	0.69%
Egypt 2005	13851	33	41	33	39	34	38	32	109	0.29%
Ethiopia 2000	10873	97	166	97	165	104	151	104	237	88.77%
Ethiopia 2005	9861	77	124	78	132	84	115	83	197	85.80%
Gabon 2000	4405	57	89	55	96	59	87	62	144	16.51%
Ghana 1993	2204	66	119	63	NE	68	NE	58	NE	37.77%
Ghana 1998	3298	57	108	59	104	64	95	71	179	32.90%
Ghana 2003	3844	64	111	65	116	71	102	68	166	27.34%
Guatemala 1995	9952	51	68	52	67	54	64	53	158	27.74%

Guatemala 1998/99	4943	45	59	45	57	51	57	47	146	21.54%
Guinea 1999	5834	98	177	101	185	118	170	117	255	61.65%
Guinea 2005	6364	91	163	89	166	97	146	102	200	58.67%
Haiti 1994/95	3564	74	131	75	139	79	124	91	212	50.63%
Haiti 2000	6685	80	119	81	117	85	108	83	199	47.35%
Honduras 2005	10800	23	30	22	29	23	27	25	81	10.95%
India 1992/93	48959	79	109	75	NE	77	NE	70	NE	64.62%
India 1998/99	33026	68	95	62	NE	65	NE	57	NE	55.82%
Indonesia 1991	15708	68	97	67	90	71	85	64	185	30.18%
Indonesia 1994	18196	57	81	56	78	58	74	60	170	25.26%
Indonesia 1997	17444	46	58	46	57	47	54	45	134	19.16%
Indonesia 2002/2003	16206	35	46	35	48	36	44	32	104	12.82%
Kazakhstan 1995	846	40	46	41	NE	41	NE	38	NE	0.16%
Kazakhstan 1999	1345	62	71	62	72	64	69	***	156	2.48%
Kenya 1993	6115	62	96	62	102	67	93	70	182	67.50%
Kenya 1998	3531	74	112	73	NE	77	NE	67	NE	62.00%
Kenya 2003	5949	77	115	76	118	79	113	77	174	60.28%
Kyrgyz Republic 1997	1127	61	72	61	NE	60	NE	***	NE	1.62%
Lesotho 2004	3697	91	113	92	113	93	107	81	194	47.19%
Madagascar 1992	5273	93	163	92	158	100	145	98	217	78.21%
Madagascar 1997	3681	96	159	85	NE	87	NE	81	NE	69.40%
Madagascar 2003/2004	5415	58	94	58	93	61	85	51	138	57.08%
Malawi 1992	4495	135	234	138	233	146	215	145	268	80.66%
Malawi 2000	11926	104	189	103	190	111	171	116	210	74.65%
Malawi 2004	10914	76	133	75	122	83	112	84	177	74.78%
Mali 1995/96	6031	123	238	117	NE	120	NE	116	NE	74.75%
Mali 2001	13097	113	229	112	219	134	199	137	251	65.93%
Mauritania 2000/01	4764	70	104	71	110	75	100	80	191	59.01%
Moldova Republic of 2005	1552	13	14	14	14	13	13	8	32	2.80%
Morocco 1992	5197	57	76	59	76	61	73	62	185	29.83%
Morocco 2003-2004	6180	40	47	39	48	40	44	38	128	12.31%
Mozambique 1997	4122	135	201	97	NE	98	NE	84	NE	76.26%
Mozambique 2003	10326	101	152	100	150	106	137	99	222	72.37%
Namibia 1992	3916	57	84	57	88	61	80	63	171	59.64%
Namibia 2000	3989	38	62	39	71	41	62	44	108	52.12%
Nepal 1996	4417	79	118	67	NE	67	NE	65	NE	82.80%
Nepal 2001	6931	64	91	64	87	65	82	68	191	76.60%
Nicaragua 1997/98	8454	40	50	40	55	40	51	36	117	27.09%
Nicaragua 2001	6986	31	40	31	42	33	39	33	103	24.36%
Niger 1992	6899	123	318	121	319	142	283	164	267	85.09%
Niger 1998	4798	123	274	103	NE	107	NE	106	NE	84.41%
Nigeria 1990	7902	87	193	87	201	101	177	115	224	44.10%
Nigeria 1999	3552	75	140	77	NE	92	NE	74	NE	39.96%
Nigeria 2003	6029	100	201	98	205	107	185	119	212	36.41%
Pakistan 1990/91	6428	86	112	88	116	95	109	77	194	58.00%
Paraguay 1990	4246	34	43	33	39	33	38	36	115	29.77%
Peru 1992	9362	55	78	53	78	56	73	62	176	23.70%
Peru 1996	17549	43	59	43	57	44	54	51	153	25.58%
Peru 2000	13697	33	47	34	44	34	42	41	129	22.40%
Peru 2004	2537	NA	NA	23	33	23	30	29	95	19.68%
Philippines 1993	9195	34	54	33	50	37	45	36	120	11.82%
Philippines 1998	8083	35	48	34	46	36	42	36	120	11.99%
Philippines 2003	7145	29	40	30	44	30	41	30	88	9.98%
Rwanda 1992	5510	85	151	86	158	89	138	95	218	82.12%
Rwanda 2000	7922	107	196	109	188	118	175	120	216	76.20%
Rwanda 2005	8649	86	152	84	150	89	132	88	179	76.90%

Senegal 1992/93	5645	68	132	69	133	72	119	88	197	46.29%
Senegal 1997	7372	68	139	68	150	78	128	95	215	44.06%
Senegal 2005	10944	61	121	60	114	65	99	72	157	29.78%
South Africa 1998	5066	45	59	45	65	50	59	46	144	13.48%
Tanzania 1992	8138	92	141	92	141	95	129	95	222	75.96%
Tanzania 1996	6789	88	137	89	134	95	125	92	222	72.50%
Tanzania 1999	3215	99	147	98	150	103	139	97	225	71.98%
Tanzania 2004	8564	68	112	69	114	72	104	80	168	67.21%
Togo 1998	4168	80	146	71	NE	70	NE	57	NE	52.03%
Turkey 1993	3724	53	61	53	60	55	58	50	150	0.92%
Turkey 1998	3565	43	52	43	59	46	53	39	125	0.08%
Uganda 1995	5756	81	147	79	NE	84	NE	90	NE	85.18%
Uganda 2000/01	7113	88	152	90	149	94	137	95	193	80.32%
Uzbekistan 1996	1324	49	59	48	NE	48	NE	40	NE	2.11%
Vietnam 1997	1775	29	38	28	NE	27	NE	27	NE	32.44%
Vietnam 2002	1317	18	24	12	NE	12	NE	10	NE	15.35%
Yemen 1991/92	7286	85	121	84	129	94	117	87	211	40.20%
Zambia 1992	6299	107	191	109	189	112	174	128	250	48.82%
Zambia 1996	7248	109	197	109	196	117	181	132	271	58.70%
Zambia 2001/02	6877	95	168	95	181	102	165	116	222	61.26%
Zimbabwe 1994	2438	53	77	55	NE	57	NE	57	NE	59.42%
Zimbabwe 1999	3643	65	102	65	114	73	99	73	174	47.88%
Geographical situation										
SSA	319590			87	160	95	145	107	113	
Rest of the World	347469			48	64	50	58	51	54	
World Region										
Central Asia	1325			48	NE	48	NE	41	NE	
Latin America & Caribbean	155491			42	56	41	49	44	54	
North Africa/West Asia/Europe	78845			51	66	53	61	54	75	
South & Southeast Asia	218636			60	81	62	73	64	94	
Sub-Saharan Africa	346154			87	160	86	138	100	105	
Development Level										
Low-income	489742			82	145	86	128	94	105	
Lower-middle-income	293947			44	57	42	50	45	50	
Upper-middle-income	16762			49	70	56	56	58	92	
Time Period										
1990-1995	273074			71	113	73	100	79	103	
1995-2000	300418			68	110	72	98	77	88	
2000-2005	226959			63	106	74	110	83	89	
Language										
Arabic	76324			53	70	55	65	58	76	
English	345821			70	111	75	104	82	101	
French	177917			87	171	94	151	104	114	
Other	39373			75	120	82	110	85	120	
Portuguese	22653			82	114	87	108	83	135	
Russian	1325			48	NE	48	NE	41	NE	
Spanish	137038			38	50	42	52	46	59	

Note: NE = Non Exposure (Observation period inferior to 5 years). Non-complete exposure sample.

***: Model not estimated due to technical problems usually due to a small number of observations (matrix not positive definite, non convergence, etc.).

Source: Author's calculations using DHS data and sample weights. Official estimates obtained from DHS website: www.measuredhs.com

Table A8: Child Anthropological Status (Underweight).

	Year	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri
Period 1990-1995											
Bolivia	1994	15,59%	11,74%	19,72%	24,53%	19,93%	14,37%	13,24%	6,16%	19,62%	9,66%
Burkina Faso	1993	33,34%	21,78%	35,40%	35,27%	33,92%	39,01%	30,37%	28,28%	36,08%	29,30%
CAR	1995	27,01%	22,30%	31,42%	35,03%	26,84%	28,92%	23,94%	20,01%	30,22%	21,81%
Cameroon	1991	15,51%	12,81%	17,33%	22,51%	23,05%	13,74%	13,28%	7,23%	19,62%	10,12%
Colombia	1993	9,50%	7,40%	12,62%	15,62%	11,15%	9,60%	6,78%	3,80%	12,12%	5,37%
Cote d'Ivoire	1994	23,79%	16,15%	27,13%	29,43%	27,29%	26,05%	20,33%	16,06%	27,59%	18,16%
Dominican Rep	1991	10,34%	7,67%	13,87%	20,28%	10,23%	8,51%	7,94%	4,77%	12,88%	6,35%
Egypt	1994	12,21%	9,14%	13,62%	16,24%	15,21%	11,43%	10,55%	7,39%	14,27%	9,12%
Ghana	1993	28,23%	19,04%	31,46%	38,82%	25,60%	32,42%	26,60%	18,43%	32,23%	22,52%
Guatemala	1995	27,73%	20,36%	30,84%	32,80%	37,98%	32,71%	23,40%	11,76%	34,51%	17,75%
Haiti	1995	27,96%	23,16%	29,85%	38,70%	30,88%	25,33%	24,30%	18,90%	31,90%	21,68%
India	1993	53,49%	45,97%	55,65%	60,39%	59,55%	50,72%	47,01%	50,55%	56,80%	48,71%
Kenya	1993	23,27%	12,28%	24,42%	32,05%	24,29%	22,91%	23,36%	14,18%	26,26%	18,91%
Madagascar	1992	41,33%	34,66%	42,39%	42,74%	35,31%	44,37%	44,90%	39,11%	40,92%	41,94%
Malawi	1992	27,23%	15,74%	28,79%	33,34%	31,12%	28,61%	25,51%	17,19%	31,08%	21,37%
Morocco	1992	10,59%	3,49%	13,50%	21,58%	10,82%	9,16%	8,89%	2,76%	13,81%	5,83%
Namibia	1992	27,60%	20,64%	30,20%	31,02%	33,00%	33,52%	24,35%	17,21%	32,51%	20,74%
Niger	1992	42,46%	31,46%	45,19%	47,66%	47,14%	44,27%	42,73%	32,41%	46,36%	37,19%
Nigeria	1990	35,87%	26,80%	38,34%	38,76%	41,09%	38,49%	36,89%	25,40%	39,47%	30,89%
Pakistan	1991	41,30%	33,45%	45,58%	55,05%	47,50%	42,86%	36,75%	28,06%	48,52%	32,39%
Paraguay	1990	4,08%	3,21%	4,67%	7,21%	4,26%	3,95%	2,74%	1,44%	5,27%	2,21%
Peru	1992	11,32%	7,14%	18,37%	23,88%	12,88%	11,48%	6,54%	2,45%	15,95%	4,51%
Rwanda	1992	29,45%	18,26%	30,05%	33,61%	30,78%	31,09%	28,18%	22,57%	31,98%	25,39%
Senegal	1993	23,57%	14,39%	28,20%	30,60%	28,81%	27,36%	19,59%	13,63%	28,87%	16,43%
Tanzania	1992	27,67%	24,79%	28,32%	22,96%	28,24%	31,46%	28,83%	26,76%	27,58%	27,79%
Turkey	1993	12,78%	10,23%	15,53%	6,69%	8,22%	8,05%	18,20%	24,08%	7,48%	20,92%
Uganda	1995	25,99%	14,37%	27,40%	33,13%	27,42%	26,11%	23,48%	19,42%	28,80%	21,38%
Yemen	1992	29,00%	24,56%	30,90%	36,19%	35,23%	29,70%	24,47%	24,83%	33,42%	24,69%
Zambia	1992	24,48%	20,85%	27,76%	29,17%	29,49%	25,78%	21,49%	16,96%	28,18%	19,19%
Zimbabwe	1994	16,29%	12,19%	17,42%	20,86%	19,54%	13,78%	13,87%	13,36%	18,09%	13,62%
Sample Mean	1993	24,63%	18,20%	27,20%	30,54%	27,23%	25,53%	22,62%	17,84%	27,75%	20,20%
Period 1995-2000											
Bangladesh	1999	49,99%	39,29%	51,57%	61,16%	57,98%	51,78%	45,51%	34,55%	57,06%	39,93%
Benin	1996	28,84%	23,87%	30,96%	37,58%	37,96%	27,33%	22,71%	20,93%	34,12%	21,80%
Bolivia	1998	8,17%	5,62%	11,43%	14,45%	11,48%	7,20%	5,65%	2,60%	11,01%	4,15%
Brazil	1996	6,85%	5,40%	11,12%	15,83%	7,30%	6,07%	3,10%	2,62%	9,57%	2,86%
Burkina Faso	1999	34,27%	20,49%	35,96%	37,73%	38,26%	37,01%	30,71%	28,44%	37,67%	29,50%
Cameroon	1998	22,61%	15,51%	25,24%	29,34%	30,49%	22,49%	17,10%	12,84%	27,72%	14,93%
Chad	1997	37,88%	31,59%	39,65%	44,22%	32,13%	41,47%	38,28%	29,92%	40,26%	34,15%
Colombia	2000	7,52%	6,30%	9,94%	9,10%	9,16%	9,09%	6,09%	3,93%	9,12%	4,99%
Comoros	1996	25,26%	25,09%	25,31%	35,71%	36,43%	19,29%	19,96%	14,96%	30,49%	17,60%
Cote d'Ivoire	1999	21,70%	13,00%	25,34%	43,13%	24,81%	21,08%	16,89%	8,94%	28,28%	12,95%
Dominican Rep	1996	6,34%	4,53%	8,65%	14,28%	8,65%	4,38%	2,68%	1,12%	9,17%	1,88%
Egypt	2000	4,38%	3,38%	4,84%	6,47%	3,80%	3,97%	3,27%	4,37%	4,74%	3,82%
Ethiopia	2000	47,18%	34,12%	48,64%	51,11%	52,04%	45,76%	47,93%	38,53%	49,77%	43,22%
Gabon	2000	12,37%	10,26%	17,72%	19,24%	16,61%	12,31%	7,13%	5,77%	16,18%	6,44%
Ghana	1998	26,32%	16,18%	29,23%	36,74%	29,62%	25,50%	24,55%	15,61%	30,61%	19,89%

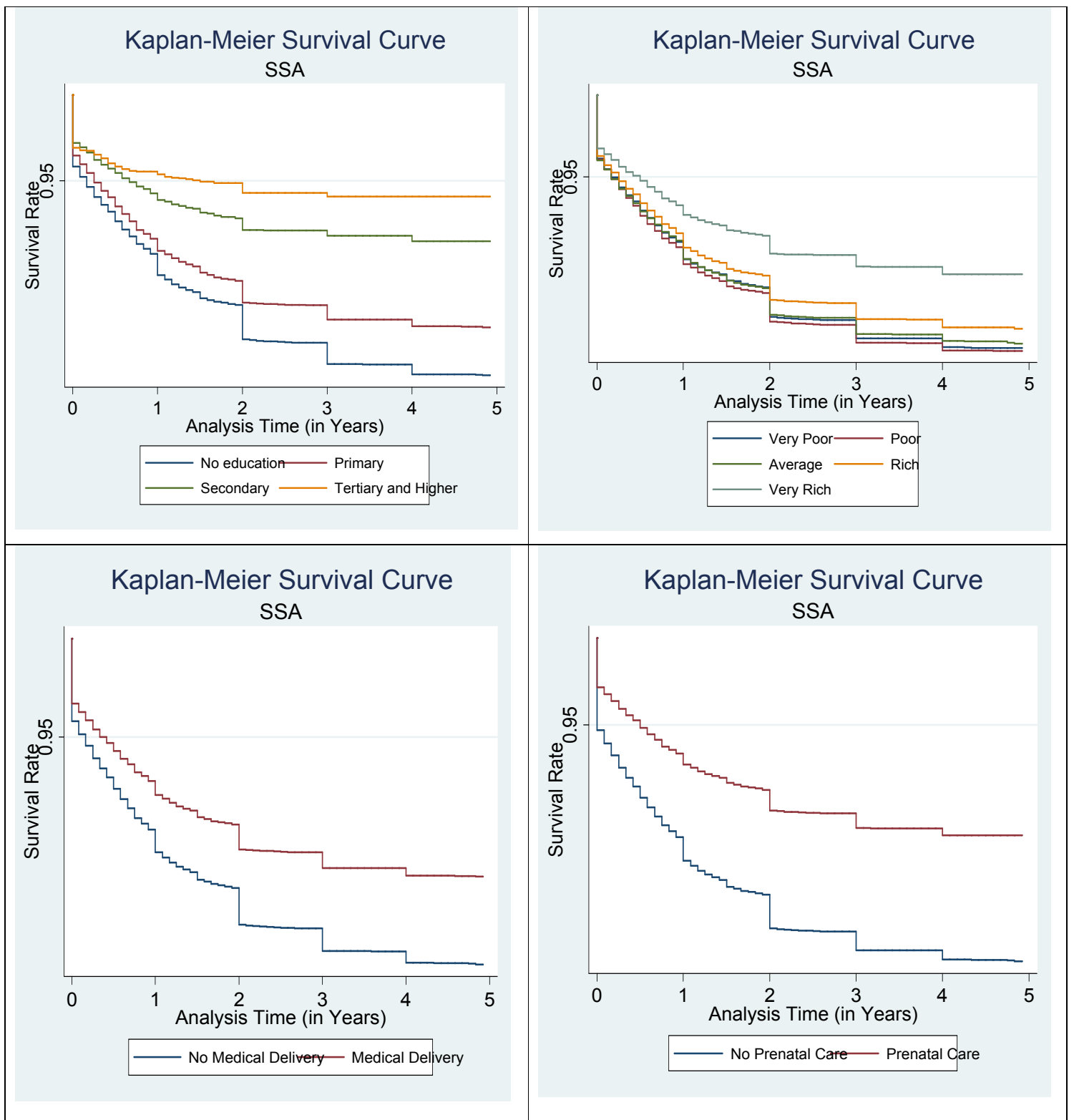
Guatemala	1999	26,32%	17,63%	30,59%	33,35%	36,85%	28,41%	23,04%	10,25%	32,81%	16,88%
Guinea	1999	22,91%	17,88%	25,46%	30,81%	23,85%	21,28%	23,55%	17,21%	25,36%	20,22%
Haiti	2000	17,53%	12,09%	19,70%	25,88%	16,99%	19,85%	14,66%	9,70%	20,92%	12,24%
India	1999	46,54%	38,61%	48,87%	59,28%	52,04%	48,43%	42,55%	31,49%	53,25%	36,83%
Kenya	1998	21,90%	12,06%	23,71%	31,00%	27,80%	20,03%	16,50%	14,28%	26,14%	15,36%
Madagascar	1997	40,69%	37,27%	41,54%	41,64%	44,11%	38,94%	43,56%	35,93%	41,34%	39,80%
Malawi	2000	24,92%	12,47%	26,86%	30,81%	27,24%	26,56%	25,64%	14,82%	28,18%	20,09%
Mali	1996	40,20%	31,82%	43,64%	50,97%	41,65%	40,93%	37,78%	30,23%	44,55%	34,01%
Mozambique	1997	24,42%	19,84%	26,11%	33,96%	31,48%	31,40%	19,09%	11,91%	32,25%	15,49%
Namibia	2000	24,36%	18,16%	26,48%	30,90%	26,47%	25,61%	18,83%	18,17%	27,87%	18,50%
Nepal	1996	46,42%	30,22%	47,45%	55,56%	45,95%	48,45%	45,68%	35,94%	50,04%	41,03%
Nicaragua	1998	13,35%	11,23%	15,57%	19,03%	17,68%	13,69%	10,95%	5,25%	16,78%	8,22%
Niger	1998	49,37%	35,42%	52,35%	54,06%	52,32%	49,88%	50,18%	40,32%	52,16%	45,13%
Nigeria	1999	27,69%	27,01%	27,92%	30,45%	33,79%	35,48%	22,07%	20,14%	33,35%	21,21%
Peru	1998	7,89%	3,92%	13,19%	17,51%	11,21%	6,02%	3,32%	1,83%	11,46%	2,60%
Rwanda	2000	23,64%	14,37%	25,55%	30,02%	26,23%	24,22%	25,40%	12,22%	26,90%	18,70%
Tanzania	1997	29,45%	19,95%	31,24%	31,08%	32,73%	32,64%	28,75%	21,37%	32,14%	25,34%
Togo	1998	26,35%	18,74%	28,48%	32,43%	29,18%	26,03%	25,26%	18,87%	29,30%	22,02%
Turkey	1998	9,66%	7,34%	12,44%	19,41%	8,36%	9,09%	7,21%	4,05%	12,30%	5,66%
Uzbekistan	1996	19,83%	17,54%	20,82%	30,29%	17,23%	17,73%	16,44%	16,40%	21,96%	16,42%
Zambia	1996	22,61%	16,45%	27,14%	27,22%	30,63%	22,55%	16,72%	15,64%	26,81%	16,30%
Zimbabwe	1999	13,39%	8,57%	15,25%	20,56%	13,99%	10,48%	13,41%	7,98%	15,10%	10,63%
Sample Mean	1998	24,84%	18,46%	27,19%	32,22%	28,23%	25,20%	22,22%	16,73%	28,56%	19,48%

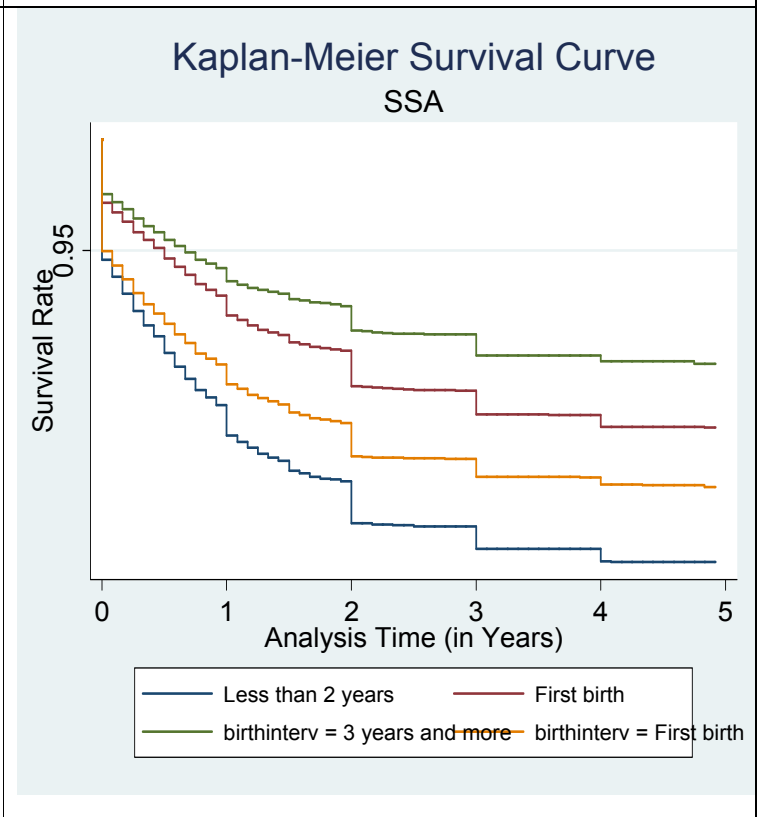
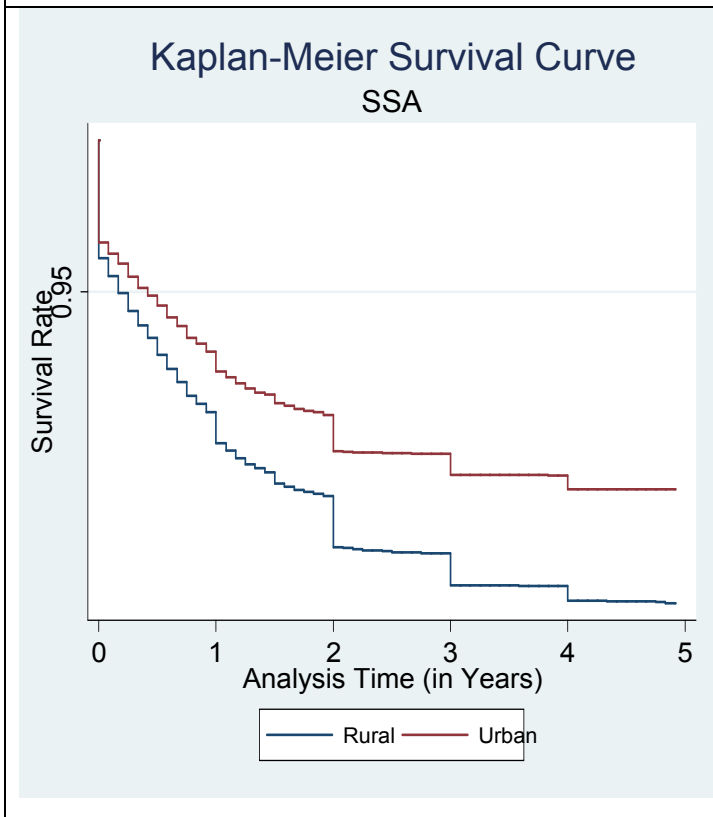
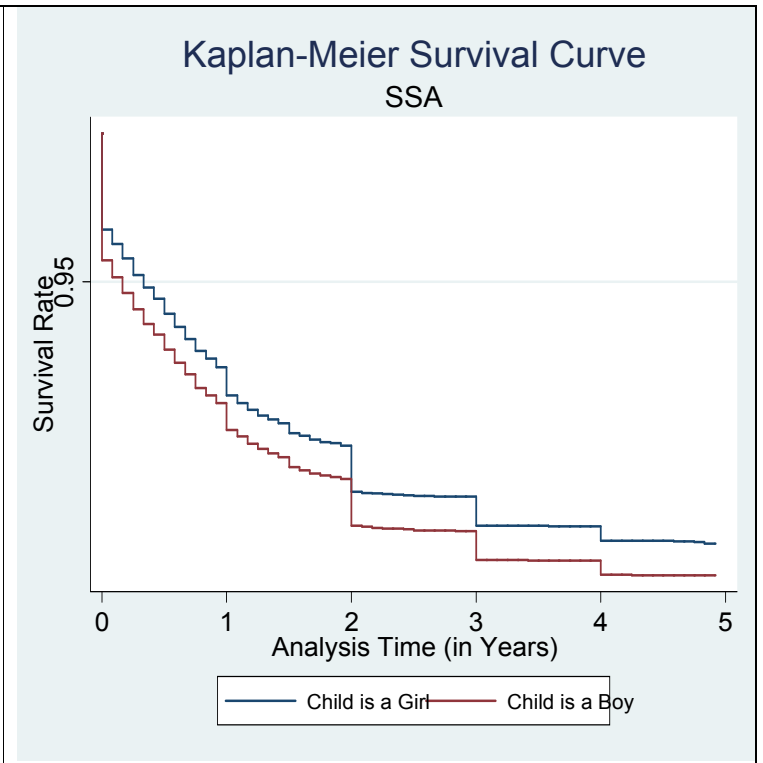
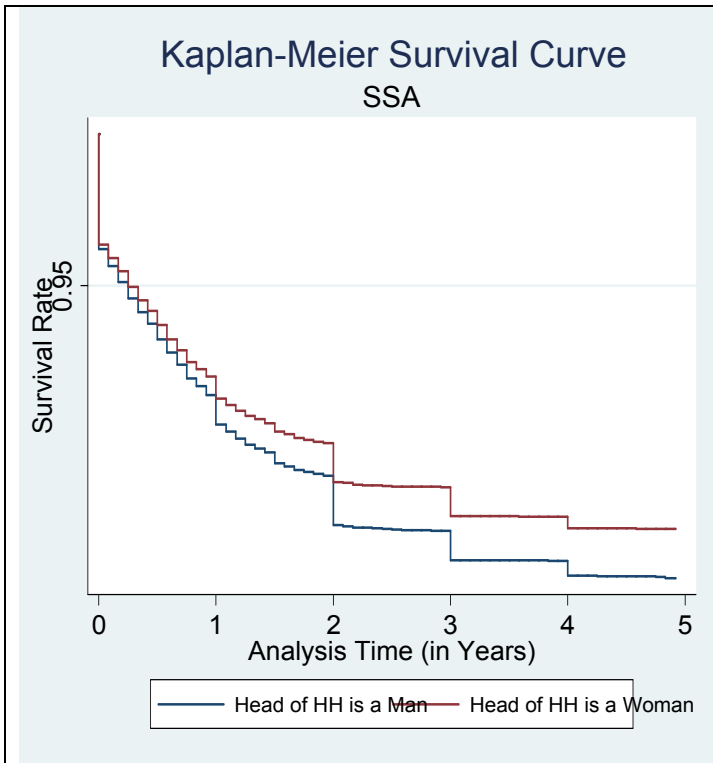
Period 2000-2005

Bangladesh	2004	46,61%	41,43%	47,85%	58,22%	53,71%	49,10%	40,16%	31,93%	53,71%	36,08%
Benin	2001	23,19%	17,18%	25,84%	31,44%	31,89%	23,63%	20,14%	12,02%	28,95%	15,96%
Burkina Faso	2003	37,54%	19,64%	40,02%	42,39%	42,98%	39,16%	38,34%	26,91%	41,41%	33,04%
Cameroon	2004	19,06%	12,97%	23,50%	29,56%	26,67%	16,30%	15,77%	6,35%	24,27%	10,98%
Chad	2004	35,92%	28,84%	37,86%	38,35%	37,34%	40,15%	34,84%	28,61%	38,62%	31,73%
Colombia	2005	7,47%	5,76%	10,81%	3,87%	5,00%	7,20%	9,12%	11,93%	5,37%	10,50%
Dominican Rep	2002	5,21%	3,99%	7,31%	7,80%	7,59%	4,60%	3,30%	2,45%	6,65%	2,89%
Egypt	2004	7,21%	6,60%	7,46%	7,34%	7,40%	6,35%	7,10%	7,87%	7,03%	7,49%
Ethiopia	2005	38,93%	23,13%	40,04%	42,62%	42,54%	36,35%	38,51%	34,65%	40,54%	36,55%
Ghana	2003	22,81%	15,47%	25,83%	28,43%	26,81%	25,58%	20,20%	12,87%	26,93%	16,55%
Kenya	2003	20,75%	13,36%	22,11%	26,47%	22,74%	21,90%	21,17%	10,52%	23,72%	15,75%
Lesotho	2004	19,55%	15,71%	19,98%	33,47%	23,81%	16,40%	8,67%	12,43%	24,94%	10,38%
Madagascar	2004	42,18%	37,37%	43,31%	48,60%	46,09%	46,71%	40,62%	29,54%	47,12%	35,24%
Mali	2001	32,96%	20,76%	37,02%	40,06%	35,80%	39,53%	33,25%	16,81%	38,42%	24,97%
Mauritania	2001	31,52%	26,29%	36,11%	36,96%	37,25%	37,52%	26,68%	20,44%	37,24%	23,48%
Morocco	2004	10,75%	6,87%	13,80%	12,91%	14,99%	9,82%	7,89%	8,20%	12,58%	8,03%
Mozambique	2003	22,25%	13,33%	26,51%	29,37%	27,97%	24,55%	20,28%	8,81%	27,40%	14,59%
Nepal	2001	48,37%	35,31%	49,25%	58,01%	51,39%	48,55%	46,95%	36,64%	52,69%	41,55%
Nicaragua	2001	10,47%	6,50%	14,30%	14,17%	15,77%	9,48%	6,71%	6,46%	13,12%	6,59%
Nigeria	2003	29,51%	23,10%	32,32%	39,64%	34,67%	34,93%	26,85%	15,37%	36,40%	20,51%
Senegal	2005	17,05%	8,79%	21,97%	27,45%	22,38%	18,36%	10,03%	6,80%	22,72%	8,30%
Tanzania	2004	20,35%	16,07%	21,20%	29,28%	17,69%	22,70%	17,57%	14,25%	23,29%	15,90%
Uganda	2001	22,42%	13,47%	23,26%	26,11%	26,14%	25,07%	21,20%	13,04%	25,78%	17,39%
Zambia	2002	28,26%	24,16%	30,14%	34,31%	34,75%	25,32%	25,47%	21,29%	31,48%	23,36%
Sample Mean	2003	25,01%	18,17%	27,41%	31,12%	28,89%	26,22%	22,53%	16,51%	28,77%	19,49%

Source: Author's own calculations using DHS data.

Figure A3: Non Parametric Survival Curves for Various Categories in SSA.

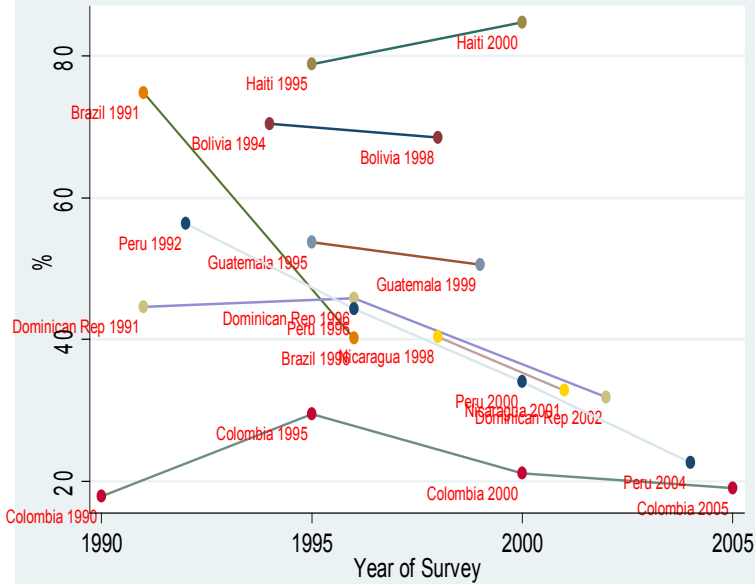




Source: Author's calculations based on DHS data.

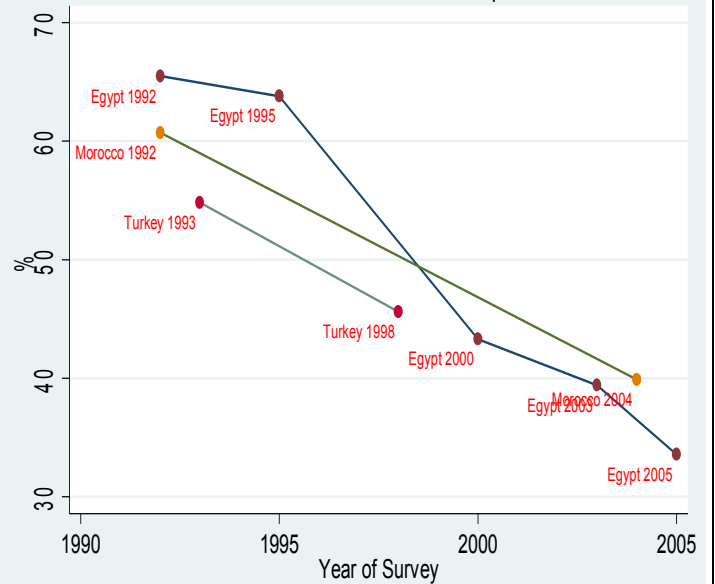
Figure A4: Trends in Infant Mortality Rates (Kaplan-Meier Estimates).

Infant Mortality Rate - Kaplan-Meier
Latin America & Caribbean



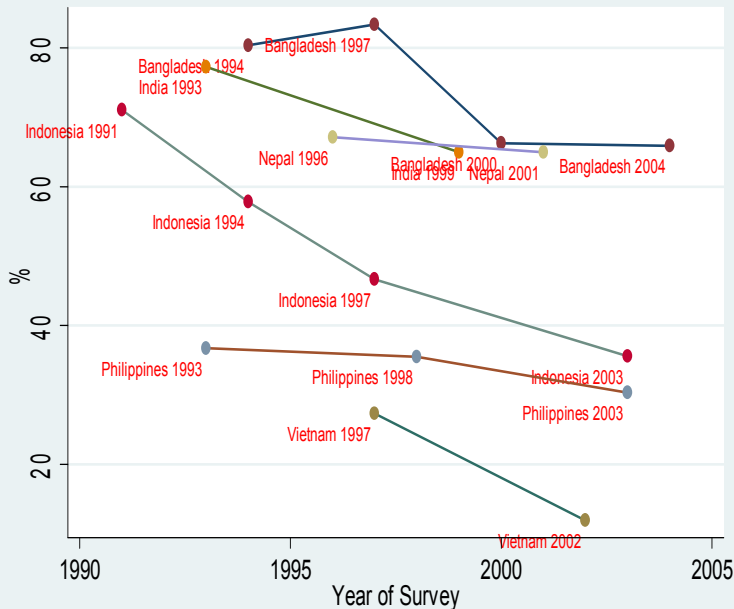
Source: DHS (Macro International Inc.)

Infant Mortality Rate - Kaplan-Meier
North Africa/West Asia/Europe



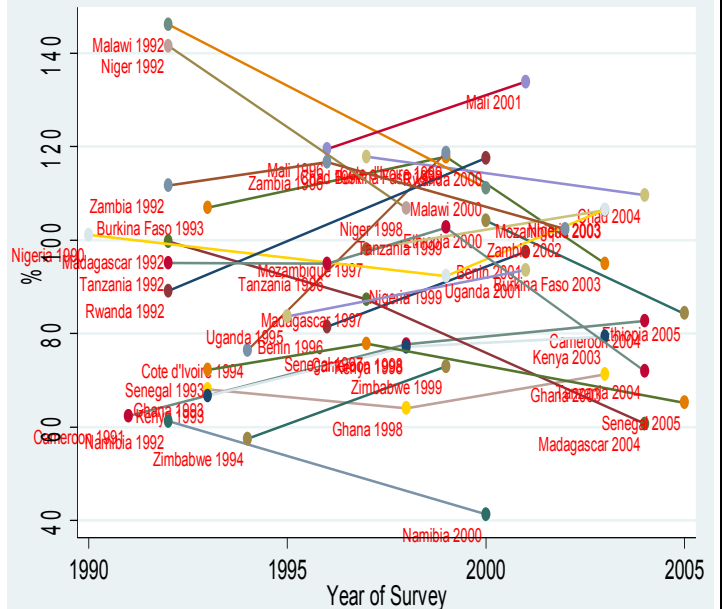
Source: DHS (Macro International Inc.)

Infant Mortality Rate - Kaplan-Meier
South & Southeast Asia



Source: DHS (Macro International Inc.)

Infant Mortality Rate - Kaplan-Meier
Sub-Saharan Africa



Chapter 4.

Table A9: Access to Health Care Services by Areas of Residency and Quintiles.

	Child is fully vaccinated											Diarrhoea: medical treatment									
	Year	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri
	Period 1990-1995																				
Bangladesh	1994											20.83%	32.35%	19.77%	20.04%	21.81%	22.53%	20.27%	18.73%	21.54%	19.41%
Bolivia	1994	36.97%	43.77%	30.31%	28.80%	30.04%	30.29%	37.47%	58.45%	29.67%	48.19%	32.76%	37.16%	27.56%	23.45%	30.52%	27.56%	35.95%	49.01%	26.99%	41.10%
Brazil	1991											26.27%	29.55%	21.52%	16.73%	20.42%	32.44%	28.26%	29.61%	24.41%	28.79%
Burkina Faso	1993	34.42%	62.96%	29.76%	18.24%	33.95%	35.61%	34.65%	49.10%	28.80%	42.34%	13.26%	25.46%	11.36%	10.12%	15.37%	8.67%	11.73%	21.50%	11.05%	16.91%
CAR	1995	39.83%	56.05%	23.94%	18.44%	29.89%	38.59%	53.11%	57.93%	29.56%	55.85%	32.03%	39.15%	26.51%	24.15%	21.53%	33.92%	36.94%	45.81%	26.36%	41.24%
Cameroon	1991	38.93%	46.47%	34.41%	31.39%	27.69%	31.45%	46.36%	56.22%	30.18%	51.25%	21.89%	22.75%	21.35%	21.39%	26.48%	16.68%	22.23%	21.72%	21.84%	22.01%
Colombia	1993	63.49%	66.72%	58.30%	48.06%	63.01%	63.43%	71.48%	69.38%	58.24%	70.57%	31.62%	35.48%	25.54%	23.79%	23.76%	34.46%	35.61%	44.81%	27.39%	39.51%
Cote d'Ivoire	1994	38.86%	54.20%	30.31%	20.04%	30.00%	35.66%	43.03%	60.45%	28.83%	52.18%	23.20%	31.99%	18.21%	13.38%	22.17%	18.42%	24.49%	34.08%	17.93%	29.29%
Dominican Rep	1991	35.31%	45.25%	23.21%	13.36%	30.12%	39.82%	44.55%	49.86%	27.75%	47.40%	30.06%	32.37%	27.01%	22.35%	20.80%	34.70%	36.38%	33.91%	26.90%	35.41%
Egypt	1994	70.39%	78.52%	66.59%	60.23%	60.71%	68.20%	77.76%	84.21%	63.18%	80.71%	46.09%	50.34%	44.14%	36.86%	43.53%	52.15%	47.81%	50.03%	44.46%	48.72%
Ghana	1993	52.26%	70.15%	45.36%	39.02%	47.74%	49.47%	52.99%	68.96%	45.62%	61.21%	22.05%	32.68%	19.09%	19.66%	20.54%	12.07%	28.00%	34.13%	17.67%	30.98%
Guatemala	1995	42.22%	35.76%	44.98%	37.72%	45.98%	41.29%	46.02%	39.34%	41.83%	42.81%	25.38%	29.00%	23.86%	21.02%	23.41%	20.12%	28.46%	36.18%	21.59%	31.72%
Haiti	1995	27.91%	37.20%	23.80%	19.35%	18.46%	29.47%	32.55%	36.72%	22.88%	34.69%	24.34%	35.23%	19.74%	15.22%	17.77%	27.88%	26.94%	35.97%	19.63%	31.50%
India	1993	34.60%	49.42%	30.47%	23.53%	27.37%	46.12%	44.72%	30.46%	32.32%	37.81%	62.79%	71.46%	60.61%	55.60%	56.18%	66.47%	65.95%	70.42%	59.26%	68.02%
Indonesia	1993											49.81%	55.96%	46.97%	37.82%	47.00%	49.10%	54.49%	61.42%	44.60%	57.77%
Kenya	1993	78.30%	81.11%	77.87%	68.61%	71.57%	78.92%	87.57%	83.44%	72.89%	85.44%	39.85%	54.94%	38.45%	32.21%	37.57%	44.43%	39.58%	47.22%	38.04%	43.19%
Madagascar	1992	42.77%	56.62%	40.84%	28.07%	34.08%	38.37%	46.57%	66.83%	33.76%	56.71%	35.47%	42.54%	34.47%	28.68%	39.54%	31.89%	32.81%	47.67%	33.20%	40.01%
Malawi	1992	82.30%	86.33%	81.73%	78.44%	80.00%	79.45%	84.65%	87.70%	79.28%	86.36%	49.98%	51.59%	49.78%	52.57%	43.13%	38.52%	52.55%	61.88%	45.15%	57.55%
Morocco	1992	72.78%	93.53%	64.69%	47.62%	59.69%	75.55%	87.07%	95.22%	61.21%	91.19%	10.32%	11.84%	9.86%	8.82%	10.14%	12.74%	8.49%	12.28%	10.45%	10.09%
Namibia	1992	58.36%	60.58%	57.39%	64.42%	61.78%	51.71%	50.69%	66.17%	58.68%	57.88%	71.18%	70.57%	71.32%	72.49%	68.89%	74.72%	73.91%	58.42%	72.11%	69.02%
Niger	1992	18.60%	53.15%	10.30%	3.81%	8.63%	9.51%	17.44%	47.24%	7.21%	32.96%	10.32%	33.41%	6.44%	6.91%	7.66%	4.53%	5.79%	29.66%	6.42%	16.46%
Nigeria	1990	27.94%	45.60%	23.26%	21.30%	23.05%	15.70%	28.24%	48.91%	20.23%	38.62%	28.11%	44.44%	25.20%	27.80%	25.50%	18.39%	24.70%	48.27%	23.97%	34.33%
Pakistan	1991	36.63%	46.01%	31.96%	25.36%	30.81%	31.03%	43.45%	51.02%	29.00%	47.41%	22.07%	28.47%	18.74%	18.25%	24.06%	16.51%	20.80%	32.43%	18.98%	26.78%
Paraguay	1990	31.80%	41.94%	24.74%	19.58%	25.20%	36.89%	35.16%	45.84%	27.02%	39.34%	36.00%	51.55%	23.84%	21.97%	28.58%	38.19%	42.43%	55.58%	28.89%	47.56%
Peru	1992	55.76%	63.05%	44.13%	37.66%	56.05%	55.64%	57.39%	72.53%	49.46%	65.25%	21.54%	23.47%	18.95%	16.91%	20.11%	20.10%	25.80%	30.30%	19.06%	27.45%
Philippines	1993											35.11%	39.76%	31.04%	22.30%	33.37%	38.36%	38.66%	47.47%	31.26%	42.20%
Rwanda	1992	86.08%	92.88%	85.73%	86.51%	85.87%	83.05%	86.14%	88.84%	85.18%	87.54%	23.35%	26.97%	23.14%	13.82%	23.57%	18.94%	30.70%	32.47%	18.08%	31.59%
Senegal	1993	50.33%	66.26%	43.17%	35.62%	38.05%	45.29%	58.36%	73.31%	40.00%	66.40%	23.45%	30.87%	21.32%	13.63%	17.44%	25.45%	28.94%	35.96%	18.85%	32.15%
Tanzania	1992	68.59%	84.59%	65.10%	51.97%	66.92%	68.81%	73.02%	82.37%	62.67%	77.43%	58.37%	72.49%	54.71%	50.94%	51.84%	54.79%	60.30%	69.86%	52.91%	65.54%

Turkey	1993	59.94%	71.49%	47.92%	75.72%	83.95%	61.54%	48.86%	32.39%	72.24%	40.67%	23.24%	30.27%	17.24%	35.54%	32.50%	22.71%	22.79%	9.05%	30.01%	15.67%
Uganda	1995	46.75%	54.59%	45.88%	34.88%	52.88%	42.26%	43.60%	60.88%	43.36%	52.76%	54.98%	62.86%	54.15%	51.17%	51.27%	47.39%	64.47%	65.65%	50.03%	65.01%
Yemen	1992	43.71%	70.16%	37.49%	22.24%	31.03%	41.69%	52.15%	68.02%	31.49%	59.60%	30.83%	51.37%	27.40%	13.38%	25.57%	27.93%	41.04%	56.94%	21.82%	47.20%
Zambia	1992	67.60%	73.99%	62.12%	59.65%	55.02%	64.33%	75.32%	84.36%	59.58%	79.61%	56.34%	61.99%	52.15%	49.80%	48.38%	59.87%	62.95%	65.42%	52.31%	63.82%
Zimbabwe	1994	78.16%	81.62%	76.88%	67.03%	83.00%	75.92%	84.54%	81.53%	74.87%	82.97%	31.28%	22.70%	32.93%	29.69%	36.07%	29.29%	30.12%	32.09%	31.41%	31.04%
Sample Mean	1993	50.72%	62.33%	45.42%	39.56%	46.42%	48.83%	54.83%	63.26%	44.90%	59.11%	33.06%	40.38%	30.13%	27.31%	30.49%	31.82%	35.60%	41.94%	29.84%	38.50%
Period 1995-2000																					
Bangladesh	1999	57.09%	67.42%	55.55%	48.38%	47.61%	57.85%	61.38%	69.84%	50.98%	65.70%	28.04%	38.37%	26.32%	24.21%	25.54%	27.93%	23.85%	37.23%	25.80%	31.56%
Benin	1996	54.34%	55.17%	53.98%	37.37%	47.10%	62.86%	59.24%	66.40%	48.81%	63.02%	25.45%	31.83%	23.00%	25.63%	17.94%	23.82%	23.60%	38.61%	22.60%	30.54%
Bolivia	1998	24.63%	25.92%	23.00%	22.19%	26.49%	21.67%	20.51%	32.42%	23.44%	26.28%	35.66%	39.42%	31.49%	28.78%	36.44%	34.20%	36.01%	46.81%	33.01%	40.28%
Brazil	1996	70.71%	76.29%	51.47%	46.88%	66.87%	76.37%	83.82%	75.92%	64.01%	79.87%	29.82%	34.16%	18.22%	25.33%	30.67%	20.86%	36.74%	41.30%	25.71%	38.60%
Burkina Faso	1999	28.75%	56.80%	25.92%	23.50%	20.12%	24.88%	33.63%	41.27%	22.73%	37.55%	18.13%	37.31%	16.24%	15.91%	16.69%	15.23%	17.12%	24.61%	15.98%	20.74%
Cameroon	1998	34.03%	45.93%	29.83%	21.78%	27.53%	31.23%	36.64%	57.30%	26.77%	46.70%	30.46%	39.98%	27.14%	20.34%	28.64%	26.03%	44.19%	39.15%	25.40%	41.64%
Chad	1997	14.02%	21.41%	12.11%	2.06%	23.50%	5.41%	16.67%	27.83%	8.98%	22.35%	21.65%	30.39%	19.00%	12.44%	23.24%	15.39%	25.75%	33.09%	16.61%	29.31%
Colombia	2000	14.35%	15.00%	13.06%	11.57%	12.02%	18.60%	19.68%	10.65%	14.23%	14.54%	28.31%	32.16%	21.64%	28.60%	20.68%	27.57%	36.99%	31.71%	25.64%	34.61%
Comoros	1996	54.35%	55.54%	53.98%	36.52%	52.67%	58.01%	56.20%	72.94%	48.47%	63.96%	27.97%	34.59%	25.35%	25.59%	20.98%	30.43%	29.97%	36.17%	25.02%	33.13%
Cote d'Ivoire	1999	46.38%	70.20%	37.15%	26.30%	24.77%	44.43%	57.05%	79.10%	31.79%	68.75%	29.40%	41.63%	26.00%	23.26%	24.30%	28.69%	30.40%	42.80%	25.50%	37.11%
Dominican Rep	1996	37.97%	43.11%	30.43%	21.93%	31.43%	43.68%	40.29%	51.89%	32.18%	46.35%	35.72%	38.57%	32.29%	28.09%	34.91%	40.43%	38.62%	43.22%	33.78%	40.63%
Egypt	2000	91.57%	91.85%	91.44%	91.36%	91.21%	94.16%	91.96%	89.04%	92.22%	90.51%	45.17%	51.87%	42.67%	44.77%	44.30%	56.61%	33.97%	44.08%	48.43%	39.36%
Ethiopia	2000	13.98%	43.35%	10.76%	5.72%	8.67%	8.69%	16.69%	30.05%	7.58%	23.19%	13.37%	46.40%	10.69%	6.90%	11.64%	13.10%	10.36%	26.55%	10.68%	17.85%
Gabon	2000	12.80%	15.86%	4.64%	2.70%	10.35%	14.43%	15.16%	22.38%	8.99%	18.79%	32.94%	34.92%	27.09%	23.54%	37.36%	31.20%	30.05%	41.90%	30.81%	36.00%
Ghana	1998	60.19%	71.52%	56.39%	49.98%	54.10%	60.84%	57.04%	76.73%	54.93%	67.10%	25.55%	24.83%	25.74%	21.97%	24.85%	24.34%	29.59%	30.55%	23.52%	29.99%
Guatemala	1999	58.17%	51.95%	61.38%	57.57%	60.89%	53.86%	50.99%	67.36%	57.58%	58.96%	29.56%	44.70%	22.72%	20.07%	33.98%	31.94%	31.58%	30.61%	28.86%	31.03%
Guinea	1999	33.52%	49.15%	26.47%	20.64%	27.03%	26.52%	40.54%	47.82%	24.88%	44.58%	53.44%	66.77%	49.20%	43.60%	48.07%	48.93%	60.52%	68.74%	46.69%	64.27%
Haiti	2000	33.48%	36.81%	32.09%	26.85%	29.02%	36.43%	34.31%	40.66%	30.72%	37.68%	23.49%	30.79%	20.72%	18.22%	18.91%	18.98%	29.62%	33.12%	18.69%	31.25%
India	1999	38.97%	53.36%	34.83%	23.48%	38.96%	36.11%	39.41%	56.78%	32.84%	48.38%	63.70%	74.84%	60.41%	55.20%	60.24%	62.80%	64.56%	76.45%	59.52%	70.14%
Indonesia	1997											54.28%	53.00%	54.70%	50.88%	57.49%	45.17%	56.78%	64.34%	51.11%	60.08%
Kenya	1998	59.27%	57.09%	59.71%	49.35%	53.09%	64.62%	69.74%	60.29%	56.02%	64.38%	45.15%	51.51%	43.89%	49.99%	41.07%	45.53%	33.87%	52.44%	45.65%	44.17%
Madagascar	1997	36.29%	44.96%	33.88%	17.26%	25.50%	33.45%	46.14%	59.79%	24.05%	53.10%	40.36%	47.35%	38.23%	34.28%	49.45%	31.23%	30.12%	58.60%	37.19%	44.09%
Malawi	2000	68.45%	77.99%	66.91%	63.83%	70.32%	66.11%	65.82%	75.92%	66.77%	70.98%	27.61%	32.92%	27.00%	26.50%	23.58%	27.54%	30.74%	29.83%	25.89%	30.34%
Mali	1996	31.14%	50.71%	23.34%	16.55%	22.39%	25.04%	33.99%	56.29%	21.28%	44.97%	19.83%	34.28%	15.73%	10.15%	19.50%	15.49%	23.50%	36.67%	15.02%	29.05%
Mozambique	1997	51.27%	86.62%	39.21%	19.88%	32.34%	49.10%	70.77%	86.94%	32.97%	77.24%	36.60%	45.07%	32.00%	29.94%	29.07%	33.18%	43.32%	51.57%	30.62%	47.35%
Namibia	2000	69.09%	75.23%	66.67%	56.42%	72.86%	68.46%	77.53%	71.06%	65.81%	74.43%	49.73%	56.54%	46.17%	47.32%	52.76%	39.93%	52.21%	54.83%	47.01%	53.39%
Nepal	1996	43.86%	70.98%	42.13%	29.93%	39.48%	36.39%	46.42%	65.52%	35.32%	55.52%	13.13%	17.05%	12.91%	13.61%	10.80%	13.24%	13.42%	14.13%	12.66%	13.75%
Nicaragua	1998	70.64%	75.20%	65.85%	51.06%	73.38%	75.97%	78.24%	76.14%	66.19%	77.24%	43.67%	45.52%	41.70%	37.47%	41.78%	53.14%	42.35%	43.61%	44.09%	42.89%

Niger	1998	18.78%	52.14%	10.57%	8.47%	6.33%	7.44%	26.82%	41.88%	7.43%	34.37%	16.36%	38.80%	12.42%	12.02%	13.81%	9.89%	14.95%	33.34%	11.91%	23.82%
Nigeria	1999	16.71%	31.83%	11.53%	4.63%	2.48%	15.51%	22.97%	38.17%	7.40%	31.23%	56.33%	63.86%	53.72%	38.77%	50.03%	62.63%	60.16%	70.92%	50.88%	65.89%
Peru	1998	59.42%	62.22%	55.69%	50.67%	57.81%	60.07%	64.52%	63.70%	56.22%	64.11%	33.33%	32.09%	34.68%	29.92%	36.21%	32.43%	30.99%	38.83%	32.89%	34.29%
Philippines	1998											44.60%	47.67%	42.53%	43.90%	38.29%	46.05%	46.49%	50.76%	42.72%	48.26%
Rwanda	2000	76.64%	79.01%	76.09%	74.38%	75.19%	73.42%	77.91%	81.99%	74.32%	79.99%	12.96%	14.31%	12.77%	6.17%	12.07%	11.41%	15.11%	23.63%	9.79%	19.10%
Senegal	1997											33.18%	29.36%	34.80%	29.72%	38.52%	34.88%	28.47%	36.03%	33.67%	32.44%
South Africa	1998											61.59%	63.66%	60.36%	66.11%	61.13%	56.59%	58.78%	65.83%	61.28%	62.19%
Tanzania	1997	68.33%	79.38%	66.06%	55.62%	65.08%	68.11%	74.01%	79.12%	62.79%	76.47%	58.68%	69.12%	57.00%	61.58%	60.99%	47.14%	57.00%	69.26%	56.43%	62.18%
Togo	1998	30.40%	45.75%	26.61%	22.74%	22.14%	32.38%	32.95%	42.91%	25.41%	37.83%	18.18%	22.25%	17.27%	13.52%	18.63%	21.68%	19.78%	17.82%	17.73%	18.87%
Turkey	1998	40.30%	44.92%	34.76%	19.30%	38.08%	44.28%	42.97%	56.15%	33.85%	49.46%	35.68%	44.19%	27.81%	28.77%	31.15%	41.22%	40.89%	40.10%	33.44%	40.54%
Uzbekistan	1996	78.54%	70.89%	82.23%	75.16%	77.86%	80.37%	81.09%	78.74%	77.55%	80.07%	39.13%	47.87%	29.23%	0.00%	48.97%	38.44%	37.84%	52.32%	32.03%	45.45%
Vietnam	1997											49.83%	35.69%	51.07%	26.88%	59.96%	55.45%	62.76%	36.08%	47.51%	54.18%
Zambia	1996	79.06%	82.38%	76.69%	78.80%	74.37%	78.65%	80.56%	84.07%	77.33%	81.95%	45.13%	44.27%	45.78%	52.91%	41.67%	42.12%	45.70%	42.22%	45.67%	44.32%
Zimbabwe	1999	64.63%	66.30%	64.00%	64.43%	64.10%	69.82%	55.81%	68.37%	66.07%	62.43%	32.08%	30.99%	32.46%	33.08%	37.47%	35.93%	22.03%	32.83%	35.53%	26.65%
Sample Mean	1998	47.08%	56.76%	43.42%	36.09%	42.52%	46.63%	50.80%	59.55%	41.59%	55.14%	34.89%	41.45%	32.15%	29.43%	34.14%	33.78%	35.73%	42.44%	32.45%	39.08%
Period 2000-2005																					
Bangladesh	2004	74.34%	83.75%	72.03%	65.14%	71.30%	73.14%	78.86%	83.23%	69.79%	81.27%	15.67%	30.05%	12.46%	8.20%	20.18%	19.30%	6.55%	28.28%	15.14%	16.61%
Benin	2001	58.03%	62.31%	55.93%	47.31%	48.26%	53.98%	68.05%	68.51%	49.87%	68.30%	23.11%	30.81%	20.38%	19.20%	17.97%	31.40%	19.86%	29.12%	22.55%	24.07%
Burkina Faso	2003	40.98%	61.68%	38.48%	36.09%	33.62%	43.31%	42.32%	46.05%	38.15%	43.99%	17.02%	32.20%	14.73%	10.54%	14.83%	12.26%	20.22%	25.61%	12.63%	22.77%
Cameroon	2004	46.19%	56.33%	38.32%	34.18%	48.78%	39.00%	43.72%	62.72%	41.53%	53.10%	20.30%	27.78%	16.50%	19.45%	16.26%	20.45%	23.48%	25.14%	18.62%	24.27%
Chad	2004	13.05%	21.44%	10.57%	13.65%	5.99%	4.16%	16.73%	25.18%	7.68%	20.94%	17.51%	35.79%	12.93%	10.48%	7.87%	15.83%	19.41%	35.89%	11.30%	27.16%
Colombia	2005	58.47%	62.53%	50.72%	72.87%	60.85%	58.63%	53.38%	48.11%	63.88%	50.77%	30.83%	30.72%	31.01%	29.72%	29.95%	29.30%	32.38%	31.81%	29.63%	32.11%
Dominican Rep	2002	33.12%	34.22%	31.18%	27.57%	30.19%	41.97%	32.34%	34.43%	32.96%	33.35%	36.74%	34.95%	39.77%	37.25%	36.50%	36.52%	34.63%	39.01%	36.77%	36.68%
Egypt	2004	82.32%	82.49%	82.25%	83.12%	84.71%	85.61%	81.33%	76.73%	84.49%	78.98%	45.16%	50.99%	43.03%	45.79%	46.37%	45.19%	43.15%	44.96%	45.81%	44.16%
Ethiopia	2005	20.61%	49.02%	18.76%	20.02%	19.61%	23.38%	18.12%	21.81%	20.95%	20.11%	21.98%	36.41%	21.34%	18.27%	19.25%	21.48%	17.10%	35.70%	19.63%	26.29%
Ghana	2003	67.76%	76.90%	63.72%	52.12%	62.20%	75.17%	75.50%	75.02%	62.26%	75.25%	28.29%	42.42%	23.34%	29.20%	17.50%	25.37%	34.72%	39.17%	23.55%	36.50%
Indonesia	2003											51.43%	55.81%	47.25%	46.54%	47.47%	50.69%	54.93%	60.39%	48.34%	57.44%
Kenya	2003	52.05%	52.98%	51.88%	50.63%	54.37%	49.10%	53.37%	52.82%	51.44%	53.09%	30.20%	30.64%	30.10%	26.05%	32.17%	30.20%	28.60%	34.62%	29.44%	31.48%
Lesotho	2004	68.97%	71.50%	68.57%	67.23%	60.07%	73.35%	76.78%	68.46%	66.33%	72.73%	29.55%	39.45%	28.84%	19.11%	31.14%	35.95%	34.15%	28.24%	28.45%	31.81%
Madagascar	2004	51.88%	67.85%	48.40%	30.22%	46.64%	41.97%	55.69%	77.80%	39.94%	68.57%	28.73%	37.77%	26.87%	28.97%	23.43%	17.64%	43.04%	33.25%	24.15%	38.71%
Mali	2001	30.07%	51.26%	22.29%	22.43%	22.48%	16.89%	28.00%	58.60%	20.60%	43.76%	12.68%	33.97%	8.22%	6.93%	6.58%	11.21%	12.90%	30.95%	8.36%	20.94%
Mauritania	2001	35.38%	42.97%	29.41%	18.88%	23.69%	47.97%	45.94%	41.59%	30.02%	43.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Morocco	2004	87.78%	93.97%	82.14%	85.48%	81.06%	92.41%	92.03%	88.25%	86.29%	90.05%	22.71%	29.76%	17.36%	20.44%	21.44%	24.97%	30.70%	17.83%	22.19%	23.55%
Mozambique	2003	65.79%	82.04%	57.58%	52.11%	52.35%	58.97%	72.32%	91.69%	54.33%	81.77%	48.88%	51.81%	47.08%	37.04%	43.50%	60.13%	58.55%	47.59%	46.27%	52.59%
Nepal	2001	64.92%	75.42%	64.16%	48.83%	58.37%	71.04%	69.32%	77.71%	59.40%	73.95%	20.73%	22.09%	20.65%	15.94%	18.77%	25.98%	22.34%	20.77%	20.28%	21.58%

Nicaragua	2001	62.69%	66.79%	58.95%	51.62%	71.25%	71.58%	58.61%	60.89%	64.62%	59.68%	44.56%	48.14%	41.60%	36.04%	49.67%	44.69%	51.39%	42.12%	43.34%	46.46%
Nigeria	2003	11.59%	22.44%	7.10%	0.54%	4.58%	5.08%	11.77%	34.75%	3.52%	23.19%	21.78%	26.37%	20.38%	7.98%	18.70%	29.61%	31.74%	30.96%	17.30%	31.49%
Peru	2004											47.17%	42.51%	52.38%	48.30%	44.80%	47.85%	43.91%	49.95%	46.92%	47.52%
Philippines	2003											32.22%	37.29%	27.27%	25.03%	28.85%	31.92%	35.61%	40.94%	28.63%	38.30%
Senegal	2005	59.63%	64.95%	56.54%	60.22%	50.30%	54.89%	58.44%	75.57%	55.31%	66.36%	20.84%	20.77%	20.89%	19.16%	19.91%	23.75%	18.25%	23.44%	20.88%	20.79%
Tanzania	2004	26.02%	33.14%	24.71%	26.20%	19.66%	21.70%	29.41%	34.20%	22.46%	31.84%	46.03%	48.84%	45.60%	46.35%	49.35%	51.51%	33.69%	47.74%	49.05%	40.63%
Uganda	2001	36.64%	45.13%	35.72%	36.19%	33.77%	34.95%	35.85%	42.82%	34.97%	39.26%	44.58%	66.09%	42.72%	39.09%	37.18%	53.00%	42.54%	55.18%	42.58%	48.19%
Vietnam	2002											58.50%	51.09%	58.92%	43.59%	62.13%	65.95%	70.62%	63.84%	56.35%	68.19%
Zambia	2002	70.06%	76.10%	67.56%	64.51%	62.53%	65.84%	76.24%	81.27%	64.27%	78.69%	42.44%	42.80%	42.27%	40.61%	38.38%	46.93%	39.66%	48.70%	41.73%	43.63%
Sample Mean	2003	50.76%	59.88%	47.37%	44.46%	46.11%	50.17%	53.09%	59.51%	46.88%	56.37%	30.70%	37.05%	29.07%	26.26%	28.58%	32.47%	32.29%	36.11%	28.92%	34.07%

Source: Author's calculations using DHS datasets and population weights. Note: N (National) U(Urban) R(Rural) Q1(Very Poor) Q2(Poor) Q3(Average) Q4(Rich) Q5(Very Rich) P(Poor Q1-Q3) Ri(Rich Q4-Q5)

Table A9 (C'd): Access to Health Care Services by Areas of Residency and Quintiles.

	Medical delivery										
	Year	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri
	Period 1990-1995										
Bangladesh	1994	14.24%	42.53%	11.22%	4.30%	7.13%	11.23%	16.72%	32.20%	7.54%	24.44%
Bolivia	1994	45.52%	64.77%	25.44%	10.18%	26.35%	43.06%	60.34%	89.60%	26.22%	74.88%
Brazil	1991	77.71%	90.19%	65.18%	53.31%	64.51%	81.31%	92.48%	97.16%	66.35%	94.82%
Burkina Faso	1993	61.97%	93.86%	56.80%	52.05%	53.91%	60.84%	61.21%	82.73%	55.33%	71.99%
CAR	1995	51.68%	79.99%	25.42%	14.84%	28.78%	54.56%	76.64%	85.35%	33.22%	81.16%
Cameroon	1991	64.71%	81.71%	53.80%	51.47%	42.56%	60.89%	76.11%	92.69%	51.62%	84.41%
Colombia	1993	79.98%	89.51%	64.80%	50.74%	73.48%	85.44%	93.84%	96.85%	69.90%	95.27%
Cote d'Ivoire	1994	46.29%	74.97%	33.76%	21.59%	35.33%	43.72%	57.23%	73.90%	33.48%	65.56%
Dominican Rep	1991	97.41%	98.74%	95.64%	93.60%	97.11%	98.86%	99.18%	98.34%	96.52%	98.77%
Egypt	1994	37.77%	59.76%	27.97%	18.64%	24.11%	28.97%	47.12%	74.79%	23.95%	59.51%
Ghana	1993	55.95%	85.29%	46.18%	29.48%	45.98%	53.43%	67.50%	83.86%	42.90%	75.72%
Guatemala	1995	79.40%	94.36%	73.08%	56.16%	70.25%	85.78%	89.47%	95.61%	70.67%	92.50%
Haiti	1995	46.21%	66.93%	37.43%	25.60%	33.09%	51.00%	53.56%	69.38%	36.20%	61.47%
India	1993	39.75%	70.07%	31.40%	26.60%	29.30%	48.22%	56.02%	38.14%	34.68%	47.36%
Indonesia	1993	38.27%	72.55%	24.06%	14.78%	24.07%	36.73%	44.47%	71.78%	25.11%	58.05%
Kenya	1993	50.69%	83.52%	46.89%	31.74%	46.93%	45.59%	58.97%	70.22%	41.43%	64.59%
Madagascar	1992	58.18%	82.68%	54.55%	44.44%	49.49%	54.79%	60.27%	83.58%	49.70%	71.93%
Malawi	1992	67.53%	90.19%	64.33%	60.09%	60.61%	62.00%	70.79%	84.24%	60.89%	77.50%
Morocco	1992	26.82%	63.05%	12.19%	3.36%	8.69%	17.63%	34.33%	70.26%	9.86%	52.26%
Namibia	1992	66.43%	85.17%	59.07%	56.74%	60.14%	55.32%	71.25%	89.10%	57.37%	80.26%
Niger	1992	34.56%	79.38%	25.35%	17.68%	23.42%	22.69%	35.08%	74.35%	21.16%	54.79%
Nigeria	1990	35.49%	59.51%	29.56%	25.41%	29.82%	23.83%	35.20%	63.25%	26.34%	49.23%
Pakistan	1991	55.63%	69.71%	49.02%	42.85%	43.70%	52.92%	61.25%	77.61%	46.46%	69.40%
Paraguay	1990	62.68%	85.69%	45.56%	38.28%	44.38%	60.31%	83.99%	88.23%	47.41%	85.69%
Peru	1992	81.62%	91.38%	65.69%	63.05%	71.98%	84.51%	91.97%	96.94%	73.07%	94.46%
Philippines	1993	93.27%	96.70%	89.97%	82.67%	92.72%	95.88%	96.42%	98.69%	90.41%	97.55%
Rwanda	1992	65.83%	87.03%	64.69%	62.75%	65.31%	65.04%	66.09%	70.61%	64.24%	68.31%
Senegal	1993	46.00%	83.17%	30.34%	13.97%	31.77%	36.04%	63.51%	85.04%	27.28%	74.27%
Tanzania	1992	53.89%	86.92%	46.49%	38.84%	42.18%	49.59%	64.21%	74.69%	43.53%	69.44%
Turkey	1993	68.12%	82.97%	52.31%	90.15%	86.86%	74.59%	53.01%	34.34%	84.25%	43.88%
Uganda	1995	37.76%	78.88%	32.62%	18.69%	30.11%	34.40%	35.13%	70.86%	27.92%	53.77%
Yemen	1992	66.30%	75.26%	64.28%	65.29%	64.91%	65.50%	64.96%	70.89%	65.23%	67.91%
Zambia	1992	53.01%	80.32%	28.86%	22.98%	26.48%	48.87%	76.98%	90.35%	32.62%	83.60%
Zimbabwe	1994	81.18%	92.87%	77.89%	69.70%	78.74%	82.10%	83.68%	91.86%	76.81%	87.72%
Sample Mean	1993	57.11%	79.99%	47.41%	40.35%	47.48%	55.17%	64.68%	78.46%	47.64%	71.54%
	Period 1995-2000										
Bangladesh	1999	20.07%	47.23%	16.14%	9.33%	11.80%	11.17%	21.70%	46.39%	10.77%	34.04%
Benin	1996	63.86%	80.75%	56.49%	40.56%	54.49%	58.66%	75.16%	92.55%	50.77%	83.96%
Bolivia	1998	54.75%	74.87%	30.45%	17.06%	33.65%	53.86%	76.46%	92.94%	34.84%	84.69%
Brazil	1996	92.48%	96.43%	81.30%	75.66%	93.60%	95.65%	98.48%	99.04%	88.29%	98.76%
Burkina Faso	1999	48.08%	92.93%	43.79%	40.39%	38.99%	40.09%	50.23%	71.18%	39.83%	60.78%
Cameroon	1998	58.44%	82.68%	49.19%	34.00%	42.38%	53.14%	81.26%	82.27%	42.90%	81.76%
Chad	1997	26.17%	51.37%	18.59%	14.77%	20.54%	15.97%	27.32%	53.92%	16.68%	40.75%
Colombia	2000	84.51%	93.36%	66.83%	65.92%	76.26%	85.23%	97.49%	98.43%	75.96%	97.97%
Comoros	1996	51.99%	80.61%	43.39%	25.54%	38.39%	55.72%	61.16%	82.06%	39.51%	70.80%
Cote d'Ivoire	1999	45.67%	80.23%	32.47%	12.14%	26.58%	48.50%	61.40%	80.31%	29.21%	70.98%

Dominican Rep	1996	95.07%	97.73%	91.42%	86.37%	95.65%	96.86%	97.47%	99.06%	92.94%	98.27%
Egypt	2000	54.16%	76.45%	43.94%	42.22%	46.83%	53.63%	67.24%	61.41%	47.56%	64.29%
Ethiopia	2000	9.67%	44.86%	5.72%	4.09%	4.73%	4.89%	7.75%	27.20%	4.56%	17.33%
Gabon	2000	87.06%	92.57%	72.17%	70.99%	84.31%	89.62%	93.89%	96.84%	81.53%	95.36%
Ghana	1998	64.20%	87.04%	57.87%	39.71%	50.67%	57.43%	84.21%	89.24%	49.21%	86.72%
Guatemala	1999	82.37%	94.86%	75.79%	58.52%	77.93%	87.24%	91.00%	97.40%	74.61%	94.13%
Guinea	1999	41.28%	80.67%	26.26%	15.88%	24.80%	30.85%	50.13%	85.83%	23.64%	67.84%
Haiti	2000	57.08%	76.85%	48.75%	41.22%	46.32%	53.61%	62.86%	81.57%	47.02%	72.19%
India	1999	41.32%	72.51%	32.76%	19.03%	35.46%	36.49%	41.27%	74.74%	30.24%	57.95%
Indonesia	1997	48.97%	79.35%	37.27%	26.15%	42.01%	46.36%	56.89%	73.55%	38.18%	65.16%
Kenya	1998	53.78%	77.53%	49.30%	31.92%	46.11%	55.28%	63.22%	73.22%	44.55%	68.37%
Madagascar	1997	47.50%	67.65%	42.41%	29.20%	36.41%	42.64%	54.09%	80.32%	34.67%	67.17%
Malawi	2000	56.59%	82.30%	52.83%	47.98%	52.18%	48.80%	56.35%	77.68%	49.65%	67.01%
Mali	1996	42.17%	80.98%	26.77%	13.69%	22.45%	35.83%	53.40%	85.66%	23.94%	69.52%
Mozambique	1997	48.05%	81.86%	37.22%	17.61%	25.89%	45.68%	70.54%	81.48%	29.57%	75.79%
Namibia	2000	73.45%	93.27%	65.05%	55.51%	60.39%	75.14%	85.08%	91.70%	63.49%	88.39%
Nepal	1996	10.26%	48.34%	7.86%	8.61%	7.82%	6.01%	10.90%	18.29%	7.48%	14.44%
Nicaragua	1998	62.43%	83.21%	41.13%	28.36%	45.91%	68.20%	81.28%	89.50%	47.40%	85.26%
Niger	1998	43.97%	78.98%	36.71%	28.08%	37.41%	34.27%	50.99%	70.45%	33.13%	60.92%
Nigeria	1999	39.54%	53.04%	34.63%	15.65%	18.71%	34.13%	60.39%	68.88%	22.82%	64.63%
Peru	1998	55.96%	81.27%	23.28%	13.99%	28.75%	61.44%	82.85%	93.10%	34.72%	87.91%
Philippines	1998	55.34%	77.82%	36.34%	17.73%	34.95%	60.13%	80.30%	84.55%	37.52%	82.09%
Rwanda	2000	31.56%	68.93%	23.97%	17.67%	19.16%	23.94%	29.91%	67.47%	20.16%	48.67%
Senegal	1997	58.52%	90.87%	43.32%	26.42%	39.06%	57.54%	80.66%	91.35%	40.37%	86.00%
South Africa	1998	83.03%	93.45%	74.62%	64.83%	79.80%	84.32%	92.59%	93.85%	76.38%	93.21%
Tanzania	1997	53.05%	83.99%	47.17%	35.26%	45.56%	46.60%	57.68%	82.52%	42.40%	69.37%
Togo	1998	46.31%	84.62%	35.86%	23.44%	33.98%	36.48%	55.52%	83.02%	31.21%	69.23%
Turkey	1998	74.26%	83.33%	63.80%	41.86%	71.96%	79.56%	84.86%	93.35%	64.45%	89.02%
Uzbekistan	1996	97.40%	%	96.13%	88.43%	99.65%	99.32%	%	99.66%	95.78%	99.84%
Vietnam	1997	75.18%	97.88%	71.31%	42.46%	64.08%	81.89%	92.10%	96.31%	62.55%	94.17%
Zambia	1996	48.46%	78.06%	26.92%	19.26%	24.92%	42.71%	75.06%	82.54%	28.86%	77.96%
Zimbabwe	1999	84.99%	95.28%	81.01%	76.50%	83.32%	79.99%	88.68%	96.77%	79.93%	92.77%
Sample Mean	1998	56.41%	80.14%	46.39%	35.33%	45.81%	54.16%	66.90%	80.66%	44.98%	73.70%
Period 2000-2005											
Bangladesh	2004	78.06%	82.06%	77.08%	73.55%	77.86%	75.87%	80.46%	82.64%	75.73%	81.55%
Benin	2001	75.55%	84.17%	71.97%	55.53%	66.05%	73.09%	85.10%	98.09%	64.87%	91.57%
Burkina Faso	2003	55.43%	89.87%	50.84%	39.10%	45.86%	52.34%	55.60%	80.10%	46.20%	66.63%
Cameroon	2004	59.40%	82.96%	42.87%	27.52%	42.00%	60.94%	75.81%	91.25%	43.31%	83.53%
Chad	2004	23.24%	60.46%	13.18%	12.25%	11.59%	11.73%	22.48%	58.22%	11.86%	40.32%
Colombia	2005	89.21%	96.63%	74.18%	98.75%	98.52%	94.22%	84.72%	69.78%	97.16%	77.27%
Dominican Rep	2002	97.44%	98.76%	95.06%	96.08%	95.84%	98.75%	98.03%	98.51%	96.89%	98.27%
Egypt	2004	66.97%	85.31%	59.51%	55.70%	66.87%	72.21%	75.58%	64.69%	64.92%	70.10%
Ethiopia	2005	11.45%	53.90%	8.48%	6.41%	4.60%	9.76%	9.70%	26.74%	6.95%	18.24%
Ghana	2003	43.60%	79.35%	28.62%	18.48%	22.92%	34.76%	55.67%	86.40%	25.38%	71.06%
Indonesia	2003	65.43%	77.79%	54.35%	39.00%	51.57%	66.61%	79.57%	90.48%	52.40%	84.99%
Kenya	2003	38.67%	70.50%	32.37%	24.13%	30.63%	32.11%	34.54%	72.21%	28.99%	53.86%
Lesotho	2004	53.86%	87.43%	49.93%	32.26%	42.07%	54.20%	63.52%	78.76%	42.40%	71.15%
Madagascar	2004	49.01%	75.05%	43.29%	24.60%	32.17%	42.98%	57.37%	87.97%	33.25%	72.68%
Mali	2001	42.16%	84.86%	28.27%	30.98%	24.27%	29.23%	43.40%	82.96%	28.16%	63.15%
Mauritania	2001	59.69%	89.03%	34.83%	26.21%	44.69%	59.64%	74.37%	94.06%	43.47%	84.22%

Morocco	2004	57.91%	84.22%	37.21%	47.00%	45.31%	68.28%	74.20%	53.79%	53.53%	64.48%
Mozambique	2003	51.49%	83.00%	36.26%	27.51%	32.45%	42.36%	66.55%	89.20%	33.95%	77.83%
Nepal	2001	12.82%	50.65%	10.37%	2.95%	4.78%	10.65%	9.72%	36.14%	6.18%	23.46%
Nicaragua	2001	88.48%	95.83%	81.59%	77.03%	85.45%	90.71%	96.65%	92.61%	84.39%	94.63%
Nigeria	2003	33.95%	52.77%	26.65%	9.11%	17.45%	25.69%	41.96%	75.70%	17.43%	58.90%
Peru	2004	72.31%	91.34%	47.30%	42.63%	77.03%	89.23%	98.05%	54.76%	69.70%	76.26%
Philippines	2003	57.83%	78.00%	38.46%	22.64%	38.53%	58.26%	73.63%	86.28%	40.11%	80.27%
Senegal	2005	67.16%	92.10%	53.15%	35.29%	54.13%	68.65%	83.94%	94.98%	52.77%	89.58%
Tanzania	2004	54.80%	82.96%	49.09%	40.89%	53.74%	46.59%	52.53%	80.32%	47.07%	66.40%
Uganda	2001	38.47%	79.06%	34.14%	23.32%	24.76%	34.20%	39.47%	70.92%	27.42%	55.05%
Vietnam	2002	82.61%	99.32%	78.96%	50.60%	74.52%	91.88%	97.50%	98.76%	72.40%	98.13%
Zambia	2002	45.08%	80.30%	28.63%	20.40%	23.91%	31.00%	61.02%	89.14%	25.10%	75.09%
Sample Mean	2003	56.15%	80.99%	45.95%	37.85%	46.06%	54.50%	63.97%	78.05%	46.14%	71.02%

Source: Author's calculations using DHS datasets and population weights.

Note: N (National) U(Urban) R(Rural) Q1 (Very Poor) Q2(Poor) Q3(Average) Q4(Rich) Q5(Very Rich) P(Poor Q1-Q3) Ri(Rich Q4-Q5)

Table A10: Access to Sanitation Infrastructures by Areas of Residency and Quintiles.

	Tap Water in Residence										Tap (Public & Private)										
	Year	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri
	Period 1990-1995																				
Bangladesh	1994	4.63%	36.36%	0.54%	0.02%	0.34%	0.98%	4.01%	17.88%	0.43%	10.98%	4.63%	36.36%	0.54%	0.02%	0.34%	0.98%	4.01%	17.88%	0.43%	10.98%
Bolivia	1994	53.45%	76.36%	23.25%	0.05%	27.12%	55.73%	88.71%	97.67%	27.54%	93.25%	64.17%	88.55%	32.04%	8.94%	45.69%	76.04%	93.93%	98.16%	43.41%	96.08%
Brazil	1991	51.36%	77.45%	13.17%	0.02%	14.83%	60.00%	88.92%	94.57%	25.08%	91.39%	58.65%	82.86%	23.20%	9.90%	32.25%	67.24%	90.48%	94.57%	36.57%	92.26%
Burkina Faso	1993	5.64%	27.56%	0.96%	0.00%	0.17%	2.43%	2.99%	22.94%	0.80%	13.12%	15.80%	66.99%	4.87%	0.00%	0.17%	2.51%	3.32%	73.49%	0.82%	38.95%
CAR	1995	2.65%	6.24%	0.00%	0.00%	0.00%	0.00%	0.00%	13.27%	0.00%	6.64%	21.73%	49.09%	1.55%	0.00%	2.44%	10.00%	36.53%	60.18%	4.02%	48.36%
Cameroon	1991	12.07%	27.94%	1.99%	0.00%	0.00%	1.73%	13.33%	45.44%	0.58%	29.37%	34.41%	68.13%	12.99%	0.00%	3.96%	24.45%	55.42%	88.51%	9.47%	71.95%
							100.00	100.00	100.00		100.00						100.00	100.00			100.00
Colombia	1995	74.11%	95.28%	28.65%	20.06%	51.74%	98.89%	%	%	57.70%	%	84.29%	97.76%	55.36%	37.52%	84.22%	99.82%	%	%	74.34%	100.00
Cote d'Ivoire	1994	23.98%	55.38%	5.13%	0.00%	0.17%	0.38%	24.66%	94.76%	0.18%	59.71%	45.43%	77.23%	26.33%	13.60%	28.96%	30.25%	57.25%	97.61%	24.10%	77.43%
Dominican Rep	1991	66.41%	81.67%	43.01%	15.39%	74.07%	89.68%	75.94%	77.07%	59.68%	76.51%	66.41%	81.67%	43.01%	15.39%	74.07%	89.68%	75.94%	77.07%	59.68%	76.51%
Egypt	1995	70.17%	91.30%	53.36%	7.12%	58.66%	88.85%	98.74%	99.91%	50.94%	99.28%	80.93%	95.80%	69.10%	42.60%	72.56%	92.42%	98.79%	99.91%	68.79%	99.30%
Ghana	1993	13.65%	38.43%	1.81%	0.00%	2.80%	0.62%	16.88%	48.14%	1.13%	32.58%	32.30%	75.33%	11.74%	0.00%	3.63%	2.70%	61.25%	94.52%	2.09%	77.96%
Guatemala	1995	58.24%	64.31%	54.35%	21.77%	63.22%	66.93%	80.37%	60.44%	50.52%	70.26%	64.50%	70.04%	60.96%	34.36%	71.52%	73.73%	83.25%	60.89%	59.74%	71.91%
Haiti	1995	12.08%	30.18%	1.77%	0.00%	1.42%	5.93%	20.20%	33.11%	2.44%	26.64%	35.97%	50.80%	27.52%	0.00%	31.74%	44.13%	58.09%	47.14%	24.94%	52.63%
India	1993	17.96%	48.20%	7.13%	0.00%	0.00%	0.20%	17.86%	71.79%	0.06%	44.82%	31.47%	68.56%	18.18%	1.85%	14.96%	22.37%	39.89%	79.28%	12.74%	59.58%
Indonesia	1994	10.52%	27.25%	3.03%	0.78%	6.24%	15.30%	13.83%	16.47%	7.45%	15.16%	15.88%	37.70%	6.11%	3.50%	10.95%	21.62%	20.62%	22.72%	12.04%	21.67%
									100.00										100.00		
Kazakhstan	1995	59.27%	88.29%	33.75%	3.47%	25.16%	73.59%	95.00%	%	33.94%	97.36%	81.11%	96.32%	67.74%	57.17%	67.18%	84.47%	97.16%	%	69.55%	98.50%
Kenya	1993	16.04%	58.24%	9.47%	1.11%	5.12%	12.04%	25.57%	36.47%	6.05%	31.02%	27.19%	86.49%	17.96%	1.29%	8.24%	22.77%	44.94%	58.92%	10.70%	51.93%
Madagascar	1992	5.29%	28.85%	0.84%	0.00%	2.36%	2.00%	1.21%	20.95%	1.43%	11.25%	17.00%	77.62%	5.55%	0.00%	2.45%	2.14%	13.66%	67.30%	1.51%	40.93%
Malawi	1992	6.11%	37.05%	1.78%	0.00%	0.00%	0.42%	2.81%	27.37%	0.13%	15.10%	25.65%	82.97%	17.62%	0.00%	2.08%	13.28%	48.01%	65.86%	4.84%	56.94%
Morocco	1992	39.52%	77.87%	9.16%	0.00%	0.30%	13.94%	83.69%	99.72%	4.74%	91.70%	51.69%	94.33%	17.92%	0.93%	16.12%	50.35%	91.43%	99.72%	22.43%	95.57%
Namibia	1992	30.53%	84.08%	8.02%	0.00%	0.00%	0.11%	53.68%	98.91%	0.03%	76.28%	49.74%	96.27%	30.18%	10.03%	19.31%	45.55%	75.95%	99.12%	24.54%	87.53%
Niger	1992	5.39%	27.57%	0.83%	0.00%	0.11%	0.06%	2.23%	24.82%	0.05%	14.14%	16.70%	66.94%	6.38%	0.00%	0.11%	0.21%	14.43%	70.33%	0.10%	43.92%
Nigeria	1990	10.58%	33.52%	3.49%	0.02%	0.07%	0.34%	4.13%	48.32%	0.14%	26.23%	23.70%	62.23%	11.81%	0.02%	0.07%	10.37%	31.55%	76.52%	3.48%	54.04%
Pakistan	1991	28.59%	68.64%	10.18%	0.00%	0.07%	7.34%	43.79%	92.26%	2.42%	68.10%	35.65%	79.59%	15.46%	0.07%	3.08%	21.67%	57.46%	96.77%	8.15%	77.17%
Paraguay	1990	27.02%	51.64%	2.28%	0.02%	1.26%	7.84%	42.16%	83.91%	3.02%	63.02%	27.94%	53.20%	2.56%	0.02%	1.66%	10.82%	43.40%	83.91%	4.15%	63.64%
Peru	1992	63.48%	79.97%	21.23%	2.71%	32.49%	83.14%	99.34%	99.81%	39.43%	99.57%	71.22%	88.24%	27.65%	13.11%	55.50%	88.35%	99.42%	99.81%	52.31%	99.61%
Philippines	1993	28.76%	44.62%	11.95%	0.84%	4.35%	14.89%	49.53%	75.03%	6.68%	61.89%	37.64%	53.90%	20.39%	10.86%	19.48%	27.94%	54.86%	75.73%	19.41%	64.98%
Rwanda	1992	1.77%	28.04%	0.31%	0.00%	0.02%	0.79%	1.20%	7.11%	0.25%	4.07%	22.69%	68.12%	20.15%	0.00%	0.02%	2.62%	36.34%	76.28%	0.83%	55.67%
Senegal	1993	26.60%	56.90%	8.54%	0.00%	0.00%	1.12%	39.91%	92.80%	0.38%	66.54%	44.55%	84.90%	20.48%	0.05%	4.06%	39.47%	81.56%	98.51%	14.64%	90.09%
Tanzania	1992	10.23%	38.35%	2.36%	0.01%	0.10%	1.58%	16.33%	37.10%	0.56%	24.75%	30.68%	75.35%	18.18%	0.01%	0.18%	7.66%	66.52%	82.14%	2.59%	72.85%
Turkey	1993	60.93%	75.66%	38.50%	80.11%	90.39%	80.33%	53.07%	0.00%	83.82%	26.49%	70.07%	79.93%	55.03%	80.11%	90.39%	82.57%	71.30%	25.47%	84.49%	48.35%
Uganda	1995	1.80%	14.10%	0.14%	0.00%	0.00%	0.00%	0.37%	8.72%	0.00%	4.65%	5.97%	43.64%	0.88%	0.00%	0.00%	0.01%	2.34%	27.86%	0.00%	15.42%
Yemen	1992	33.21%	83.62%	21.20%	0.00%	10.11%	20.69%	48.57%	86.85%	10.22%	67.70%	37.17%	88.73%	24.89%	1.33%	13.67%	25.75%	54.75%	90.54%	13.53%	72.64%
Zambia	1992	31.41%	61.54%	3.45%	0.16%	1.74%	1.45%	92.07%	47.95%	5.91%	69.97%	49.33%	91.38%	10.31%	0.16%	1.85%	49.09%	99.37%	98.91%	16.38%	99.14%
Zimbabwe	1994	26.68%	93.33%	3.24%	0.00%	0.00%	1.59%	36.92%	96.49%	0.53%	65.99%	34.69%	97.42%	12.63%	0.00%	16.74%	11.54%	48.16%	98.36%	9.43%	72.66%
Sample Mean		28.29%	54.74%	12.25%	4.39%	13.55%	23.60%	41.09%	59.37%	13.84%	50.16%	40.48%	74.70%	22.78%	9.79%	22.85%	35.84%	57.47%	77.26%	22.75%	67.35%
	Period 1995-2000																				
Armenia	2000	86.26%	96.51%	72.22%	59.22%	79.85%	93.88%	98.65%	99.87%	77.60%	99.26%	91.58%	98.13%	82.62%	73.16%	87.83%	97.66%	99.39%	%	86.18%	99.69%
Bangladesh	2000	6.11%	30.70%	0.40%	0.00%	0.00%	0.00%	1.03%	29.56%	0.00%	15.37%	6.11%	30.70%	0.40%	0.00%	0.00%	0.00%	1.03%	29.56%	0.00%	15.37%
Benin	1996	23.15%	51.75%	6.50%	0.00%	3.94%	10.42%	32.02%	69.71%	4.79%	50.98%	28.64%	54.13%	13.81%	3.50%	12.53%	18.42%	37.36%	71.77%	11.47%	54.67%
Bolivia	1998	66.32%	86.15%	31.22%	8.48%	48.40%	81.53%	94.53%	99.01%	46.14%	96.78%	74.64%	91.96%	43.98%	20.95%	66.96%	89.67%	96.50%	99.47%	59.17%	97.99%

Brazil	1996	71.91%	84.44%	24.77%	19.74%	61.17%	91.19%	91.02%	96.43%	57.39%	93.72%	71.91%	84.44%	24.77%	19.74%	61.17%	91.19%	91.02%	96.43%	57.39%	93.72%
Burkina Faso	1999	3.62%	24.88%	0.09%	0.00%	0.00%	0.00%	0.67%	17.57%	0.00%	9.06%	11.91%	72.64%	1.83%	0.00%	0.00%	0.00%	5.07%	54.92%	0.00%	29.81%
Cameroon	1998	11.34%	29.40%	2.81%	0.00%	0.54%	6.03%	21.68%	28.83%	2.21%	25.23%	34.73%	72.07%	17.11%	0.00%	11.62%	34.92%	53.50%	74.45%	15.56%	63.90%
Chad	1997	3.36%	13.76%	0.22%	0.00%	0.00%	0.00%	0.25%	16.56%	0.00%	8.43%	9.04%	24.60%	4.33%	0.00%	1.88%	3.07%	12.27%	28.68%	1.43%	20.50%
								100.00	100.00		100.00						100.00	100.00	100.00		100.00
Colombia	2000	84.20%	97.70%	50.34%	40.51%	82.90%	98.09%	%	%	75.50%	%	84.31%	97.78%	50.54%	40.95%	83.02%	98.09%	%	%	75.68%	%
Comoros	1996	22.67%	42.52%	15.06%	0.21%	37.22%	12.72%	26.65%	41.25%	15.18%	33.93%	49.33%	72.71%	40.37%	69.22%	53.29%	26.94%	45.25%	48.64%	50.93%	46.94%
Cote d'Ivoire	1999	27.93%	64.58%	6.73%	0.00%	0.56%	7.47%	41.60%	90.53%	2.65%	66.05%	51.05%	79.94%	34.34%	25.24%	33.32%	34.50%	68.18%	94.61%	30.93%	81.38%
Dominican Rep	1999	39.38%	39.46%	39.23%	47.23%	59.01%	50.73%	25.12%	13.37%	52.31%	19.79%	40.29%	39.75%	41.21%	51.25%	59.52%	50.73%	25.12%	13.37%	53.82%	19.79%
Egypt	2000	78.03%	96.63%	64.11%	41.57%	65.60%	88.23%	95.57%	99.43%	65.07%	97.50%	85.08%	98.79%	74.82%	59.66%	77.00%	92.29%	97.05%	99.57%	76.28%	98.31%
Ethiopia	2000	4.21%	29.57%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	21.15%	0.00%	10.57%	15.83%	80.24%	5.14%	0.00%	0.00%	16.05%	63.38%	0.00%	39.71%
Gabon	2000	43.03%	55.06%	8.84%	0.07%	7.99%	31.20%	76.17%	99.83%	13.09%	87.99%	73.38%	92.25%	19.77%	14.84%	61.16%	93.27%	97.72%	99.95%	56.43%	98.83%
Ghana	1998	15.38%	42.30%	2.77%	0.00%	0.43%	5.27%	26.98%	45.35%	1.92%	35.98%	36.56%	85.01%	13.87%	0.00%	0.79%	9.48%	77.61%	97.32%	3.46%	87.25%
Guatemala	1999	57.60%	61.12%	55.05%	32.81%	67.51%	66.63%	74.28%	46.97%	55.56%	60.65%	62.51%	64.63%	60.98%	44.01%	74.25%	71.70%	75.47%	47.30%	63.25%	61.41%
Guinea	1999	9.62%	29.77%	1.24%	0.00%	0.38%	1.26%	7.81%	38.87%	0.52%	23.27%	20.56%	59.80%	4.25%	0.10%	1.56%	4.47%	23.48%	73.73%	1.96%	48.49%
Haiti	2000	10.71%	22.18%	4.21%	0.13%	5.99%	7.13%	13.29%	27.20%	4.41%	20.17%	52.49%	82.25%	35.62%	7.88%	38.85%	50.21%	76.56%	89.24%	32.27%	82.84%
India	1999	20.61%	51.80%	9.35%	0.00%	0.00%	2.83%	24.91%	75.85%	0.88%	50.22%	36.48%	73.08%	23.28%	11.49%	28.11%	18.48%	44.28%	79.85%	19.51%	61.95%
Indonesia	1997	13.94%	34.26%	5.40%	3.70%	14.74%	18.11%	18.94%	14.20%	12.18%	16.57%	18.88%	42.73%	8.87%	8.38%	20.38%	24.14%	23.51%	18.02%	17.63%	20.76%
Kazakhstan	1999	50.15%	81.93%	22.45%	13.11%	15.33%	35.00%	89.14%	98.89%	21.14%	93.93%	59.42%	87.25%	35.17%	27.48%	33.35%	46.71%	90.97%	99.17%	35.84%	95.00%
Kenya	1998	19.54%	57.85%	10.84%	0.00%	0.02%	7.46%	27.15%	64.45%	2.30%	45.73%	28.94%	82.46%	16.80%	2.60%	3.42%	25.55%	41.02%	74.74%	9.95%	57.81%
Kyrgyz Republic	1997	43.53%	84.58%	25.56%	0.00%	7.68%	36.65%	77.63%	96.17%	14.76%	86.71%	69.98%	96.09%	58.55%	57.61%	44.74%	65.91%	83.21%	98.80%	56.08%	90.84%
Madagascar	1997	5.90%	17.11%	2.27%	0.00%	0.10%	1.45%	4.19%	23.89%	0.49%	14.04%	17.11%	55.37%	4.71%	0.00%	0.10%	6.86%	12.74%	66.35%	2.18%	39.54%
Malawi	2000	7.74%	44.53%	1.73%	0.00%	0.18%	0.46%	4.57%	33.52%	0.21%	19.06%	23.51%	84.40%	13.56%	1.15%	7.00%	17.19%	28.73%	63.54%	8.44%	46.15%
Mali	1996	5.66%	18.03%	0.69%	0.22%	1.10%	1.45%	3.99%	21.57%	0.92%	12.78%	16.80%	50.21%	3.37%	0.22%	2.09%	4.01%	15.70%	62.01%	2.10%	38.85%
Mozambique	1997	6.55%	25.92%	0.81%	0.00%	1.03%	1.15%	10.18%	20.75%	0.72%	15.34%	24.31%	74.23%	9.52%	0.00%	4.63%	17.68%	32.59%	68.68%	7.13%	50.23%
Namibia	2000	37.29%	79.30%	16.48%	0.80%	2.65%	17.54%	66.17%	99.69%	6.87%	82.92%	58.09%	97.98%	38.33%	19.93%	27.33%	54.54%	89.52%	99.83%	33.70%	94.68%
Nepal	1996	9.47%	45.68%	6.15%	5.00%	1.58%	3.71%	16.77%	20.73%	3.52%	18.80%	30.35%	56.12%	27.99%	15.68%	8.03%	30.38%	38.20%	59.62%	18.34%	49.20%
Nicaragua	1998	61.55%	88.35%	22.59%	3.75%	36.20%	78.65%	94.10%	98.14%	38.79%	96.05%	64.98%	89.74%	29.00%	11.40%	43.78%	80.23%	94.36%	98.21%	44.38%	96.22%
Niger	1998	6.09%	31.29%	0.20%	0.00%	0.00%	0.53%	4.00%	26.17%	0.18%	15.19%	18.67%	68.77%	6.96%	0.00%	0.00%	0.56%	36.36%	57.64%	0.19%	47.10%
Nigeria	1999	10.28%	25.97%	3.84%	0.10%	4.18%	3.11%	7.83%	36.25%	2.46%	22.03%	23.81%	50.06%	13.02%	4.06%	11.04%	14.94%	33.39%	55.70%	10.01%	44.54%
Peru	2000	66.16%	82.65%	37.56%	12.93%	54.54%	71.92%	92.46%	99.81%	46.28%	96.00%	72.40%	87.96%	45.40%	23.77%	65.60%	79.09%	94.45%	99.84%	55.97%	97.05%
Philippines	1998	37.18%	55.13%	19.19%	3.50%	29.20%	49.95%	56.04%	47.30%	27.53%	51.68%	48.65%	66.42%	30.83%	17.87%	46.14%	62.92%	63.66%	52.71%	42.29%	58.20%
Rwanda	2000	6.28%	35.71%	0.98%	0.00%	0.06%	0.10%	1.59%	29.77%	0.05%	15.93%	35.69%	76.97%	28.25%	0.21%	26.33%	34.71%	46.32%	72.39%	20.25%	59.59%
Senegal	1997	31.10%	67.66%	8.50%	0.00%	0.00%	1.10%	56.05%	98.82%	0.36%	77.21%	47.61%	85.05%	24.47%	0.50%	16.24%	38.69%	84.05%	99.23%	18.31%	91.56%
South Africa	1998	59.18%	87.72%	24.99%	4.03%	26.17%	69.86%	97.07%	98.82%	33.34%	97.95%	78.43%	97.87%	55.15%	34.13%	72.78%	88.77%	97.62%	98.91%	65.21%	98.27%
Tanzania	1999	13.78%	47.40%	4.09%	0.00%	0.00%	0.11%	3.92%	65.17%	0.03%	34.43%	34.17%	78.41%	21.42%	5.72%	9.38%	28.92%	43.94%	84.57%	14.19%	64.17%
Togo	1998	17.75%	51.30%	3.11%	0.76%	2.48%	5.40%	19.58%	61.05%	2.88%	40.12%	35.39%	74.40%	18.36%	8.69%	14.05%	24.21%	49.58%	80.86%	15.65%	65.08%
Turkey	1998	67.29%	69.78%	62.89%	45.13%	76.91%	78.12%	78.05%	57.82%	66.79%	68.06%	85.06%	84.37%	86.27%	80.10%	90.32%	92.96%	87.12%	74.28%	87.83%	80.78%
Uzbekistan	1996	55.84%	85.00%	37.32%	8.31%	26.99%	60.19%	90.27%	97.81%	32.28%	93.90%	75.24%	91.75%	64.76%	47.41%	63.19%	76.92%	93.03%	98.30%	62.66%	95.57%
Vietnam	1997	14.51%	66.71%	2.75%	0.40%	1.43%	2.34%	7.75%	61.07%	1.38%	34.24%	15.68%	70.28%	3.38%	0.97%	3.58%	9.41%	62.50%	3.28%	25.81%	35.81%
Zambia	1996	21.03%	50.30%	1.78%	0.00%	0.57%	9.36%	43.78%	55.36%	3.08%	47.98%	36.96%	82.24%	7.19%	0.00%	1.74%	28.44%	70.76%	91.79%	9.37%	78.40%
Zimbabwe	1999	32.75%	93.04%	4.43%	0.00%	11.33%	6.95%	48.14%	97.79%	6.05%	72.82%	39.96%	98.77%	12.33%	0.72%	19.05%	18.02%	63.53%	98.95%	12.52%	81.14%
Sample Mean		30.80%	55.06%	16.04%	7.82%	18.58%	27.01%	41.59%	59.61%	17.77%	50.54%	44.37%	75.22%	27.93%	18.01%	30.80%	41.13%	57.04%	75.53%	29.96%	66.20%
Period 2000-2005																					
Bangladesh	2004	6.69%	30.31%	0.13%	0.00%	0.00%	0.09%	2.15%	31.29%	0.03%	16.76%	6.69%	30.31%	0.13%	0.00%	0.00%	0.09%	2.15%	31.29%	0.03%	16.76%
Benin	2001	28.74%	60.37%	10.91%	0.39%	7.28%	11.84%	37.57%	86.73%	6.50%	62.17%	42.86%	66.30%	29.64%	12.06%	25.70%	33.73%	52.88%	90.02%	23.84%	71.46%
Bolivia	2003	70.54%	86.39%	44.58%	7.77%	61.49%	88.59%	96.85%	98.04%	52.62%	97.44%	76.59%	89.55%	55.36%	25.54%	72.92%	89.55%	96.93%	98.04%	62.67%	97.48%
Burkina	2003	5.89%	32.98%	0.06%	0.00%	0.00%	0.00%	0.41%	34.07%	0.00%	14.92%	18.63%	86.18%	4.09%	0.00%	0.47%	4.11%	18.77%	79.11%	1.58%	44.79%

Faso																						
Cameroon	2004	12.95%	24.23%	2.20%	0.00%	0.53%	4.31%	11.10%	48.84%	1.61%	29.97%	38.96%	67.49%	11.75%	0.52%	17.17%	32.00%	62.26%	83.31%	16.42%	72.78%	
Chad	2004	4.45%	21.71%	0.00%	0.00%	0.00%	0.00%	0.02%	22.25%	0.00%	11.20%	11.07%	44.72%	2.38%	0.00%	2.93%	4.35%	7.46%	40.72%	2.41%	24.18%	
Colombia	2005	72.76%	91.27%	21.08%	99.86%	94.73%	91.68%	62.60%	14.71%	95.50%	38.66%	84.20%	91.89%	62.73%	99.86%	94.73%	92.70%	76.64%	56.84%	95.84%	66.74%	
Congo (Brazza)	2005	25.81%	46.21%	2.99%	0.00%	0.27%	5.31%	37.00%	86.57%	1.86%	61.78%	49.30%	85.92%	8.33%	3.93%	12.25%	51.94%	83.24%	95.29%	22.69%	89.26%	
Dominican Rep	2002	30.04%	28.71%	32.51%	49.80%	44.65%	30.62%	19.56%	4.85%	41.64%	12.44%	30.04%	28.71%	32.51%	49.80%	44.65%	30.62%	19.56%	4.85%	41.64%	12.44%	
Egypt	2005	88.33%	97.46%	81.89%	45.10%	98.10%	99.07%	99.67%	99.92%	80.74%	99.73%	92.13%	98.41%	87.70%	63.21%	98.68%	99.27%	99.71%	99.95%	87.05%	99.77%	
Ethiopia	2005	5.98%	48.45%	0.21%	0.00%	0.00%	0.00%	0.00%	29.92%	0.00%	14.96%	21.81%	89.31%	12.62%	0.10%	11.12%	14.59%	18.73%	64.65%	8.55%	41.69%	
Ghana	2003	15.08%	33.91%	1.66%	0.26%	1.47%	3.13%	13.36%	58.11%	1.60%	35.35%	35.56%	72.06%	9.55%	6.27%	19.65%	18.87%	48.55%	85.22%	14.94%	66.57%	
Guinea	2005	9.13%	28.06%	1.22%	0.00%	0.00%	0.45%	1.52%	43.83%	0.15%	22.62%	21.88%	66.14%	3.38%	0.00%	0.00%	4.56%	18.73%	86.42%	1.49%	52.48%	
Honduras	2005	39.80%	18.28%	58.81%	50.76%	63.70%	53.68%	25.80%	4.89%	56.04%	15.34%	57.63%	51.56%	63.00%	51.92%	70.14%	75.76%	59.22%	31.01%	65.95%	45.11%	
Indonesia	2003	15.13%	25.62%	5.77%	1.79%	6.17%	12.35%	18.58%	36.76%	6.77%	27.67%	17.70%	29.20%	7.44%	3.51%	9.19%	16.18%	21.35%	38.28%	9.62%	29.81%	
Kenya	2003	17.94%	49.67%	10.04%	0.01%	1.25%	5.52%	21.10%	61.89%	2.25%	41.49%	27.38%	70.11%	16.74%	2.85%	9.21%	14.20%	35.90%	74.96%	8.70%	55.42%	
Lesotho	2004	10.74%	50.44%	2.13%	0.00%	0.38%	0.21%	3.12%	50.01%	0.19%	26.56%	58.78%	88.78%	52.28%	49.61%	48.39%	56.79%	58.65%	80.49%	51.60%	69.57%	
Madagascar	2004	5.30%	17.20%	2.03%	0.19%	0.00%	0.00%	2.39%	23.92%	0.07%	13.14%	23.24%	63.71%	12.14%	0.19%	0.37%	6.47%	36.02%	73.24%	2.34%	54.61%	
Malawi	2004	6.49%	32.04%	1.68%	0.00%	0.83%	0.41%	1.03%	30.33%	0.41%	15.63%	19.21%	75.08%	8.68%	0.00%	0.87%	10.58%	19.53%	65.25%	3.82%	42.32%	
Mali	2001	9.06%	29.25%	1.86%	0.24%	0.56%	2.02%	5.04%	37.52%	0.93%	21.30%	29.36%	60.94%	18.11%	0.99%	15.03%	27.50%	31.39%	72.34%	14.41%	51.89%	
Mauritania	2001	17.41%	27.51%	9.84%	0.00%	0.00%	5.99%	26.89%	54.31%	1.96%	40.59%	32.30%	51.30%	18.04%	0.00%	24.80%	26.62%	46.74%	66.76%	16.00%	56.75%	
Moldova	2005	35.28%	72.69%	11.46%	2.93%	7.49%	15.06%	60.85%	90.11%	8.49%	75.48%	36.09%	73.42%	12.32%	3.43%	8.24%	16.31%	62.11%	90.42%	9.32%	76.27%	
Morocco	2004	56.72%	85.22%	18.66%	7.90%	25.23%	55.44%	96.17%	99.99%	29.49%	97.88%	67.48%	96.12%	29.25%	18.58%	44.50%	76.56%	98.51%	99.99%	46.52%	99.17%	
Mozambique	2003	6.86%	19.72%	0.33%	0.00%	0.00%	0.00%	0.00%	34.54%	0.00%	17.27%	24.49%	62.58%	5.13%	0.00%	2.56%	7.77%	29.95%	83.33%	3.27%	56.63%	
Nepal	2001	8.86%	38.28%	5.63%	0.00%	0.00%	0.00%	14.88%	29.66%	0.00%	22.16%	33.91%	53.04%	31.81%	30.14%	31.76%	34.65%	29.31%	44.08%	32.14%	36.58%	
Nicaragua	2001	63.16%	89.20%	29.00%	12.23%	42.60%	76.32%	90.86%	93.83%	43.73%	92.35%	66.53%	90.37%	35.26%	19.21%	48.20%	79.27%	92.15%	93.88%	48.90%	93.01%	
Nigeria	2003	6.88%	15.49%	2.49%	0.50%	1.14%	2.99%	11.10%	18.68%	1.54%	14.89%	16.26%	32.40%	8.05%	4.24%	7.85%	11.15%	25.30%	32.79%	7.74%	29.05%	
Peru	2004	70.99%	89.70%	37.34%	21.57%	59.94%	75.55%	98.01%	99.97%	52.34%	98.98%	73.77%	92.43%	40.21%	25.97%	67.17%	77.82%	98.01%	99.97%	56.98%	98.98%	
Philippines	2003	38.87%	55.21%	21.37%	6.01%	23.34%	41.93%	51.36%	72.41%	24.17%	62.26%	52.36%	66.69%	37.00%	28.39%	44.82%	55.95%	59.49%	73.40%	43.34%	66.69%	
Rwanda	2005	2.95%	15.97%	0.59%	0.00%	0.00%	0.03%	0.14%	14.60%	0.01%	7.37%	27.66%	56.57%	22.43%	1.69%	19.90%	38.26%	25.45%	54.55%	19.44%	40.00%	
Senegal	2005	43.36%	76.76%	17.68%	1.03%	12.17%	35.22%	73.29%	95.72%	16.21%	84.53%	61.49%	88.48%	40.73%	18.81%	45.07%	58.80%	87.18%	98.05%	40.94%	92.63%	
Tanzania	2004	7.36%	21.87%	2.86%	0.00%	0.00%	0.36%	7.74%	28.81%	0.12%	18.22%	32.56%	67.17%	21.83%	11.18%	14.96%	21.82%	43.19%	71.84%	15.99%	57.44%	
Uganda	2001	1.99%	14.39%	0.15%	0.00%	0.00%	0.13%	0.05%	9.80%	0.04%	4.97%	9.22%	61.88%	1.39%	0.38%	0.58%	0.61%	2.98%	41.65%	0.52%	22.52%	
Vietnam	2002	19.21%	74.75%	6.10%	0.00%	3.34%	3.12%	15.63%	74.24%	2.15%	45.19%	19.88%	76.39%	6.54%	0.42%	4.04%	4.35%	16.23%	74.62%	2.93%	45.68%	
Zambia	2002	18.32%	46.43%	2.73%	0.00%	0.13%	0.06%	17.02%	74.43%	0.06%	45.72%	33.93%	82.63%	6.93%	0.04%	3.28%	14.07%	59.81%	92.62%	5.76%	76.21%	
Sample Mean		25.12%	45.59%	12.80%	8.81%	15.91%	20.61%	29.22%	51.30%	15.12%	40.20%	38.60%	68.80%	23.30%	15.22%	26.32%	34.51%	46.97%	70.55%	25.30%	58.65%	

Source: Author's calculations using DHS datasets and population weights. Note: N (National) U(Urban) R(Rural) Q1(Very Poor) Q2(Poor) Q3(Average) Q4(Rich) Q5(Very Rich) P(Poor Q1-Q3) Ri(Rich Q4-Q5)

Table A10 (C'd): Access to Sanitation Infrastructures by Areas of Residency and Quintiles.

	Electricity										Flush Toilet											
	Year	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri	N	U	R	Q1	Q2	Q3	Q4	Q5	P	Ri	
	Period 1990-1995																					
Bangladesh	1994	19.77%	77.54%	12.32%	0.06%	0.98%	5.67%	26.88%	65.82%	2.15%	46.45%	10.21%	50.97%	4.95%	0.00%	0.36%	0.72%	6.30%	43.77%	0.35%	25.13%	
Bolivia	1994	64.22%	92.91%	26.44%	0.42%	36.65%	86.92%	99.27%	99.90%	41.24%	99.59%	31.03%	51.78%	3.67%	0.00%	1.32%	5.45%	53.98%	95.87%	2.26%	75.22%	
Brazil	1991	70.11%	95.09%	33.57%	11.07%	45.55%	94.53%	99.89%	100.00%	50.53%	99.94%	53.21%	77.56%	17.57%	0.06%	12.87%	60.35%	94.43%	99.94%	24.57%	96.83%	
Burkina Faso	1993	6.23%	32.51%	0.62%	0.00%	0.00%	0.72%	2.63%	28.09%	0.22%	15.53%	0.89%	5.04%	0.00%	0.00%	0.00%	0.00%	0.68%	3.78%	0.00%	2.26%	
CAR	1995	5.04%	11.16%	0.52%	0.00%	0.00%	0.02%	0.52%	24.66%	0.01%	12.62%	1.11%	2.48%	0.11%	0.00%	0.00%	0.25%	0.07%	5.26%	0.08%	2.67%	
Cameroon	1991	31.28%	65.53%	9.52%	0.00%	2.05%	8.43%	50.80%	95.47%	3.49%	73.12%	6.56%	15.75%	0.73%	0.00%	0.00%	0.48%	9.49%	22.93%	0.16%	16.20%	
Colombia	1995	90.75%	99.22%	72.54%	56.16%	97.86%	99.81%	100.00%	100.00%	84.88%	100.00%	78.79%	95.01%	43.96%	22.08%	72.85%	99.20%	100.00%	100.00%	65.36%	100.00%	
Cote d'Ivoire	1994	38.59%	75.28%	16.49%	0.00%	1.22%	17.22%	76.75%	98.08%	6.14%	87.47%	14.03%	33.69%	2.23%	0.00%	0.00%	1.70%	9.08%	59.40%	0.57%	34.24%	
Dominican Rep	1991	77.98%	97.15%	48.57%	19.73%	75.40%	97.66%	98.14%	99.06%	64.23%	98.60%	41.80%	63.42%	8.65%	2.52%	12.76%	33.32%	71.17%	89.32%	16.19%	80.23%	
Egypt	1995	95.85%	99.14%	93.23%	80.16%	99.45%	99.79%	99.90%	100.00%	93.14%	99.95%	82.83%	96.94%	71.61%	43.49%	79.52%	93.93%	98.48%	99.99%	72.04%	99.17%	
Ghana	1993	27.85%	74.76%	5.42%	0.20%	2.46%	5.13%	37.76%	94.07%	2.58%	66.04%	5.94%	16.51%	0.89%	0.00%	1.26%	0.23%	6.95%	21.34%	0.49%	14.18%	
Guatemala	1995	58.77%	88.81%	39.53%	0.41%	21.74%	76.15%	97.26%	99.79%	33.20%	98.54%	30.28%	62.52%	9.65%	0.00%	0.65%	9.10%	56.48%	87.54%	3.33%	72.24%	
Haiti	1995	31.07%	78.92%	3.84%	0.00%	0.97%	5.31%	53.83%	96.03%	2.09%	74.86%	4.51%	12.19%	0.13%	0.00%	0.52%	0.25%	4.14%	17.76%	0.25%	10.93%	
India	1993	51.42%	83.64%	39.88%	0.31%	30.90%	51.65%	78.20%	98.54%	26.80%	88.37%	20.83%	59.67%	6.92%	0.00%	0.00%	1.55%	24.00%	78.74%	0.49%	51.36%	
Indonesia	1994	63.91%	95.09%	49.94%	12.83%	50.25%	70.39%	87.33%	98.83%	44.54%	93.09%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Kazakhstan	1995	99.87%	99.91%	99.84%	99.68%	99.87%	99.81%	100.00%	100.00%	99.79%	100.00%	33.11%	68.00%	2.42%	0.00%	0.00%	0.78%	66.96%	99.88%	0.26%	82.51%	
Kenya	1993	8.81%	47.70%	2.76%	0.00%	0.13%	4.39%	6.46%	33.09%	1.50%	19.80%	7.99%	50.97%	1.31%	0.02%	0.33%	3.65%	4.54%	31.43%	1.33%	17.98%	
Madagascar	1992	9.24%	47.29%	2.05%	0.11%	0.95%	3.21%	1.25%	40.78%	1.40%	21.34%	2.54%	15.08%	0.17%	0.00%	0.51%	1.65%	0.28%	10.29%	0.71%	5.37%	
Malawi	1992	3.69%	22.81%	1.02%	0.00%	0.00%	0.38%	1.95%	16.18%	0.12%	9.06%	2.62%	16.98%	0.61%	0.00%	0.00%	0.38%	2.55%	10.21%	0.12%	6.38%	
Morocco	1992	46.94%	85.16%	16.63%	0.16%	9.05%	35.27%	90.29%	100.00%	14.80%	95.15%	49.94%	90.65%	17.71%	0.13%	8.67%	45.64%	95.58%	99.79%	18.12%	97.68%	
Namibia	1992	20.31%	63.09%	2.35%	0.00%	0.00%	0.00%	9.86%	91.97%	0.00%	50.89%	26.65%	83.04%	2.95%	0.00%	0.00%	0.08%	34.40%	98.82%	0.02%	66.59%	
Niger	1992	5.67%	32.03%	0.26%	0.00%	0.00%	0.00%	0.85%	27.61%	0.00%	15.00%	1.25%	6.90%	0.09%	0.00%	0.00%	0.00%	0.00%	6.23%	0.00%	3.29%	
Nigeria	1990	26.08%	81.89%	8.81%	0.07%	0.31%	5.30%	30.61%	93.90%	1.90%	62.26%	8.46%	29.47%	1.97%	0.00%	0.23%	0.07%	2.63%	39.35%	0.10%	21.00%	
Pakistan	1991	62.94%	96.04%	47.72%	13.58%	41.90%	69.26%	91.19%	99.70%	41.39%	95.45%	27.92%	73.95%	6.78%	0.00%	0.00%	4.18%	42.47%	93.43%	1.37%	68.02%	
Paraguay	1990	53.67%	91.76%	15.02%	0.64%	12.48%	61.26%	96.95%	99.90%	24.33%	98.50%	21.86%	40.07%	3.55%	0.00%	0.00%	1.01%	21.91%	86.43%	0.33%	54.15%	
Peru	1992	70.79%	90.81%	19.57%	4.78%	59.17%	90.45%	99.81%	99.94%	51.43%	99.88%	45.93%	62.45%	3.60%	0.01%	4.43%	35.68%	91.88%	97.86%	13.37%	94.80%	
Philippines	1993	66.13%	84.31%	46.83%	4.46%	45.31%	83.95%	97.27%	99.71%	44.53%	98.45%	63.57%	75.84%	50.56%	7.14%	52.08%	75.58%	87.07%	96.38%	44.90%	91.58%	
Rwanda	1992	2.35%	32.14%	0.68%	0.00%	0.02%	0.45%	0.78%	10.87%	0.15%	5.67%	1.05%	14.21%	0.32%	0.00%	0.07%	0.11%	0.66%	4.58%	0.05%	2.56%	
Senegal	1993	25.29%	63.49%	2.52%	0.00%	0.13%	1.03%	31.60%	94.35%	0.39%	63.20%	10.62%	25.25%	1.90%	0.00%	0.00%	0.80%	9.08%	43.45%	0.27%	26.39%	
Tanzania	1992	6.36%	23.04%	1.69%	0.36%	0.00%	0.57%	10.55%	22.66%	0.31%	15.44%	1.41%	4.58%	0.52%	0.00%	0.24%	0.34%	3.89%	2.26%	0.19%	3.23%	
Turkey	1993											54.66%	83.95%	10.04%	100.00%	99.91%	47.93%	19.59%	0.84%	84.21%	10.20%	
Uganda	1995	6.95%	44.50%	1.87%	0.00%	0.00%	0.00%	1.22%	33.84%	0.00%	17.94%	1.59%	11.22%	0.29%	0.00%	0.00%	0.17%	0.30%	7.54%	0.06%	4.01%	
Yemen	1992	48.09%	93.98%	37.15%	1.45%	18.54%	47.33%	76.35%	97.09%	22.32%	86.71%	12.91%	56.95%	2.42%	0.00%	0.21%	1.71%	6.08%	56.58%	0.64%	31.32%	
Zambia	1992	23.25%	44.50%	3.45%	0.00%	0.97%	8.75%	71.55%	35.69%	3.14%	53.60%	27.13%	54.30%	1.93%	0.00%	1.28%	8.27%	88.17%	38.92%	3.08%	63.50%	
Zimbabwe	1994	23.28%	82.85%	2.36%	0.00%	0.00%	0.53%	21.50%	96.46%	0.17%	58.00%	26.25%	95.46%	1.91%	0.00%	0.00%	0.25%	34.62%	98.05%	0.08%	65.58%	
Sample Mean		39.49%	39.49%	70.41%	22.50%	9.02%	22.19%	36.22%	54.39%	76.24%	22.44%	23.81%	23.81%	47.14%	8.30%	5.16%	10.30%	15.73%	33.76%	54.35%	10.45%	
	Period 1995-2000																					
Armenia	2000	99.24%	99.37%	99.07%	98.01%	99.28%	99.20%	99.74%	100.00%	98.83%	99.87%	60.65%	89.70%	20.89%	2.70%	19.72%	82.29%	98.86%	99.87%	34.86%	99.37%	

Bangladesh	2000	33.56%	82.68%	22.14%	0.00%	0.42%	18.88%	60.12%	89.09%	6.43%	74.68%	10.86%	36.95%	4.80%	0.00%	0.00%	0.00%	6.38%	48.04%	0.00%	27.33%
	1996	14.39%	34.95%	2.41%	0.00%	0.29%	0.43%	5.59%	65.66%	0.24%	35.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Benin								100.00													
									%	53.33%	99.94%	28.49%	43.17%	2.49%	0.29%	1.68%	6.68%	42.24%	91.87%	2.89%	67.11%
Bolivia	1998	71.90%	95.81%	29.58%	3.47%	60.87%	95.71%	99.88%	100.00												
Brazil									%	88.42%	99.97%	45.37%	53.18%	16.00%	11.13%	24.59%	41.87%	63.52%	85.76%	25.88%	74.65%
Burkina Faso	1999	6.06%	41.20%	0.23%	0.00%	0.00%	0.00%	0.29%	30.25%	0.00%	15.18%	0.58%	3.77%	0.05%	0.00%	0.00%	0.00%	0.33%	2.59%	0.00%	1.45%
Cameroon	1998	41.52%	80.82%	22.96%	0.00%	4.61%	37.20%	69.12%	97.60%	14.06%	83.25%	6.41%	17.32%	1.27%	0.00%	0.00%	1.46%	10.38%	20.54%	0.49%	15.42%
	1997	2.76%	11.29%	0.18%	0.00%	0.00%	0.00%	0.33%	13.48%	0.00%	6.92%	0.24%	1.02%	0.00%	0.00%	0.00%	0.00%	0.00%	1.18%	0.00%	0.59%
Chad								100.00													
									%												
Colombia	2000	95.16%	99.52%	84.23%	82.46%	94.32%	99.23%		%	92.50%	%	84.84%	95.47%	58.20%	49.84%	76.60%	98.27%	99.98%	%	76.51%	99.98%
Comoros	1996	30.47%	54.38%	21.36%	0.00%	0.92%	14.95%	46.50%	90.70%	5.07%	68.60%	2.93%	7.55%	1.16%	0.00%	0.08%	0.37%	0.39%	13.90%	0.14%	7.12%
									100.00												
Cote d'Ivoire									%	19.27%	95.70%	12.45%	30.07%	2.26%	0.00%	0.00%	0.34%	4.35%	57.80%	0.11%	31.06%
									100.00												
Dominican Rep	1999	91.26%	99.50%	77.05%	62.18%	96.77%	98.80%	98.89%	%	85.87%	99.39%	48.92%	67.43%	17.18%	0.28%	4.83%	47.35%	94.07%	99.62%	17.46%	96.58%
Egypt	2000	97.73%	99.39%	96.49%	92.77%	97.17%	99.05%	99.82%	99.86%	96.32%	99.84%	93.54%	99.04%	89.43%	82.66%	89.29%	96.89%	99.14%	99.81%	89.59%	99.48%
Ethiopia	2000	11.28%	77.31%	0.32%	0.00%	0.00%	0.00%	0.23%	56.37%	0.00%	28.29%	0.34%	2.41%	0.00%	0.00%	0.00%	0.00%	0.00%	1.72%	0.00%	0.86%
Gabon	2000	75.18%	90.57%	31.37%	12.72%	70.53%	94.98%	97.87%	99.79%	59.44%	98.83%	24.50%	31.56%	4.45%	0.09%	1.00%	4.80%	24.14%	92.64%	1.96%	58.36%
Ghana	1998	39.36%	83.78%	18.57%	0.06%	5.77%	29.04%	68.06%	96.11%	11.69%	81.79%	7.57%	19.90%	1.79%	0.00%	0.31%	4.24%	13.38%	20.40%	1.53%	16.82%
Guatemala	1999	68.66%	90.96%	52.54%	4.82%	56.08%	86.11%	97.64%	99.45%	48.77%	98.54%	41.20%	68.53%	21.43%	0.02%	4.69%	27.35%	77.25%	97.04%	10.60%	87.13%
	1999	17.41%	54.92%	1.79%	0.00%	0.28%	2.24%	8.72%	76.39%	0.79%	42.20%	2.65%	8.60%	0.17%	0.00%	0.10%	0.00%	1.42%	11.76%	0.04%	6.57%
Guinea	2000	33.64%	82.36%	5.97%	0.03%	1.91%	8.55%	61.35%	96.63%	3.48%	78.84%	3.43%	8.70%	0.44%	0.00%	0.10%	0.09%	3.43%	13.61%	0.07%	8.47%
Haiti	1999	60.00%	91.98%	48.47%	8.63%	63.12%	48.02%	81.59%	98.49%	40.03%	89.99%	23.27%	63.11%	8.90%	0.00%	0.91%	9.08%	29.33%	77.98%	3.14%	53.50%
India	1999	80.42%	97.77%	73.13%	37.78%	78.69%	90.22%	95.51%	99.93%	68.88%	97.72%										
	1997								100.00												
Indonesia	1999	95.89%	99.32%	92.91%	81.93%	98.82%	99.61%	99.15%	%	93.46%	99.57%	36.12%	73.15%	3.85%	0.24%	0.24%	1.48%	79.64%	%	0.65%	89.64%
Kazakhstan	1998	11.79%	49.60%	3.20%	0.00%	0.00%	0.30%	2.19%	57.10%	0.09%	29.64%	9.75%	46.07%	1.51%	0.00%	0.02%	0.03%	1.73%	47.55%	0.01%	24.55%
Kenya	1997	99.72%	99.96%	99.62%	99.86%	99.04%	99.73%		%	99.54%	%	14.82%	44.67%	1.75%	0.00%	0.00%	0.00%	0.00%	75.66%	0.00%	37.06%
Kyrgyz Republic	1997	11.13%	38.55%	2.23%	0.00%	0.00%	0.31%	4.18%	51.21%	0.10%	27.72%	2.26%	6.80%	0.78%	0.00%	0.00%	0.00%	1.23%	10.06%	0.00%	5.64%
Madagascar	2000	5.59%	32.26%	1.23%	0.00%	0.04%	0.27%	4.16%	23.50%	0.10%	13.85%	3.30%	18.50%	0.82%	0.00%	0.04%	0.11%	3.94%	12.44%	0.05%	8.19%
Malawi	1996	7.63%	25.57%	0.41%	0.00%	0.27%	0.29%	2.80%	34.69%	0.19%	18.79%	1.12%	3.74%	0.07%	0.21%	0.03%	0.02%	0.44%	4.92%	0.09%	2.68%
Mali	1997	10.00%	30.27%	3.98%	0.00%	1.19%	1.21%	9.64%	38.83%	0.80%	23.92%	3.22%	13.60%	0.14%	0.00%	1.15%	0.41%	4.92%	9.72%	0.54%	7.27%
Mozambique	2000	31.68%	74.60%	10.39%	0.00%	0.54%	4.77%	53.13%	99.95%	1.74%	76.54%	30.56%	78.54%	6.80%	0.00%	0.00%	2.19%	51.93%	98.78%	0.71%	75.35%
Namibia	1996	18.03%	79.64%	12.39%	0.00%	4.54%	6.72%	25.03%	55.30%	3.66%	40.57%	1.68%	17.61%	0.23%	0.00%	0.40%	0.76%	2.88%	4.54%	0.38%	3.73%
Nepal	1998	69.19%	92.12%	35.78%	1.47%	56.04%	94.16%	99.14%	99.96%	49.18%	99.53%	24.83%	40.35%	2.26%	0.03%	0.61%	3.93%	36.35%	85.77%	1.51%	60.17%
Nicaragua	1998	7.90%	40.52%	0.26%	0.00%	0.00%	0.00%	3.63%	36.12%	0.00%	20.06%	1.05%	4.58%	0.23%	0.00%	0.00%	0.00%	2.55%	2.80%	0.00%	2.68%
Niger	1999	44.85%	85.42%	28.08%	0.88%	11.57%	34.79%	78.11%	98.48%	15.63%	88.31%	11.90%	31.81%	3.72%	0.07%	0.54%	0.65%	6.95%	51.38%	0.42%	29.15%
Nigeria	2000	69.64%	93.16%	28.83%	4.20%	52.16%	93.23%	99.26%	99.97%	49.67%	99.60%	50.80%	75.72%	7.59%	0.54%	8.67%	54.57%	91.05%	99.62%	21.23%	95.18%
Peru	1998	71.84%	91.49%	52.15%	10.71%	61.18%	90.03%	98.34%	99.10%	53.94%	98.72%	73.36%	87.27%	59.43%	21.99%	67.78%	87.91%	92.84%	96.44%	59.20%	94.64%
Philippines	2000	7.35%	42.10%	1.08%	0.00%	0.18%	0.13%	2.33%	34.24%	0.10%	18.58%	1.47%	8.05%	0.29%	0.00%	0.00%	0.00%	0.05%	7.33%	0.00%	3.76%
Rwanda	1997	32.18%	72.66%	7.18%	0.00%	0.92%	5.26%	56.04%	99.23%	2.03%	77.43%	9.07%	22.30%	0.90%	0.00%	0.08%	1.26%	8.09%	36.27%	0.44%	22.03%
Senegal	1998	63.42%	86.47%	35.74%	5.92%	33.79%	78.41%	99.05%	99.98%	39.36%	99.52%	46.37%	80.21%	5.84%	0.31%	5.53%	35.96%	90.54%	99.55%	13.93%	95.04%
South Africa	1999	7.27%	29.35%	0.89%	0.00%	0.00%	0.00%	0.85%	35.61%	0.00%	18.19%	1.66%	5.47%	0.56%	0.00%	0.00%	0.00%	1.16%	7.18%	0.00%	4.16%
Tanzania	1998	14.91%	44.45%	2.00%	0.08%	0.09%	0.64%	6.97%	67.40%	0.27%	36.90%										
Togo																					
Turkey	1998		100.00			100.00	100.00	100.00	100.00		100.00										
Uzbekistan	1996	99.52%	%	99.21%	97.68%	%	%	%	%	99.22%	%	15.85%	36.99%	2.42%	0.00%	0.62%	1.37%	5.65%	77.78%	0.67%	40.37%
Vietnam	1997	76.74%	98.91%	71.75%	20.57%	80.44%	86.73%	96.27%	99.93%	62.53%	98.09%	17.16%	67.50%	5.81%	0.00%	0.47%	1.28%	8.03%	76.52%	0.58%	42.06%
Zambia	1996	20.28%	48.41%	1.76%	0.00%	0.36%	8.61%	37.13%	62.96%	2.78%	46.52%	20.69%	50.29%	1.23%	0.00%	0.24%	9.40%	37.20%	65.01%	2.97%	47.29%
Zimbabwe	1999	33.86%	90.08%	7.40%	0.15%	11.30%	8.56%	52.30%	97.32%	6.62%	74.69%	31.45%	95.12%	1.54%	0.00%	11.26%	6.18%	41.38%	98.94%	5.77%	69.99%

Sample Mean		45.98%	45.98%	72.78%	31.45%	18.06%	33.01%	42.79%	57.10%	79.56%	31.24%	22.59%	22.59%	40.55%	8.87%	4.02%	8.21%	16.70%	31.08%	53.59%	9.67%
		Period 2000-2005																			
Bangladesh	2004	41.35%	77.57%	31.28%	0.00%	10.02%	41.07%	66.08%	89.90%	17.08%	78.02%	9.58%	30.89%	3.66%	0.00%	0.00%	0.25%	5.49%	42.27%	0.08%	23.92%
Benin	2001	21.96%	50.95%	5.61%	0.02%	0.70%	2.08%	23.25%	83.75%	0.93%	53.50%	2.39%	6.00%	0.35%	0.00%	0.00%	0.00%	0.81%	11.13%	0.00%	5.97%
Bolivia	2003	71.25%	94.02%	34.02%	9.83%	55.05%	92.23%	99.38%	99.88%	52.33%	99.63%	37.54%	56.90%	5.85%	0.44%	6.96%	30.50%	67.61%	82.24%	12.64%	74.93%
Burkina Faso	2003	10.16%	53.51%	0.83%	0.00%	0.00%	0.46%	1.32%	57.39%	0.16%	25.50%	1.86%	8.22%	0.49%	0.00%	0.02%	0.00%	1.36%	9.10%	0.01%	4.70%
Cameroon	2004	45.76%	76.67%	16.27%	0.02%	8.83%	36.23%	84.79%	99.11%	14.96%	91.95%	8.07%	15.76%	0.73%	0.00%	0.00%	0.21%	2.21%	37.95%	0.07%	20.08%
Chad	2004	4.33%	19.90%	0.32%	0.00%	0.00%	0.00%	0.22%	21.45%	0.00%	10.92%	1.83%	7.13%	0.46%	0.00%	0.00%	0.03%	1.72%	7.40%	0.01%	4.58%
Colombia	2005	96.46%	99.39%	88.27%	99.97%	99.88%	99.57%	94.67%	88.19%	99.81%	91.43%	89.58%	97.48%	67.52%	99.97%	99.93%	98.90%	85.38%	63.69%	99.60%	74.54%
Congo (Brazza)	2005	34.86%	51.35%	16.40%	4.34%	12.91%	18.17%	47.95%	91.01%	11.80%	69.48%	5.33%	9.78%	0.35%	0.00%	0.00%	0.03%	2.24%	24.41%	0.01%	13.32%
Dominican Rep	2002	92.96%	98.94%	81.90%	69.51%	97.05%	98.92%	99.52%	99.82%	88.54%	99.66%	55.79%	70.27%	29.05%	3.54%	18.12%	62.48%	95.65%	99.84%	28.22%	97.68%
Egypt	2005	99.42%	99.70%	99.23%	97.37%	99.79%	99.97%	100.00	100.00	99.04%	100.00	97.66%	99.68%	96.24%	91.28%	97.83%	99.58%	99.89%	99.89%	96.18%	99.89%
Ethiopia	2005	12.04%	85.89%	1.98%	0.00%	0.00%	0.13%	1.28%	58.79%	0.04%	30.03%	2.13%	7.99%	1.34%	0.00%	0.00%	1.86%	2.84%	5.97%	0.62%	4.41%
Ghana	2003	44.26%	77.00%	20.88%	3.81%	35.26%	29.97%	60.98%	91.68%	23.08%	76.07%	10.28%	22.56%	1.52%	0.02%	1.13%	3.12%	6.46%	41.41%	1.40%	23.63%
Guinea	2005	20.93%	63.49%	3.19%	0.00%	0.01%	2.83%	14.08%	87.78%	0.93%	50.95%	2.62%	7.51%	0.58%	0.00%	0.00%	0.00%	1.11%	12.04%	0.00%	6.56%
Honduras	2005											42.27%	71.96%	16.04%	1.87%	8.03%	31.33%	73.13%	97.23%	13.77%	85.19%
Indonesia	2003	90.79%	98.08%	84.28%	61.72%	93.87%	99.00%	99.61%	99.81%	84.84%	99.71%	55.15%	75.70%	36.82%	10.77%	30.79%	54.93%	82.48%	96.84%	32.15%	89.65%
Kenya	2003	13.10%	51.41%	3.56%	0.00%	0.00%	1.39%	4.66%	59.43%	0.46%	32.07%	8.97%	39.06%	1.48%	0.00%	0.03%	0.54%	1.84%	42.48%	0.19%	22.16%
Lesotho	2004	5.70%	28.06%	0.84%	0.00%	0.00%	0.07%	1.31%	27.07%	0.02%	14.22%	1.61%	8.34%	0.15%	0.00%	0.00%	0.05%	0.56%	7.44%	0.02%	4.00%
Madagascar	2004	18.82%	51.98%	9.71%	0.00%	0.02%	0.66%	9.29%	84.12%	0.23%	46.68%	1.88%	6.89%	0.50%	0.00%	0.00%	0.04%	1.51%	7.84%	0.01%	4.67%
Malawi	2004	7.48%	34.05%	2.48%	0.00%	0.92%	0.08%	2.18%	34.41%	0.33%	18.23%	3.58%	17.87%	0.89%	0.00%	0.83%	0.06%	0.66%	16.44%	0.29%	8.52%
Mali	2001	12.84%	41.28%	2.65%	0.55%	1.26%	2.83%	4.74%	54.78%	1.54%	29.83%	6.05%	14.56%	3.01%	0.00%	0.77%	5.95%	5.93%	17.73%	2.20%	11.84%
Mauritania	2001	23.36%	50.72%	2.73%	0.00%	0.94%	3.93%	25.65%	86.39%	1.56%	56.15%	1.77%	4.06%	0.05%	0.00%	0.00%	0.00%	0.42%	8.43%	0.00%	4.42%
Moldova	2005	99.03%	99.64%	98.64%	95.86%	99.62%	99.97%	99.81%	99.91%	98.48%	99.86%	29.32%	69.37%	3.82%	0.00%	0.38%	1.18%	45.25%	99.84%	0.52%	72.55%
Morocco	2004	76.66%	94.78%	52.47%	28.66%	63.20%	92.62%	99.28%	100.00	61.48%	99.60%	80.49%	97.98%	57.13%	50.54%	66.82%	86.84%	98.71%	100.00	68.05%	99.29%
Mozambique	2003	11.02%	29.78%	1.49%	0.00%	0.09%	0.42%	3.77%	51.23%	0.16%	27.48%	2.88%	8.12%	0.21%	0.00%	0.00%	0.00%	0.02%	14.45%	0.00%	7.23%
Nepal	2001	23.95%	86.59%	17.08%	0.00%	0.00%	14.62%	24.39%	81.88%	4.79%	52.70%	10.87%	57.62%	5.74%	0.00%	0.00%	0.00%	3.18%	51.91%	0.00%	27.18%
Nicaragua	2001	69.88%	94.37%	37.73%	7.26%	55.98%	87.47%	98.70%	99.98%	50.25%	99.34%	23.57%	39.83%	2.24%	0.02%	0.45%	3.93%	24.40%	89.10%	1.47%	56.77%
Nigeria	2003	51.26%	84.00%	34.58%	5.45%	32.14%	41.50%	85.61%	91.51%	26.36%	88.56%	13.12%	27.80%	5.65%	0.11%	0.56%	0.89%	10.06%	53.98%	0.52%	32.02%
Peru	2004	73.42%	96.63%	31.74%	7.83%	75.49%	84.30%	99.67%	100.00	55.86%	99.83%	58.30%	84.12%	11.87%	0.86%	26.75%	67.54%	96.50%	100.00	31.70%	98.22%
Philippines	2003	76.69%	92.14%	60.14%	14.83%	71.23%	97.78%	99.79%	100.00	62.09%	99.90%	78.39%	92.19%	63.62%	21.43%	75.78%	95.73%	99.33%	99.97%	65.02%	99.66%
Rwanda	2005	5.42%	27.18%	1.49%	0.00%	0.03%	0.00%	0.41%	26.70%	0.01%	13.55%	1.16%	6.27%	0.24%	0.00%	0.00%	0.08%	0.13%	5.60%	0.03%	2.86%
Senegal	2005	46.41%	82.05%	18.97%	2.52%	13.91%	44.55%	75.88%	95.60%	20.42%	85.76%	36.04%	64.51%	14.15%	1.49%	9.86%	34.87%	54.62%	79.76%	15.47%	67.22%
Tanzania	2004	10.57%	38.90%	1.76%	0.00%	0.00%	0.16%	2.84%	50.01%	0.05%	26.34%	2.75%	10.12%	0.47%	0.00%	0.00%	0.00%	1.19%	12.63%	0.00%	6.88%
Uganda	2001	8.41%	47.48%	2.59%	0.25%	0.39%	1.41%	1.50%	38.46%	0.69%	20.24%	1.73%	10.67%	0.40%	0.00%	0.15%	0.28%	0.99%	7.23%	0.14%	4.15%
Vietnam	2002	88.40%	99.46%	85.79%	56.42%	88.62%	97.93%	99.53%	100.00	80.93%	99.77%	25.09%	82.77%	11.48%	0.05%	0.81%	2.56%	28.77%	93.80%	1.14%	61.57%
Zambia	2002	20.07%	49.99%	3.46%	0.00%	0.16%	0.24%	14.55%	85.37%	0.13%	49.95%	18.09%	46.92%	2.11%	0.00%	0.13%	0.91%	14.79%	74.67%	0.34%	44.73%
Sample Mean		42.03%	42.03%	68.44%	28.07%	16.65%	29.92%	38.02%	48.43%	77.51%	28.22%	23.65%	39.34%	12.75%	8.07%	12.75%	19.56%	29.06%	48.99%	13.48%	39.00%

Source: Author's calculations using DHS datasets and population weights. Note: N (National) U(Urban) R(Rural) Q1 (Very Poor) Q2(Poor) Q3(Average) Q4(Rich) Q5(Very Rich) P(Poor Q1-Q3) Ri(Rich Q4-Q5)

Table A11: Gains in Access to Health and Sanitation Services.

	SANITATION INFRASTRUCTURES				HEALTH				
	Tap Water in Residence	Tap (Public & Private)	Electricity	Flush Toilet	Child is dead	Child is under-weight	Child is fully vaccinated	Diarrhoea: medical treatment	Medical delivery
Bangladesh	0.02	0.02	0.22	-0.01	-0.01			-0.05	0.64
Benin	0.06	0.14	0.08	0.02	0.03	-0.06	0.04	-0.02	0.12
Bolivia	0.17	0.12	0.07	0.07	0.00	-0.07	-0.12	0.03	0.09
Brazil	0.21	0.13	0.23	-0.08	-0.03			0.04	0.15
Burkina Faso	0.00	0.03	0.04	0.01	-0.01	0.04	0.07	0.04	-0.07
Cameroon	0.01	0.05	0.14	0.02	0.02	0.04	0.07	-0.02	-0.05
Chad	0.01	0.02	0.02	0.02	-0.01	-0.02	-0.01	-0.04	-0.03
Colombia	-0.01	0.00	0.06	0.11	0.00			-0.03	0.11
Cote d'Ivoire	0.04	0.06	0.11	-0.02	0.06	-0.02	0.08	0.06	-0.01
Dominican Rep	-0.36	-0.36	0.15	0.14	-0.02	-0.05	-0.02	0.07	0.00
Egypt	0.18	0.11	0.04	0.15	-0.04	-0.05	0.17	0.01	0.34
Ethiopia	0.02	0.06	0.01	0.02	-0.03	-0.08	0.07	0.09	0.02
Ghana	0.01	0.03	0.16	0.04	0.02	-0.05	0.15	0.06	-0.12
Guatemala	-0.01	-0.02	0.10	0.11	0.00	-0.01	0.16	0.04	0.03
Guinea	0.00	0.01	0.04	0.00					
Haiti	-0.01	0.17	0.03	-0.01	0.00	-0.10	0.06	-0.01	0.11
India	0.03	0.05	0.09	0.02	-0.02	-0.07	0.04	0.01	0.02
Indonesia	0.05	0.02	0.27		-0.03			0.05	0.29
Kazakhstan	-0.09	-0.22	-0.04	0.03					
Kenya	0.02	0.00	0.04	0.01	0.01	-0.03	-0.26	-0.10	-0.12
Madagascar	0.00	0.06	0.10	-0.01	-0.04	0.01	0.09	-0.07	-0.09
Malawi	0.00	-0.06	0.04	0.01	-0.03	-0.02	-0.14	-0.22	-0.11
Mali	0.03	0.13	0.05	0.05	0.03	-0.07	-0.01	-0.07	0.00
Morocco	0.17	0.16	0.30	0.31	-0.02	0.00	0.15	0.12	0.31
Mozambique	0.00	0.00	0.01	0.00	0.02	-0.02	0.15	0.12	0.03
Namibia	0.07	0.08	0.11	0.04	-0.02	-0.03	0.11	-0.21	0.07
Nepal	-0.01	0.04	0.06	0.09	0.00	0.02	0.21	0.08	0.03
Nicaragua	0.02	0.02	0.01	-0.01	-0.01	-0.03	-0.08	0.01	0.26
Niger	0.01	0.02	0.02	0.00	-0.08	0.07	0.00	0.06	0.09
Nigeria	-0.04	-0.07	0.25	0.05	0.01	-0.06	-0.16	-0.06	-0.02
Peru	0.08	0.03	0.03	0.12	-0.04			0.26	-0.09
Philippines	0.10	0.15	0.11	0.15	0.00			-0.03	-0.35
Rwanda	0.01	0.05	0.03	0.00	0.03	-0.06	-0.09	-0.10	-0.34
Senegal	0.17	0.17	0.21	0.25	-0.02	-0.07	0.09	-0.03	0.21
Tanzania	-0.03	0.02	0.04	0.01	-0.02	-0.07	-0.43	-0.12	0.01
Turkey	0.06	0.15		0.10	0.00	-0.03	-0.20	0.12	0.06
Uganda	0.00	0.03	0.01	0.00	0.02	-0.04	-0.10	-0.10	0.01
Vietnam	0.05	0.04	0.12	0.08	-0.02			0.09	0.07
Zambia	-0.13	-0.15	-0.03	-0.09	0.00	0.04	0.02	-0.14	-0.08
Zimbabwe	0.06	0.05	0.11	0.05	0.02	-0.03	-0.14	0.01	0.04
Sample Mean	0.02	0.03	0.09	0.05	-0.01	-0.03	0.00	0.00	0.04

Source: Author's calculations using DHS datasets and population weights. Note: Only countries with at least two surveys considered. Period for each country is computed the lowest and highest year of survey.

Table A12. Gini Income Elasticity and Concentration Index for Sanitation Services, Health Status and Access to Health Care.

	SANITATION INFRASTRUCTURES										HEALTH							
	Tap Water in Residence		Tap (Public & Private)		Electricity		Flush Toilet		Child is dead		Child is under-weight		Child is fully vaccinated		Diarrhoea: medical treatment		Medical delivery	
	GIE	CI	GIE	CI	GIE	CI	GIE	CI	GIE	CI	GIE	CI	GIE	CI	GIE	CI	GIE	CI
Bangladesh 1994	1.96	0.68	1.96	0.68	1.93	0.64	2.22	0.73	0.13	0.04	0	.	0	.	0.05	0.02	1.1	0.37
Bangladesh 2000	1.39	0.79	1.39	0.79	0.98	0.57	1.3	0.76	0.14	0.08	-0.2	0.11	0.15	0.08	0.15	0.09	0.53	0.31
Bangladesh 2004	1.39	0.78	1.39	0.78	0.82	0.46	1.35	0.75	0.08	0.04	0.21	0.11	0.09	0.05	0.24	0.13	0.04	0.02
Benin 1996	1.38	0.58	1.07	0.45	1.91	0.76	0	0	0.22	-0.1	0.31	0.13	0.24	0.1	0.23	0.1	0.36	0.16
Benin 2001	1.49	0.57	0.89	0.34	1.87	0.7	2.09	0.78	0.22	0.08	0.49	0.17	0.25	0.09	0.21	0.07	0.32	0.11
Bolivia 1994	1.03	0.39	0.75	0.28	0.89	0.33	1.72	0.63	0.36	0.14	0.58	0.22	0.37	0.14	0.35	0.14	0.87	0.34
Bolivia 1998	1.03	0.28	0.75	0.2	0.95	0.26	2.31	0.63	0.65	0.21	0.89	0.28	0.15	0.05	0.24	0.08	0.88	0.29
Brazil 1991	1.36	0.41	1.04	0.31	0.87	0.27	1.38	0.42	0.26	-0.1	.	.	.	.	0.28	0.11	0.32	0.12
Brazil 1996	1.45	0.21	1.45	0.21	0.4	0.06	2.28	0.33	1.69	0.32	1.85	0.35	0.45	0.09	0.52	0.1	0.24	0.05
Burkina Faso 1993	1.16	0.69	1.27	0.76	1.34	0.75	1.32	0.74	-0.1	0.05	0.08	0.04	0.26	0.15	0.21	0.11	0.16	0.09
Burkina Faso 1999	1.4	0.79	1.37	0.77	1.48	0.8	1.4	0.76	0.09	0.05	0.12	0.06	0.26	0.14	0.15	0.08	0.23	0.12
Burkina Faso 2003	1.56	0.8	1.37	0.69	1.56	0.79	1.49	0.75	0.17	0.07	0.18	0.07	0.13	0.06	0.39	0.17	0.31	0.13
CAR 1995	1.64	0.81	1.16	0.57	1.63	0.8	1.56	0.76	0.22	0.09	0.23	-0.1	0.49	0.21	0.35	0.14	0.7	0.29
Cameroon 1991	1.72	0.69	1.32	0.53	1.44	0.61	1.59	0.68	0.19	0.08	0.49	-0.2	0.34	0.14	0.03	0.01	0.35	0.14
Cameroon 1998	1.37	0.55	1.14	0.44	1.21	0.5	1.54	0.64	0.06	0.03	0.39	0.16	0.43	0.18	0.31	0.14	0.43	0.19
Cameroon 2004	1.47	0.67	0.95	0.43	1.12	0.48	1.81	0.78	0.06	0.03	0.57	0.24	0.21	0.09	0.17	0.07	0.51	0.22
Chad 1997	1.39	0.8	1.01	0.59	1.42	0.8	1.44	0.81	0.03	0.02	0.08	0.05	0.4	0.24	0.27	0.16	0.43	0.26
Chad 2004	1.47	0.81	1.15	0.62	1.53	0.8	1.39	0.73	0.07	0.04	-0.1	0.05	0.43	0.2	0.58	0.28	0.74	0.35
Colombia 1995	0.98	0.23	0.59	0.14	0.37	0.08	0.87	0.19	0.55	0.14	0.93	0.24	0.25	0.07	0.48	0.12	0.42	0.11
Colombia 2000	0.71	0.13	0.71	0.13	0.21	0.03	0.7	0.12	0.66	0.12	0.79	0.14	0.18	0.03	0.34	0.06	0.45	0.08
Colombia 2005	-0.5	-0.2	-0.2	-0.1	0.05	-0	-0.2	0.08	0.5	0.2	0.56	0.22	-0.2	-0.1	0.04	0.02	0.16	-0.1
Comoros 1996	0.61	0.24	-0.2	-0.1	1.39	0.6	1.79	0.77	0.02	0.01	-0.4	0.18	0.24	0.11	0.19	0.08	0.45	0.21
Cote d'Ivoire 1994	1.71	0.72	0.82	0.35	1.35	0.56	1.74	0.73	0.09	0.03	-0.3	0.11	0.52	0.2	0.41	0.16	0.57	0.22
Cote d'Ivoire 1999	1.77	0.64	0.76	0.27	1.17	0.45	2.02	0.77	0.49	0.19	0.67	0.27	0.6	0.24	0.31	0.12	0.76	0.3
Dominican Rep 1991	0.98	0.15	0.98	0.15	1.11	0.19	2.65	0.45	-0.8	0.14	1.51	0.26	1.16	0.2	0.61	0.1	0.06	0.01
Dominican Rep 1999	-0.8	-0.2	-0.8	-0.2	0.24	0.07	1.64	0.47	0.55	0.14	1.63	0.41	0.57	0.15	0.29	0.07	0.09	0.02
Dominican Rep 2002	0.88	-0.3	0.88	-0.3	0.29	0.06	2.07	0.39	0.05	0.02	0.52	0.23	0.08	0.04	0.01	0	0.01	0.01
Egypt 1995	1.13	0.26	0.61	0.14	0.16	0.03	0.62	0.13	0.88	-0.2	0.56	0.13	0.28	0.06	0.18	0.04	1.19	0.28
Egypt 2000	1.03	0.15	0.65	0.09	0.11	0.01	0.29	0.04	0.12	0.06	0.18	0.09	0.01	0	0.04	0.02	0.18	0.09
Egypt 2005	0.93	0.1	0.6	0.07	0.04	0	0.15	0.02	0.05	0.03	0.02	0.01	0.04	-0	0	0	0.05	0.03

Ethiopia 2000	1.27	0.81	1.15	0.72	1.26	0.8	1.27	0.81	0.04	0.03	0.08	0.05	0.52	0.32	0.35	0.22	0.65	0.4
Ethiopia 2005	1.52	0.81	1.04	0.5	1.44	0.8	1.01	0.56	0.06	0.03	0.08	0.04	0.02	0.01	0.24	0.12	0.65	0.32
Gabon 2000	1.54	0.5	0.7	0.23	0.66	0.22	2.1	0.68	0.27	0.09	0.69	0.24	0.78	0.27	0.21	0.07	0.16	0.06
Ghana 1993	2.31	0.65	2.17	0.61	2.22	0.64	2.26	0.65	0.35	-0.1	-0.4	0.11	0.36	0.1	0.46	0.13	0.67	0.19
Ghana 1998	1.92	0.6	1.89	0.59	1.61	0.51	1.77	0.56	-0.2	-0.1	0.28	0.14	0.15	0.08	0.13	0.07	0.33	0.17
Ghana 2003	1.73	0.67	1.09	0.42	0.92	0.37	1.7	0.68	0.03	0.01	0.31	0.13	0.16	0.07	0.24	0.1	0.73	0.31
Guatemala 1995	0.3	0.13	0.18	0.08	0.87	0.38	1.41	0.6	-0.2	0.09	0.36	0.16	0.01	0.01	0.24	0.11	0.22	0.1
Guatemala 1999	0.15	0.05	0.03	0.01	0.7	0.27	1.35	0.52	0.07	0.02	0.49	0.18	0.04	0.01	0.14	0.05	0.24	0.09
Guinea 1999	1.73	0.71	1.66	0.66	1.8	0.74	1.83	0.75	0.26	0.12	0.21	0.09	0.37	0.17	0.21	0.09	0.71	0.32
Haiti 1995	1.31	0.56	0.63	0.27	1.4	0.63	1.54	0.69	0	0	0.29	0.13	0.31	0.14	0.36	0.16	0.41	0.19
Haiti 2000	1.27	0.46	0.87	0.31	1.61	0.6	1.91	0.71	0.07	0.03	0.41	0.16	0.2	0.08	0.35	0.14	0.35	0.14
India 1993	1.34	0.72	0.86	0.46	0.76	0.38	1.41	0.7	0.18	0.08	-0.1	0.05	0.16	0.07	0.11	0.05	0.22	0.1
India 1999	1.4	0.68	0.69	0.34	0.57	0.27	1.35	0.63	0.28	0.13	0.25	0.11	0.31	0.14	0.13	0.06	0.51	0.23
Indonesia 1994	1.02	0.3	0.84	0.25	1	0.26	.	.	0.52	0.15	.	.	.	.	0.3	0.09	0.89	0.26
Indonesia 1997	0.49	0.15	0.33	0.1	0.63	0.14	.	.	0.56	0.14	.	.	.	.	0.16	0.04	0.74	0.18
Indonesia 2003	1.81	0.44	1.53	0.37	0.29	0.07	1.31	0.33	0.21	-0.1	.	.	.	.	0.11	0.05	0.32	0.16
Kenya 1993	1.24	0.46	1.21	0.45	1.8	0.66	1.83	0.67	0.34	0.13	0.33	0.13	0.12	0.05	0.17	0.06	0.37	0.14
Kenya 1998	1.35	0.63	1.05	0.5	1.57	0.79	1.58	0.79	0.44	0.15	0.48	0.16	0.15	0.05	0.01	0.01	0.44	0.15
Kenya 2003	1.41	0.64	1.12	0.5	1.72	0.76	1.76	0.78	0.07	0.03	-0.3	0.13	0.01	0.01	0.08	0.04	0.48	0.21
Lesotho 2004	1.56	0.77	0.19	0.1	1.58	0.78	1.56	0.77	0.01	0	-0.5	0.24	0.05	0.02	0.12	0.06	0.35	0.17
Madagascar 1992	1.67	0.62	1.85	0.68	1.84	0.71	1.67	0.64	-0.2	0.07	0.01	0	0.47	0.17	0.19	0.07	0.34	0.12
Madagascar 1997	1.41	0.7	1.41	0.68	1.62	0.77	1.6	0.76	0.28	0.12	0.05	0.02	0.53	0.23	0.13	0.06	0.45	0.2
Madagascar 2004	1.74	0.76	1.45	0.63	1.78	0.76	1.73	0.74	-0.3	0.12	0.21	0.08	0.42	0.17	0.19	0.08	0.63	0.25
Malawi 1992	1.57	0.76	1.19	0.55	1.56	0.75	1.47	0.7	0.03	0.01	0.24	0.11	0.05	0.02	0.1	0.04	0.15	0.07
Malawi 2000	1.59	0.74	1.16	0.5	1.7	0.73	1.62	0.7	0.13	0.05	0.26	0.11	0.06	0.02	0.1	0.04	0.22	0.09
Mali 1996	1.87	0.65	1.89	0.66	2.13	0.76	1.97	0.7	0.27	0.12	0.21	0.09	0.54	0.24	0.49	0.22	0.76	0.33
Mali 2001	1.62	0.7	1.03	0.43	1.71	0.7	1.31	0.54	0.15	0.06	0.32	0.12	0.56	0.21	0.85	0.32	0.63	0.23
Mauritania 2001	1.22	0.62	0.75	0.38	1.32	0.68	1.53	0.79	0.02	0.01	0.24	0.11	0.33	0.15	0.01	0.01	0.47	0.22
Morocco 1992	1.47	0.57	1.08	0.43	1.26	0.48	1.21	0.46	0.38	0.16	0.71	-0.3	0.32	0.13	0.1	0.04	1.13	0.48
Morocco 2004	2.79	0.36	1.99	0.26	1.31	0.19	0.91	0.13	0.17	0.08	0.27	0.12	0.03	0.02	0.03	0.02	0.13	0.06
Mozambique 1997	1.33	0.61	1.07	0.54	1.33	0.68	1.12	0.57	0.06	0.03	0.38	0.18	0.57	0.27	0.26	0.12	0.61	0.29
Mozambique 2003	1.36	0.81	1.09	0.63	1.38	0.77	1.44	0.81	0.07	0.04	0.33	0.17	0.23	0.12	0.11	0.06	0.46	0.24
Namibia 1992	1.26	0.66	0.74	0.38	1.46	0.77	1.34	0.7	0.16	0.09	0.19	-0.1	0.02	-0	0.05	0.03	0.16	0.09
Namibia 2000	1.12	0.56	0.63	0.31	1.23	0.64	1.25	0.65	0.14	0.08	0.18	0.11	0.07	0.04	0.04	0.02	0.18	0.11
Nepal 1996	1.04	0.39	1.1	0.31	1.57	0.57	1.48	0.54	0.03	0.01	0.16	0.07	0.34	0.14	0.05	0.02	0.42	0.17

Nepal 2001	1.18	0.67	0.12	0.06	1.08	0.63	1.35	0.78	0.11	0.06	0.14	0.08	0.15	0.08	0.09	0.05	0.8	0.44
Nicaragua 1998	0.89	0.32	0.77	0.28	0.74	0.28	1.78	0.66	0.38	0.15	0.53	-0.2	0.16	0.06	0.06	0.02	0.51	0.2
Nicaragua 2001	0.83	0.27	0.72	0.23	0.79	0.26	2.08	0.69	0.31	0.16	0.37	0.19	0.01	0.01	0.05	0.03	0.08	0.04
Niger 1992	1.31	0.77	1.27	0.73	1.39	0.79	1.41	0.81	0.08	0.04	0.12	0.06	0.79	0.44	0.57	0.32	0.52	0.29
Niger 1998	1.27	0.74	1.11	0.64	1.31	0.77	1.05	0.61	0.11	0.07	0.08	0.05	0.65	0.38	0.35	0.21	0.3	0.18
Nigeria 1990	2.01	0.77	1.66	0.63	1.73	0.67	1.99	0.77	0.01	0.01	0.18	0.07	0.47	0.18	0.3	0.11	0.49	0.18
Nigeria 1999	1.79	0.59	1.28	0.42	1.36	0.47	2.13	0.74	0.17	0.07	0.23	0.09	1.07	0.42	0.27	0.11	0.77	0.3
Nigeria 2003	1.47	0.54	1.02	0.37	1.03	0.35	2.09	0.72	0.39	0.12	0.47	0.15	1.68	0.53	0.62	0.2	1.17	0.37
Pakistan 1991	1.27	0.64	1.11	0.56	0.58	0.28	1.35	0.66	-0.3	0.13	0.27	0.12	0.31	0.14	0.2	0.09	0.28	0.12
Paraguay 1990	1.39	0.62	1.35	0.6	0.99	0.42	1.69	0.72	0.19	0.07	0.72	0.27	0.42	0.15	0.47	0.17	0.48	0.18
Peru 1992	1.02	0.33	0.76	0.25	0.83	0.26	1.56	0.5	0.52	-0.2	0.91	0.34	0.27	0.1	0.3	0.11	0.23	0.09
Peru 2000	0.78	0.26	0.61	0.2	0.81	0.28	1.3	0.44	0.33	0.18	0.73	0.39	0.09	0.05	0.06	0.03	0.53	0.28
Peru 2004	0.8	0.22	0.7	0.2	0.79	0.23	1.28	0.37	0.06	0.04	.	.	.	.	0.01	0	0.09	0.05
Philippines 1993	1.81	0.54	1.17	0.35	0.91	0.3	0.84	0.27	0.48	0.17	.	.	.	.	0.35	0.12	0.09	0.03
Philippines 1998	0.92	0.25	0.54	0.15	0.86	0.24	0.68	0.19	0.52	0.17	.	.	.	.	0.12	0.04	0.79	0.26
Philippines 2003	1.39	0.33	0.69	0.16	0.77	0.21	0.68	0.19	0.29	0.14	.	.	.	.	0.2	0.1	0.5	0.23
Rwanda 1992	1.65	0.68	1.73	0.66	2.03	0.75	1.96	0.72	0.01	0	-0.2	0.07	0.01	0	0.44	0.15	0.06	0.02
Rwanda 2000	1.21	0.78	0.68	0.37	1.28	0.77	1.33	0.8	0.02	0.01	0.21	0.12	0.03	0.02	0.37	0.22	0.47	0.28
Senegal 1993	1.46	0.68	1.06	0.49	1.59	0.7	1.66	0.72	0.27	0.12	0.33	0.14	0.35	0.15	0.43	0.19	0.7	0.3
Senegal 1997	1.42	0.65	0.97	0.45	1.53	0.63	1.72	0.71	0.29	0.11	.	.	.	.	0.02	0.01	0.58	0.23
Senegal 2005	1.39	0.46	0.78	0.26	1.33	0.43	1.39	0.45	0.42	0.13	0.79	0.25	0.16	0.05	0.08	0.03	0.56	0.18
South Africa 1998	1.03	0.36	0.46	0.16	0.93	0.32	1.42	0.49	0.62	-0.2	.	.	.	.	0.01	0	0.22	0.07
Tanzania 1992	2.07	0.66	2.08	0.59	2.11	0.65	1.59	0.49	-0.2	0.05	0.1	0.02	0.31	0.08	0.26	0.06	0.56	0.14
Tanzania 1999	1.52	0.78	1.01	0.45	1.55	0.8	1.46	0.75	-0.1	0.05	0	0	0.17	0.09	0.01	0	0.34	0.17
Tanzania 2004	1.43	0.71	0.72	0.37	1.61	0.78	1.59	0.77	0.08	0.04	0.26	0.12	0.17	0.08	0.05	0.02	0.25	0.11
Togo 1998	1.54	0.62	1	0.41	1.84	0.76	0	0	0.02	0.01	0.21	0.09	0.3	0.13	0.1	0.04	0.55	0.24
Turkey 1993	-0.6	-0.3	-0.3	-0.1	.	.	-0.9	0.41	0.38	0.16	0.67	0.27	0.39	-0.2	-0.5	-0.2	0.42	-0.2
Turkey 1998	0.24	0.03	-0	-0	.	.	1.88	0.33	0.87	0.17	1.38	0.27	0.82	0.16	0.37	0.07	0.65	0.13
Uganda 1995	2.37	0.79	2.35	0.77	2.18	0.79	2.13	0.77	0.09	0.03	0.25	-0.1	0.19	0.07	0.16	0.06	0.6	0.23
Uganda 2001	1.98	0.79	1.86	0.74	1.9	0.74	1.82	0.71	-0.1	0.04	0.29	0.11	0.09	0.03	0.17	0.07	0.59	0.23
Uzbekistan 1996	1.93	0.34	0.76	0.14	0.02	0	4.97	0.76	0.21	0.03	0.82	0.12	0.07	0.01	1.49	0.22	0.13	0.02
Vietnam 1997	2.16	0.7	2.05	0.66	0.56	0.18	2.3	0.75	0.55	0.19	.	.	.	.	0.1	0.04	0.41	0.15
Vietnam 2002	2.11	0.67	2.04	0.65	0.3	0.09	2.3	0.69	1.03	0.34	.	.	.	.	0.2	0.07	0.35	0.12
Yemen 1992	1.38	0.51	1.27	0.47	1.05	0.42	1.87	0.74	0.31	0.11	0.24	0.09	0.56	0.21	0.67	0.25	0.04	0.01
Zambia 1992	1.26	0.47	1.35	0.48	1.42	0.49	1.41	0.49	0.16	0.07	0.24	0.11	0.18	0.08	0.14	0.06	0.62	0.28

Zambia 1996	1.67	0.57	1.44	0.53	1.49	0.6	1.49	0.6	0.06	0.03	-0.3	0.13	0.04	0.02	0.07	0.03	0.67	0.29
Zambia 2002	1.47	0.73	1.16	0.57	1.49	0.74	1.46	0.73	0.03	0.01	-0.2	-0.1	0.11	0.05	0.07	0.03	0.63	0.31
Zimbabwe 1994	1.29	0.68	1	0.52	1.34	0.73	1.29	0.7	-0.2	0.08	0.26	-0.1	0.08	0.03	0.01	0	0.12	0.05
Zimbabwe 1999	1.05	0.57	0.89	0.48	1.02	0.56	1.06	0.58	0.07	0.04	0.28	0.16	0	0	0.07	0.04	0.08	0.04

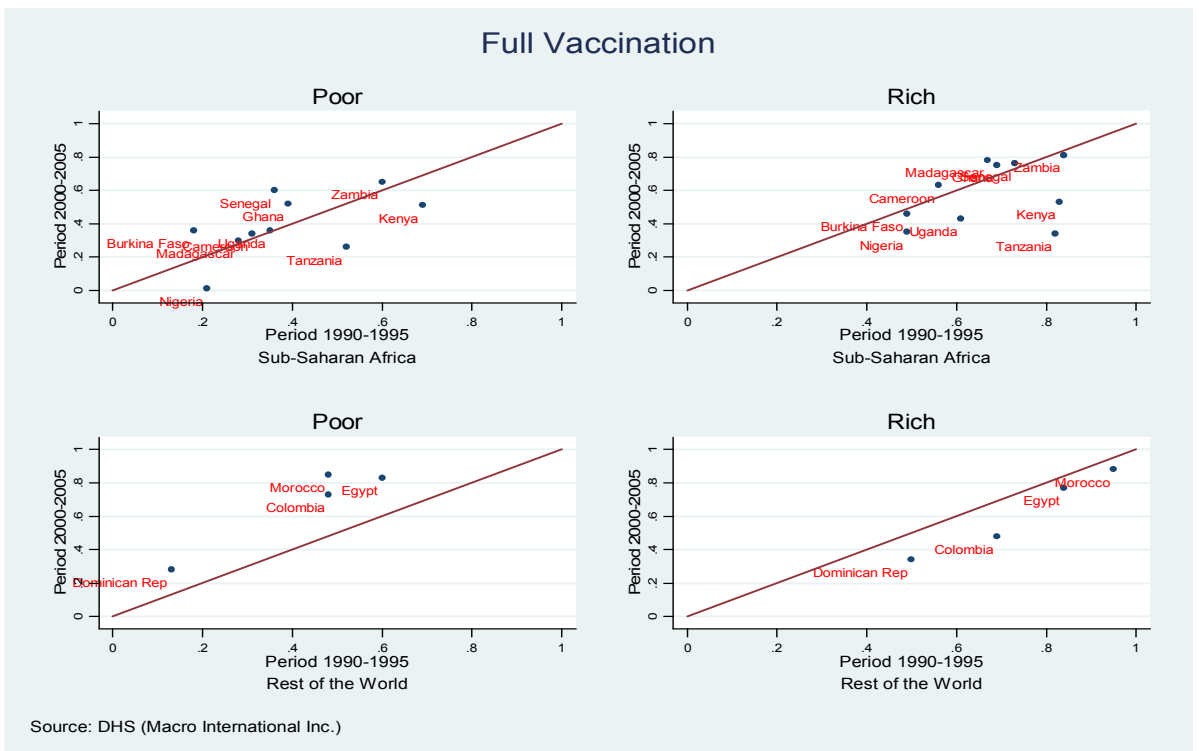
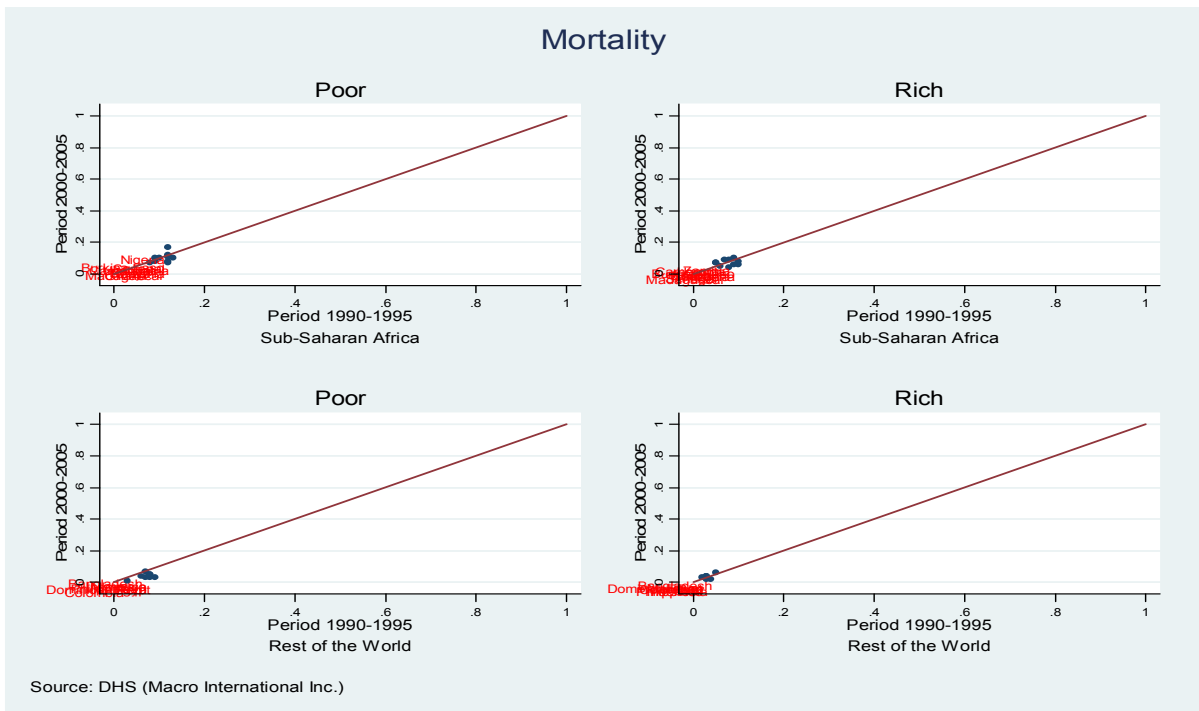
Source: Author's calculations using DHS datasets and population weights.

Table A13. Marginal Gini Income Elasticity for Sanitation Services, Health Status and Access to Health Care.

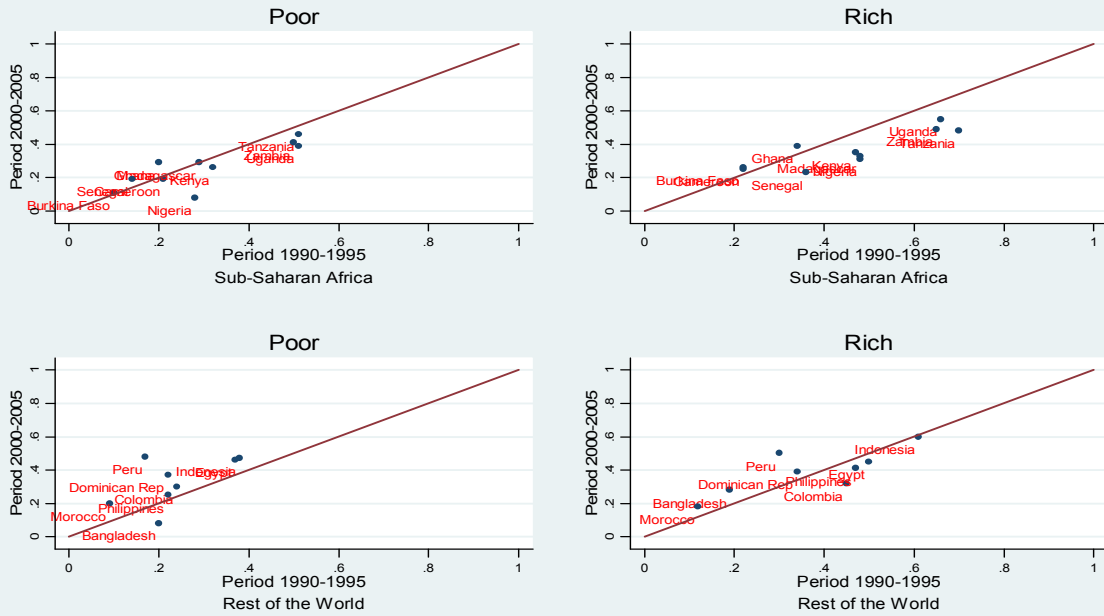
	SANITATION INFRASTRUCTURES				HEALTH				
	Tap Water in Residence	Tap (Public & Private)	Electricity	Flush Toilet	Child is under-weight	Child is fully vaccinated	Diarrhoea : medical treatment	Medical delivery	Child is dead
Bangladesh	2.42	2.42	0.72	1.08	.	.	-1.45	-0.14	-0.06
Benin	1.34	0.32	1.48	2.02	0.08	-0.64	0.86	-0.38	-0.07
Bolivia	-0.65	-1.27	-1.48	-0.86	-0.43	0.97	-1.52	0.04	-8.28
Brazil	-1.58	-1.36	-2.88	4.57	.	.	0.25	-1.37	0.84
Burkina Faso	2.33	0.94	1.55	1.42	-0.70	-0.93	0.83	-0.52	0.39
Cameroon	0.89	-0.73	0.45	2.87	-1.09	-0.44	-5.68	-1.65	0.57
Chad	1.53	1.42	1.51	1.33	-0.05	0.85	-0.69	-0.83	-1.59
Colombia	79.91	430.76	-5.77	-6.96	.	.	3.54	-4.56	21.70
Cote d'Ivoire	0.40	-0.81	0.11	1.04	10.20	1.07	0.04	-16.27	-0.99
Dominican Rep	2.97	2.97	-3.57	1.22	-1.35	12.23	-1.99	-75.37	-2.14
Egypt	-3.67	-3.45	-5.52	-4.38	-1.29	-1.29	-9.83	-0.76	-0.98
Ethiopia	1.35	-0.14	1.10	0.85	-0.16	-1.16	-0.09	-0.29	-0.39
Ghana	2.64	-4.40	-0.32	2.15	-0.09	-0.09	0.03	-0.74	0.92
Guatemala	12.97	5.13	-0.88	0.67	0.49	0.08	-0.86	-0.48	-2.09
Haiti	3.32	0.95	0.61	1.54	-0.21	-0.49	1.94	-0.19	-13.09
India	0.92	-0.94	-0.94	0.19	0.84	1.40	1.42	6.84	0.18
Indonesia	2.96	5.80	-1.49	.	.	.	-0.63	-0.06	-0.28
Kenya	5.59	19.93	2.40	4.05	-0.23	0.33	0.37	-0.18	1.77
Madagascar	-757.59	1.16	2.00	0.94	-9.56	0.40	0.10	-1.41	-0.02
Malawi	1.30	0.67	1.47	1.57	-0.36	0.05	0.12	-0.08	0.28
Mali	2.07	0.37	1.62	1.32	0.10	2.25	0.07	273.81	0.41
Morocco	-0.62	-1.38	-1.34	-1.98	35.30	-1.33	-0.02	-0.71	-0.67
Mozambique	9.70	653.38	3.26	-2.48	-0.37	-0.87	-0.29	-0.71	-0.19
Namibia	0.22	-0.24	0.80	0.68	-0.12	0.56	-0.26	0.42	-0.18
Nepal	-7.68	-4.64	1.76	1.85	-0.65	-0.07	0.21	3.26	-1.96
Nicaragua	-8.10	-7.53	9.97	0.67	-0.67	1.15	0.18	-0.85	-0.27
Niger	0.92	-0.24	1.22	3.41	0.11	-1.36	0.00	-0.39	-0.02
Nigeria	3.23	3.25	0.07	1.70	1.01	-0.22	-0.85	-11.65	-4.51
Peru	-2.35	-4.02	-2.28	-0.33	.	.	-0.23	0.85	-0.68
Philippines	-0.89	-1.13	-1.12	-0.61	.	.	1.01	-0.72	-1.25
Rwanda	2.38	-3.04	2.01	3.94	0.40	-0.26	0.12	-0.53	-0.12
Senegal	0.32	-0.95	0.29	0.90	0.33	-1.27	3.17	-0.25	-0.11
Tanzania	1.51	-13.72	2.78	2.83	1.35	0.25	1.29	-4.57	-0.26
Turkey	11.09	2.41	.	15.79	6.86	-3.02	2.45	12.29	13.23
Uganda	2.24	1.80	1.33	-0.11	-0.02	0.56	0.09	0.16	-0.12
Vietnam	1.83	1.88	-1.69	1.78	.	.	0.51	-0.54	-0.32
Zambia	0.30	0.67	-2.59	0.02	-0.14	-1.63	0.34	0.23	-4.44
Zimbabwe	0.06	0.37	0.30	-0.08	0.29	0.38	-3.12	-0.15	0.14

Source: Author's calculations using DHS datasets and population weights.

Figure A6: Trends in Access to Sanitation Services (Electricity and Water) for Poor and Rich.

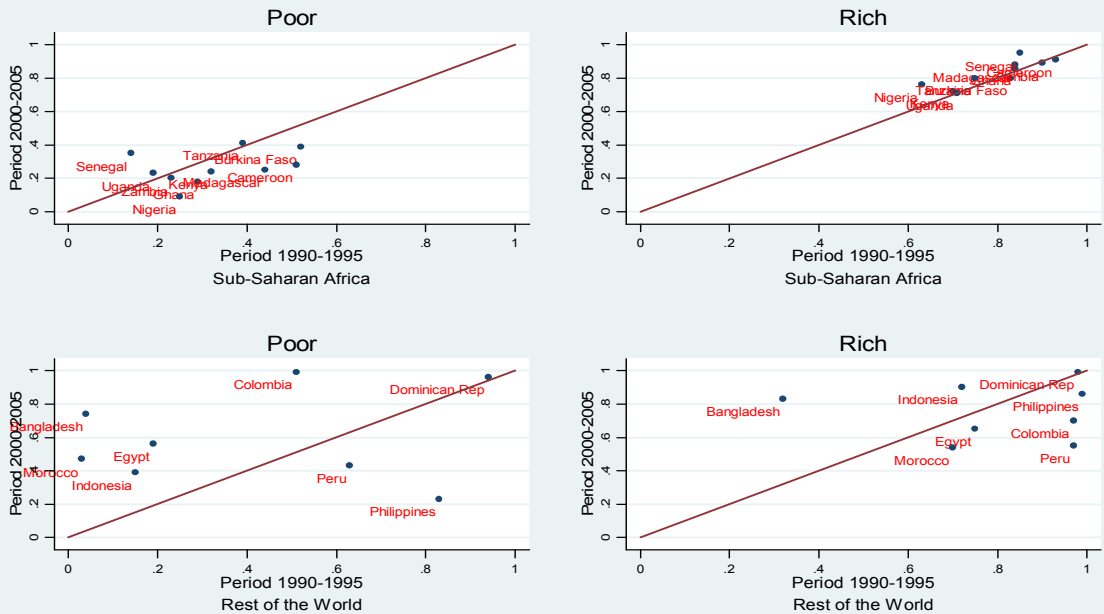


Medical Treatment for Diarrhea



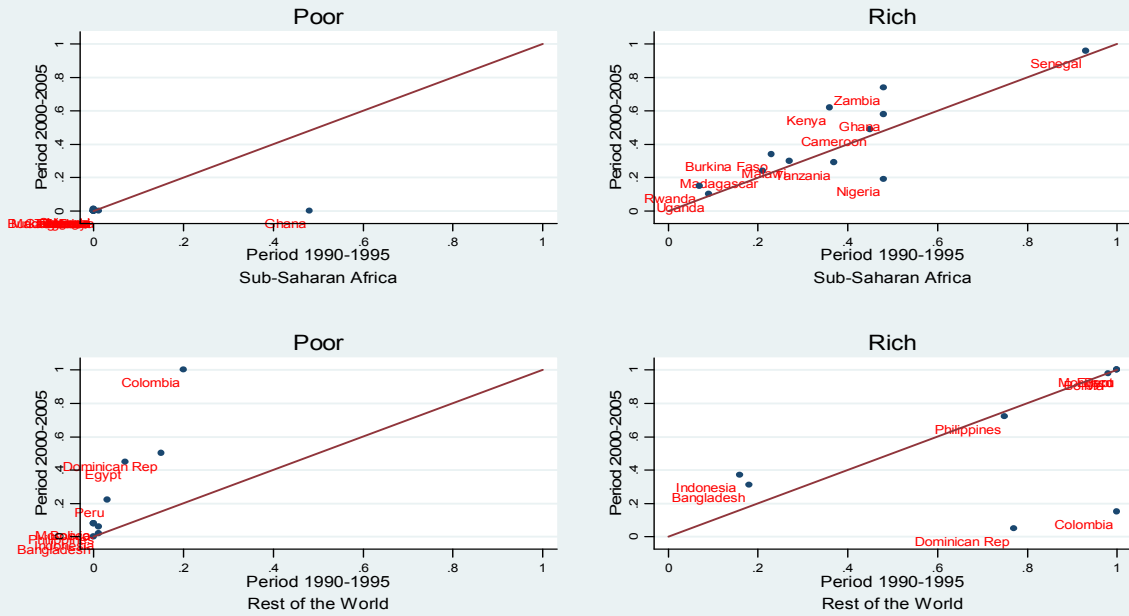
Source: DHS (Macro International Inc.)

Medical Assistance at Delivery



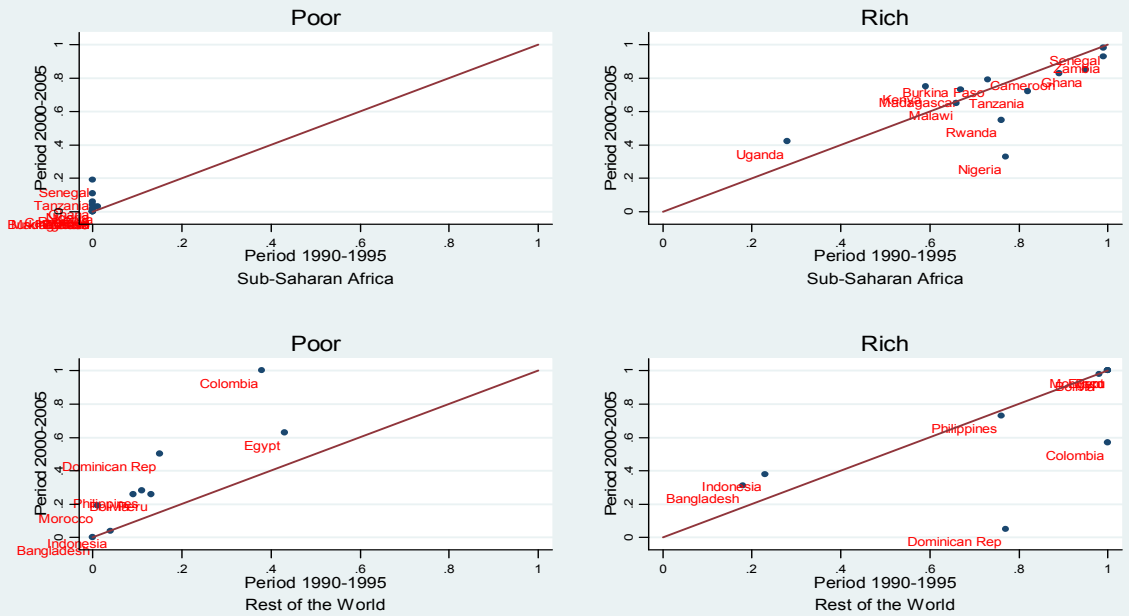
Source: DHS (Macro International Inc.)

Water in Residence



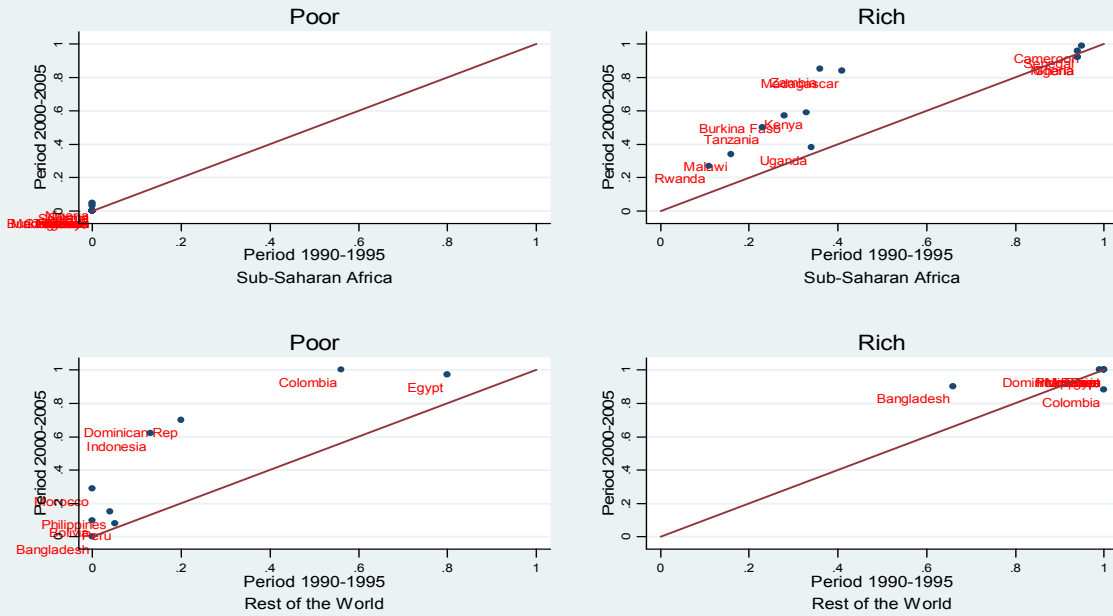
Source: DHS (Macro International Inc.)

Tap Water (Public & Private)



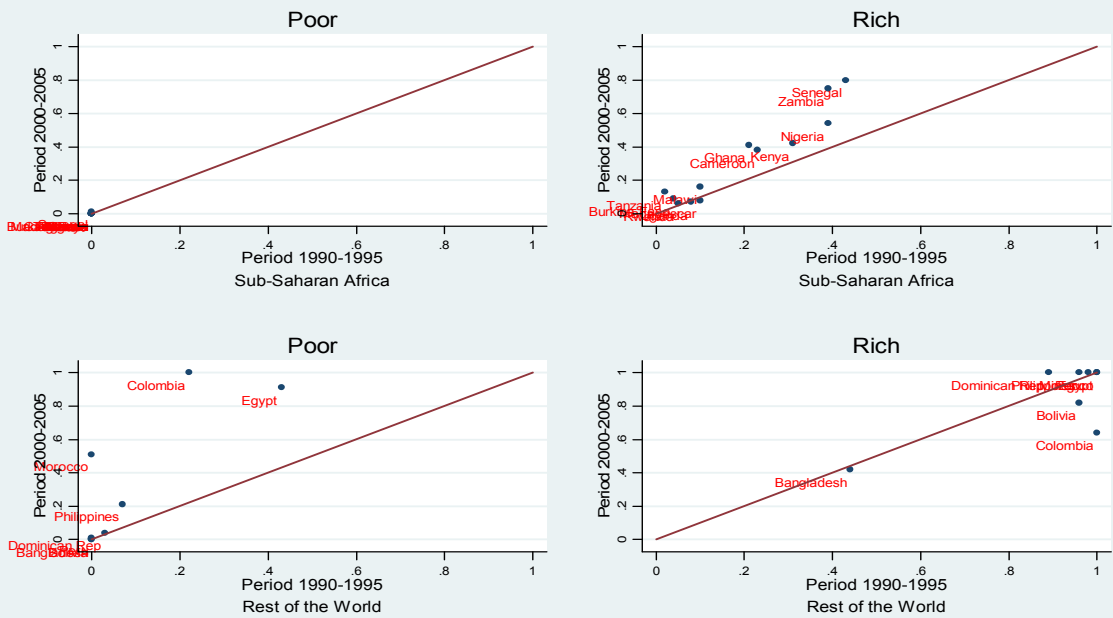
Source: DHS (Macro International Inc.)

Electricity



Source: DHS (Macro International Inc.)

Flush Toilet



Source: DHS (Macro International Inc.)

Source: Author's own calculations using DHS data.

COMPUTER PROGRAMS

CHAPTER 2

Appendix 1: Stata code for the hypothetical example.

```
*
*                               Begin do file
*Version 1.0.0 03/01/2007
cd e:\data\dhs\data
clear
set more off
set memory 150m
capture matrix drop _all
capture macro drop _all
capture scalar drop _all
capture log close
log using demographysimul.log, text replace
capture matrix drop _all
matrix mis = .....
// Nominal income of 100 for each HH
// Equivalent per equivalent adult income
forvalue i = 1/10 {
  forvalue j = 0(.1)1 {
    local c = 100/(i^j)
    matrix N = nullmat(N), `c'
  }
  matrix M = nullmat(M) \ N
  matrix drop N
}
matrix colname M = "Beta 0" "Beta 0,1" "Beta 0,2" "Beta 0,3" "Beta 0,4" "Beta 0,5" ///
"Beta 0,6" "Beta 0,7" "Beta 0,8" "Beta 0,9" "Beta 1"
matrix rowname M = "Household size 1" "Household size 2" "Household size 3" ///
"Household size 4" "Household size 5" "Household size 6" "Household size 7" ///
"Household size 8" "Household size 9" "Household size 10"
matrix list M
matrix demography = nullmat(demography) \ M
matrix demography = nullmat(demography) \ mis
// Equivalent HH nominal income
forvalue i = 1/9 {
  local w = `i' + 1
  forvalue j = 1/11 {
    scalar c = (el(M, `w', `j') / el(M, `i', `j')) * 100
    matrix N = nullmat(N), c
  }
  matrix T = nullmat(T) \ N
  matrix drop N
}
matrix colname T = "Beta 0" "Beta 0,1" "Beta 0,2" "Beta 0,3" "Beta 0,4" "Beta 0,5" ///
"Beta 0,6" "Beta 0,7" "Beta 0,8" "Beta 0,9" "Beta 1"
matrix rowname T = "Household size 1" "Household size 2" "Household size 3" ///
"Household size 4" "Household size 5" "Household size 6" "Household size 7" ///
"Household size 8" "Household size 9" "Household size 10"
matrix li T
matrix demography = nullmat(demography) \ T
matrix demography = nullmat(demography) \ mis
// Required growth rate to keep consumption constant without population growth
forvalue i = 2/10 {
  local w = `i' - 1
  forvalue j = 1/11 {
    scalar c = (((el(T, `w', `j') * `i' - (`w' * 100)) / (`w' * 100)) * 100
    matrix N = nullmat(N), c
  }
  matrix W = nullmat(W) \ N
  matrix drop N
}
matrix colname W = "Beta 0" "Beta 0,1" "Beta 0,2" "Beta 0,3" "Beta 0,4" "Beta 0,5" ///
"Beta 0,6" "Beta 0,7" "Beta 0,8" "Beta 0,9" "Beta 1"
matrix rowname W = "Size 2 to 1" "Size 3 to 2" ///
"Size 4 to 3" "Size 5 to 4" "Size 6 to 5" "Size 7 to 6" ///
"Size 8 to 7" "Size 9 to 8" "Size 10 to 9"
matrix list W
```



```

local e = (`d' - `e') / `c'
local f = `e' * `a'
local g = (1+`e')^(1/(`maxy' - `miny'))-1
local h = (1+`f')^(1/(`maxy' - `miny'))-1
matrix M`n' = `c' \ `d' \ `e' \ `f' \ `g' \ `h'
local n = `n' + 1
}
forvalue j = 1/14 {
matrix N = nullmat(N) , M`j'
matrix drop M`j'
}
matrix N = A \ N
matrix drop A
matrix rowname N = "i" "A" "B" "C" "D" "E" "F"
matrix colname N = "Period under review" "Cumulative Population Growth" "Annual Rate of Population Growth" ///
"Beta values 0" "Beta values 0,1" "Beta values 0,2" "Beta values 0,3" "Beta values 0,4" "Beta values 0,5" ///
"Beta values 0,6" "Beta values 0,7" "Beta values 0,8" "Beta values 0,9" "Beta values 1"
/*
A Required GDP per equivalent adult, period 1
B Required GDP per equivalent adult, period 2
C Increase in GDP needed to compensate for smaller household size, without pop. Growth
D Increase in GDP needed to compensate for smaller household size, with pop. growth
E Annual required increase in GDP, without pop. Growth
F Annual required increase in GDP, with pop. Growth
*/
matrix M = nullmat(M) \ N
matrix drop N
}
matrix list M
capture noisily xml_tab M , save(demography.xls) replace
if _rc == 920 {
preserve
drop _all
svmat M
outsheet using demography.xls, replace
restore
}
matrix drop _all
log close
exit
*
End do file

```

CHAPTER 4

Program 1: STATA Code to Compute the Concentration Index on Grouped Data.

```

*!Program to compute the concentration index on grouped databulate using covariance/formulabel method.
#d;
program concindexg, rclass sortpreserve byable(recall);
set more 1;
preserve;
version 8.2;
syntax [aweight pweight fweight iweight] [if] [in] , Welfarevar(varname) [Drop Format(string) Info Matrix(string) SET SPLITvars(varlist)
Vars(varlist)];
if ("vars" ~= "" & "matrix" ~= "") | ("splitvars" ~= "" & "matrix" ~= "") {
noisily display as error "May not combine varlist with matrix option" _n;
exit;
};
marksample touse, novar;
if "by" ~= "" {
markout `touse' `by' , strok;
};
tempname N T W w W2 V R SD A A1 A2 A3 A3C A1s A2s A3s W2 ;
quietly {
missing `welfarevar';
if r(N) > 0 {
noisily display _n;
}
}

```

```

noisily display in yellow ""welfarevar"" in green " has " in yellow r(N) in green " missings. Dropped." _n;
drop if `welfarevar' == .;
};
// Welfare indicator;
capture sort `welfarevar';
tabulate `welfarevar' [`weight' `exp'] if `touse', m;
// Number of persons per quintiles;
tabulate `welfarevar' [`weight' `exp'], matcell(`W');
matsum `W', col(`w');
local ssw = `w'[1,1];
local n = rowsof(`W');
// Relative percentage of people;
forvalue i = 1 / `n' {;
    local ele = el(`W', i, 1) / `ssw';
    matrix `W2' = nullmat(`W2') \ `ele';
};
// Cumul % of people;
Cum `W2' \ V' `n';
// R matrice;
matrix `R' = 0.5 * el(`W2', 1, 1);
forvalue i = 2 / `n' {;
    local e11 = el(`V', i-1, 1);
    local e12 = 0.5 * el(`W2', i, 1);
    local ele = `e11' + `e12';
    matrix `R' = nullmat(`R') \ `ele';
};
if ""matrix"" == "" {;
    // Are there variables with more than 2 modalities? ;
    // Checking that and put variables for analysis in a macro;
    if ""splitvars"" ~= "" {;
        local splited;
        tokenize `splitvars';
        while ""1"" ~= "" {;
            capture drop `1' *;
            tabulate `1', generate(`1_');
            local splited ""splited' `1_ *";
            macro shift;
        };
    };
    local fact ""vars' `splited"";
    unab fact: `fact';
    local Rownames `fact';
    quietly foreach i of local fact {;
        nmissing `i';
        if r(N) > 0 {;
            noisily display in yellow ""i"" in green " has " in yellow r(N) in green " missings. You should check it." _n;
        };
    };
    quietly foreach var of local fact {;
        if ""se"" ~= "" {;
            levelsof `welfarevar', l(1);
            foreach i of local l {;
                summarize `var' [`weight' `exp'] if `welfarevar' == `i' & `touse';
                local sd `i' = r(sd);
                matrix `SD' = nullmat(`SD') \ `sd `i";
            };
        };
        // Target variable (quintile means);
        capture tabulate `welfarevar' `var' [`weight' `exp'] if `touse', row nof matcell(`A') ;
        if (r(N) == 0 | r(N) == .) {;
            noisily display _n;
            noisily display in green "No observation on " in yellow ""var"" _n;
            matrix `T' = ,,,;
            local nam `var';
            matrix colnames `T' = CI varCI seCI ttestCI;
            matrix rownames `T' = `nam';
        };
        else if (r(N) ~= 0 | r(N) < .) {; // Redundant here but prefer to code that way;
            local nam `nam' `var';
            // Constructing matrice for thoset with "access";

```

```

local c = colsof(`A`);
matrix `A1' = `A'[1,...,1];
matrix `A1s' = `A1'; // not be used;
if `c' > 1 {;
  matrix `A2' = `A'[1,...,2];
  matrix `A3' = `A1' + `A2';
  Cum `A3' `A3C' `n';
};
else {;
  matrix `A2' = `A1';
  matrix `A2s' = `A1';
  matrix `A3' = `A1';
  matrix `A3s' = `A1';
};
local A1s `A1s';
local A2s `A2s';
local A3s `A3s';
// Building up the matrice;
forvalue i = 1 / `c' {;
  local nmt `A' `i's;
  noisily display "" `nmt"";
  forvalue j = 1 / `n' {;
    local ele = (el(`A' `i', `j', 1) / el(`A3' `j', 1));
    matrix "" `nmt" = nullmat(`nmt") \ `ele';
  };
};
if "" `se"" ~="" {;
  local sds sds(`SD');
};
// Results;
CI, g(`A2s') ta(`W2') `se' vm(`V') nm(`N') tm(`T') rm(`R') ssw(`ssw') `sds';
matrix colnames `T' = CI varCI seCI ttestCI;
matrix rownames `T' = `nam';
};
};
};
else if "" `matrix"" != "" {; // Redundant here;
capture conf matrix `matrix';
if _rc != 0 {;
  noisily display as error "Invalid matrix" _n;
  exit;
};
else {;
  local na2 = rowsof(`matrix');
  if `n' ~="" `na2' {;
    noisily display as error "Conformability error" _n;
    exit;
  };
  matrix `A2s' = `matrix';
  CI, g(`A2s') ta(`W2') `se' vm(`V') nm(`N') tm(`T') rm(`R') ssw(`ssw') `sds';
  matrix colnames `T' = CI varCI seCI ttestCI;
  matrix rownames `T' = Results;
};
};
display _n;
display in green "Final matrice of Concentration Indices on Grouped Data." _n;
if "" `format"" ~="" {;
  noisily display _n;
  noisily matrix list `T', noh f(`format');
  noisily display _n;
};
else {;
  noisily display _n;
  noisily matrix list `T', noh;
  noisily display _n;
};
if ~missing("" `info'") {;
  noisily display _n;
  noisily display in yellow "CI : " in green "Concentration index using formula/covariance method" ;
  noisily display in yellow "varCI : " in green "Variance of the concentration index" ;
};

```

```

    noisily display in yellow "seCI : " in green "Standard errors of the concentration index" ;
    noisily display in yellow "ttestCI : " in green "T-test of the concentration index" _n ;
};
return matrix CIG = `T', copy;
};
restore;
end;

program CI;
syntax , Group(string) TArget(string) [SET SDS(string)] VM(string) NM(string) RM(string) TM(string) SSW(string) ; // Have not found any
bette idea - yet;
local n = rowsof(`group');
tempname F FC f Q CI ci F FR fr AM FA fa SIG sig JJ jj ;
// f_mu matrice;
forvalue i = 1 / `n' {;
    local e11 = el(`target',i,1);
    local e12 = el(`group',i,1);
    local ele = (`e11' * `e12');
    matrix `F' = nullmat(`F') \ `ele';
};
// cum_f_mu matrice;
Cum `F' `FC' `n';
// Computing the sumproduct;
matsum `F', col(`f');
local fel = `f'[1,1];
// q matrice;
forvalue i = 1 / `n' {;
    local ele = el(`FC',i,1) / `fel';
    matrix `Q' = nullmat(`Q') \ `ele';
};
// Concentration Index;
local n2 = `n'-1;
forvalue i = 1 / `n2' {;
    local e11 = el(`vm',i,1) * el(`Q',i+1,1);
    local e12 = el(`vm',i+1,1) * el(`Q',i,1);
    local ele = `e11'-`e12';
    matrix `CI' = nullmat(`CI') \ `ele';
};
matrix `CI' = nullmat(`CI') \ 0;
matsum `CI', col(`ci');
local ci = `ci'[1,1];
matrix `nm' = nullmat(`nm'), `ci';
// f_mu_R matrice;
forvalue i = 1 / `n' {;
    local e11 = el(`F',i,1);
    local e12 = el(`rm',i,1);
    local ele = (`e11' * `e12');
    matrix `FR' = nullmat(`FR') \ `ele';
};
matsum `FR', col(`fr');
local fr = `fr'[1,1];
local fr = (2 / `fel') * `fr'-1;
// "a" matrice;
local e11 = (el(`group',1,1) / `fel') ;
local e12 = 2 * el(`rm',1,1) - 1 - `ci';
local e13 = 2 - el(`Q',1,1);
matrix `AM' = (`e11' * `e12') + `e13';
forvalue i = 2 / `n' {;
    local e11 = el(`group',i,1) / `fel';
    local e12 = 2 * el(`rm',i,1) - 1 - `ci';
    local e13 = 2 - el(`Q',i-1,1) - el(`Q',i,1);
    local ele = (`e11' * `e12') + `e13';
    matrix `AM' = nullmat(`AM') \ `ele';
};
// f*a^2 matrice;
forvalue i = 1 / `n' {;
    local e11 = el(`AM',i,1)^2;
    local e12 = el(`target',i,1);
    local ele = (`e11' * `e12');
    matrix `FA' = nullmat(`FA') \ `ele';
};

```

```

};
matsum `FA', col(`fa');
local fa = `fa'[1,1];
// Calculating the variance of the concentration index;
if "`se'" == "" { // If Standard Errors requested;
// f x sig tsq etc. matrice;
local fa2 = (1 / `ssw') * (`fa' - ((1 + `ci') ^ 2));
forvalue i=1 / `n' {
local el1 = el(`target', `i', 1);
local el2 = el(`sds', `i', 1)^2;
local el3 = (2 * el(`rm', `i', 1) - 1 - `fr') ^ 2;
local ele = (`el1' * `el2' * `el3');
matrix `SIG' = nullmat(`SIG') \ `ele';
local el2 = el(`group', `i', 1);
local ele = (`el1' * `el2');
matrix `JJ' = nullmat(`JJ') \ `ele';
};
matsum `SIG', col(`sig');
local sig = `sig'[1,1];
matsum `JJ', col(`jj');
local jj = `jj'[1,1];
local fx = (`sig' / (`ssw' * (`jj' ^ 2)));
local vari = `fa2' + `fx';
matrix `nm' = nullmat(`nm'), `vari';
};
else { // No Standard Errors available;
local vari = (1 / `n') * (`fa' - ((1 + `ci') ^ 2));
matrix `nm' = nullmat(`nm'), `vari';
};
// Standard deviation of the concentration index;
local svar = sqrt(`vari');
matrix `nm' = nullmat(`nm'), `svar';
// Ttest for the concentration index;
local ttvar = `ci' / `svar';
matrix `nm' = nullmat(`nm'), `ttvar';
// Final results;
matrix `tm' = nullmat(`tm') \ `nm';
end;

program Cum;
local elist = 0;
forvalue i = 1 / `3' {
local el = el(`1', `i', 1);
local elist = `eli' + `el';
matrix `2' = nullmat(`2') \ `eli';
local elist = `eli';
};
end;
exit;
syntax: concindexg $po, w(quiet) d sp(v113 v116 v127) set cl v(v119 v120 v121 v122 v123 v124 v125)

```

Program 2: STATA Code to Compute the Concentration Index on Individual (Micro) Data.

```

*!Program to compute the concentration index on individual (micro) data.
program concindexi, byable(recall) rclass sortpreserve
quietly {
version 8.2
set more 1
preserve
syntax varlist [if] [in] [aweight fweight pweight iweight], Welfarevar(string) ///
[CUrve CONvenient CLean Format(string) ]
tempname CIF CISEF CIC CISEC M
capture matrix drop CH `CIF' `CISEF' `CIC' `CISEC' `M'
if ""weight"" == "" & ""convenient"" == "" {
noisily display _n
noisily display in red "Weights generally inappropriate to compute concentration index (see Wagstaff and al.)" _n
}
}

```

```

noisily display in red "Warning...You have specified weights and requested both formulabel and convenient regression method."
noisily display in red "This could produce different concentration indices between the estimated concentration indices." _n
}
drop if `welfarevar' == .
marksample touse, novar
if ""by"" ~="" {
    markout `touse' `by', strok
}
// Concentration index using the "convenient covariance" formula:
display _n
display in green "Concentration index estimation using the covariance/formulabel method" _n
// If convenient regression
if ""convenient"" ~="" {
    display in green "Concentration index alsort estimated using the convenient regression method" _n
}
local nam CIF CISEF
if ""convenient"" ~="" {
    local matrix ", `CIC', `CISEC'"
    local nam `nam' CIC CISEC
}
foreach i of local varlist {
    tempvar rank ccurve glvar cclag a2 va2 sa2
    summarize `i' [`weight' `exp'] if `touse'
    if r(sd) == 0 {
        noisily display _n
        noisily display in green "No observation on " in yellow ""i"" _n
        matrix `M' = .
    }
    else {
        local mn `mn' `i'
        local mean = r(mean)
        glcurve `i' [`weight' `exp'] if `touse', glvar(`glvar') pvar(`rank') sortvar(`welfarevar') nogr
        label var `glvar' "Y coordinates of the Lorenz curve of `i'"
        label var `rank' "X coordinates of the Lorenz curve of `i'"
        generate double `ccurve' = `glvar' / `mean'
        label var `ccurve' "Concentration curve for `i'"
        corr `rank' `i' [`weight' `exp'] if `touse', c
        local cov = r(cov_12)
        local ccindex = 2 * ( `cov' / `mean' )
        capture matrix `CIF' = (nullmat(`CIF') \ `ccindex' )
        sort `ccurve'
        generate `cclag' = `ccurve'[_n - 1] if `touse'
        generate `a' = ( `i' / `mean' ) * ( 2 * `rank' - 1 - `ccindex' ) + 2 - `cclag' - `ccurve' if `touse'
        generate `a2' = `a'^2
        local mea = r(mean)
        count if `touse'
        local n = r(N)
        egenerate `sa2' = sum(`a2')
        generate `va2' = (1 / `n') * (( `sa2' / `n') - ((1 + `ccindex')^2)) if `touse'
        summarize `va2' [`weight' `exp']
        local ccindexsd = sqrt(`va2')
        capture matrix `CISEF' = (nullmat(`CISEF') \ `ccindexsd')
        // If convenient regression requested
        if ""convenient"" ~="" {
            sort `ccurve'
            tempvar sdrank lhs
            egenerate `sdrank' = sd(`rank') if `touse'
            generate `lhs' = 2 * ( `sdrank'^2 ) * `i' / `mean' if `touse'
            newey2 `lhs' `rank' if `touse', lag(1) t(`rank') force
            capture matrix b = get(_b)
            capture matrix v = get(VCE)
            local ci = b[1,1]
            local varci = sqrt(v[1,1])
            capture matrix `CIC' = (nullmat(`CIC') \ `ci')
            capture matrix `CISEC' = (nullmat(`CISEC') \ `varci')
        }
        capture matrix `M' = `CIF', `CISEF' `mat'
        //capture matrix rownames `M' = `varlist'
        capture matrix rownames `M' = `mn'
        capture matrix colnames `M' = `nam'
    }
}

```



```

}
}
display _n
noisily display in green "Final matrice of Concentration Indices on Individual (Micro) Data." _n
if "`format'" ~= "" {
    noisily matrix list `M', noh f(`format')
    display _n
}
else {
    noisily matrix list `M', noh
    display _n
}
noisily display _n
noisily display in yellow "CIF : " in green "Concentration index using formula/covariance method"
noisily display in yellow "CIC : " in green "Concentration index using convenient regression method"
noisily display in yellow "CISEF : " in green "Standard errors of the concentration index using formula/covariance method"
noisily display in yellow "CISEC : " in green "Standard errors of the concentration index convenient regression method" _n
return matrix CII = `M', copy
// If concentration curves requested
if "`curve'" ~= "" {
    noisily capture graph `ccurve' `rank' `rank', sy(..) ylabel xlabel l1(Cum. Prop. of `i') saving(CC`i', replace)
}
restore
}
end
exit

```

Program 3: STATA Code to Compute the Gini Income Elasticity on Grouped Data.

```

*!Program to compute Gini Income Elasticity on grouped data.
program ginincelastgd, rclass sortpreserve byable(recall)
version 8.2
set more 1
tempname ginim V J W w A A1 A2 A3 A1s A2s A3s a
tempvar v
preserve
syntax varlist(min=1) [if] [in] [fweight pweight aweight iweight], ///
    Welfarevar(string) ///
    [
        ///
        Drop          ///
        Format(string) ///
        Marginal(string) ///
        PERiod(string) ///
        NQ(real 5)    ///
        PARameter(real 2) ///
        Quintilevar(string) ///
        SPlitvars(varlist) ///
    ]
noisily display _n(2)
quietly drop if `welfarevar' == .
marksample touse, novar
if "`by'" ~= "" {
    markout `touse' `by', strok
}
capture sort `welfarevar' // Welfare indicator
if missing("`quintilevar'") {
    tempvar quintilevar
    xtile `quintilevar' = `welfarevar' [`weight' `exp'] if `touse', nq(`nq')
}
quietly tabulate `quintilevar' [`weight' `exp'] if `touse', m
local nn = r(r)
quietly {
    if (`nn' == 5) {
        generate `v' = .9 ^ (`parameter'-1) if `quintilevar' == 1
        replace `v' = .7 ^ (`parameter'-1) if `quintilevar' == 2
        replace `v' = .5 ^ (`parameter'-1) if `quintilevar' == 3
        replace `v' = .3 ^ (`parameter'-1) if `quintilevar' == 4
        replace `v' = .1 ^ (`parameter'-1) if `quintilevar' == 5
    }
}

```

```

}
else if (`nn' == 10) {
generate `v' = .95 ^ (`parameter'-1) if `quintilevar' == 1
replace `v' = .85 ^ (`parameter'-1) if `quintilevar' == 2
replace `v' = .75 ^ (`parameter'-1) if `quintilevar' == 3
replace `v' = .65 ^ (`parameter'-1) if `quintilevar' == 4
replace `v' = .55 ^ (`parameter'-1) if `quintilevar' == 5
replace `v' = .45 ^ (`parameter'-1) if `quintilevar' == 6
replace `v' = .35 ^ (`parameter'-1) if `quintilevar' == 7
replace `v' = .25 ^ (`parameter'-1) if `quintilevar' == 8
replace `v' = .15 ^ (`parameter'-1) if `quintilevar' == 9
replace `v' = .05 ^ (`parameter'-1) if `quintilevar' == 10
}
else {
noisily display _n
noisily display as error "Invalid quintiles Variable. Pleaset group into 5 or 10 categories." _n
exit 198
}
}
quietly {
// Rank vector
sort `v'
tabulate `v', matrow(`V')
matrix `J' = J(`nn', `nn', 0)
forvalue i = 1 / `nn' {
matrix `J'[i, `nn' - i + 1] = 1
}
matrix `V' = `J'*`V'
}
tokenize `varlist'
local myvars "`varlist'"
// Are there variables with more than 2 modalities?
//Checking that and put variables for analysis in a macro.
if ("`splitvars' ~=" "") {
tokenize `splitvars'
local tosplit "`splitvars'"
local rest: list myvars - tosplit
local splited
tokenize `splitvars'
while "1" ~=" {
capture drop `1'_*
levelsof `1', l(l)
foreach kk of local ll {
generate `1'_'kk' = `1' == `kk' if `1' < . & `touse'
}
local splited "'splited' `1'_*"
macro shift
}
local fact "'rest' `splited'"
}
else {
local fact "`varlist'"
}
quietly unab fact: `fact'
noisily display in yellow "Checking missings..." _n
quietly foreach i of local fact {
nmissing `i'
if (r(N) ~= 0) {
display _n
noisily display in yellow "`i'" in green "has " in yellow r(N) in green " missings. You should check it."
if ~missing("drop") drop if `i' == .
}
}
}
quietly {
// Welfare vector
levelsof `quintilevar' if `touse', l(l)
foreach i of local l {
summarize `welfarevar' [`weight' `exp'] if `quintilevar' == `i' & `touse'
matrix `W' = nullmat(`W') \ r(mean)
}
}

```

```

}
matsum `W', col(`w')
local mean1 = `w'[1,1]/rowsof(`W')
quietly matcorr `V' `W'
local corr1 = r(corr)
foreach var of local fact {
  quietly {
    // Target variable
    tabulate `quintilevar' `var' [ `weight' `exp' ] if `touse', row nof matcell(`A') m
    // Constructing matrice for thoset with access
    local r = rowsof(`A')
    local c = colsof(`A')
    matrix `A1' = `A'[1...,1]
    if `c' > 1 {
      matrix `A2' = `A'[1...,2]
      matrix `A3' = `A1' + `A2'
    }
    else {
      matrix `A2' = `A1'
      matrix `A3' = `A1'
    }
    // Building up the matrice
    forvalue j = 1 / `r' {
      matrix `A2s' = nullmat(`A2s') \ (el(`A2', `j', 1) / el(`A3', `j', 1)) // * 100
    }
  }
  matsum `A2s', col(`a')
  local mean2 = `a'[1,1]/rowsof(`A2s')
  quietly matcorr `V' `A2s'
  local corr2 = r(corr)
  local gini = ( `corr2' / `mean2' ) / ( `corr1' / `mean1' )
  matrix `ginim' = nullmat(`ginim') \ `gini'
}
matrix colnames `ginim' = "GIE on Grouped data"
matrix rownames `ginim' = `fact'
noisily display _n
noisily display in green "Final matrice of Gini Income Elasticities on Grouped Data."
if ""format"" ~= "" {
  matrix list `ginim', noh format(`format')
  display _n
}
else {
  matrix list `ginim', noh
  display _n
}
return matrix gieg = `ginim', copy
restore
end
exit

```

Program 4: STATA Code to Compute the Gini Income Elasticity on Individual (Micro) Data.

```

program giei, rclass sortpreserve byable(recall)
version 8.2
set more 1
capture matrix drop giei
preserve
syntax varlist(min=1 numeric) [if] [in] [aweight fweight] , Welfarevar(varname)
quietly drop if `welfarevar' == .
marksample touse, novar
if ""by"" ~= "" {
  markout `touse' `by', strok
}
tokenize `varlist'
while ""1"" ~= "" {
  quietly {
    conf new var x v denom numer
  }
}

```

```

// Verifying not the same variables
if "`1'"=="welfarevar" {
    noisily display _n
    noisily display as error "welfarevar" in re " could not be both target and source" _n
    exit
}
// Verifying if dichotomic variable
levelsof `1', k(1)
if "`1'"~="0 1" {
    noisily display _n
    noisily display as error "1" in re " is not a dichotomous (0/1) variable" _n
    noisily display in green "Pleaset recode `1' into a" in ye " 0/1" in green " variable" _n
    exit
}
summarize `welfarevar' [`weight' exp] if `touse'
local mn = _result(3)
local tot = _result(1)
*THE DENOMINATOR
sort `welfarevar'
local wt : word 2 of `exp'
if "`wt'"==" {
    generate x = [_n] if `touse'
    local wt = 1
}
else generate x = sum(`wt') if `touse'
generate v = sum(`wt'*x*(`welfarevar'-'mn')) if `touse'
generate denom = (v[_N])/(`tot'^2*`mn') if `touse'
local denom = (v[_N])/(`tot'^2*`mn')
// noisily display in gre "The denominator value for wealth variable is: " in ye `denom'
*THE NUMERATOR
summarize `1' [`weight' exp] if `touse'
local mn = _result(3)
local tot = _result(1)
replace v = sum(`wt'*x*(`1'-'mn')) if `touse'
generate numer = (v[_N])/(`tot'^2*`mn') if `touse'
local numer = (v[_N])/(`tot'^2*`mn')
// noisily display in gre "The nominator value for variable `1' is: " in ye `numer'
*THE GINI welfarevar ELASTICITY
sca gie = `numer'/`denom'
matrix giei = (nullmat(giei) \ gie)
capture drop x v denom numer
macro shift
}
}
noisily display _n
display in green "Final matrice of Gini Income Elasticities on Individual (Micro) Data." _n
matrix colnames giei = GIE
matrix rownames giei = `varlist'
matrix list giei, noh
return matrix giei= giei, copy
capture matrix drop giei
restore
end
exit

```

Program 5: STATA Code to Compute the Marginal Gini Income Elasticity on Grouped Data.

```

prog mgie, rclass
vers 8.2
se mo 1
syntax anything [if] [in] , ///
Welfarevar(string) [data1(string) data2(string) Name(string) PERiod(string) Drop Format(string) SPlit PARAMeter(real 2) weight(string)]
cap mat drop G
qui {
    noi di _n
    cap preserve
    drop _all
    // Checking existence of the two datasets

```

```

conf file `data1'.dta
conf file `data2'.dta
// Checking existence of specified variables the two datasets
cap u `welfarevar' using `data1'
if _rc ~= 0 {
  noi di as err "'welfarevar' not found in `data1'. `welfarevar' is required in both datasets."
  exit
}
else {
  cap assert mi(`welfarevar')
  if _rc == 0 {
    noi di as err "'welfarevar' is all missing in `data1'"
    exit
  }
  else {
    ta `welfarevar' `if' `in'
    loc nn1 = r(r)
  }
}
cap u `welfarevar' using `data2'
if _rc ~= 0 {
  noi di as err "'welfarevar' not found in `data2'. `welfarevar' is required in both datasets."
  exit
}
else {
  cap assert mi(`welfarevar')
  if _rc == 0 {
    noi di as err "'welfarevar' is all missing in `data2'"
    exit
  }
  else {
    ta `welfarevar' `if' `in'
    loc nn2 = r(r)
    if `nn1' ~= `nn2' {
      noi di as err "Different modalities for `welfarevar' in both datasets according to your settings."
      exit
    }
  }
}
}
loc oklist
foreach i of local anything {
  cap u `i' using `data1'
  if _rc ~= 0 {
    noi di as err "'i' not found in `data1'"
    noi di as err "MGIE will not be computed for variable `i'"
  }
  else {
    cap assert mi(`i')
    if _rc == 0 {
      noi di as err "'i' is all missing in `data1'"
      noi di as err "MGIE will not be computed for variable `i'"
    }
    else loc oklist `oklist' `i'
  }
}
cap u `i' using `data2'
if _rc ~= 0 {
  noi di as err "'i' not found in `data2'"
  noi di as err "MGIE will not be computed for variable `i'"
}
else {
  cap assert mi(`i')
  if _rc == 0 {
    noi di as err "'i' is all missing in `data1'"
    noi di as err "MGIE will not be computed for variable `i'"
  }
  else loc oklist `oklist' `i'
}
}
}
loc oklist: list uniq oklist
cap mat drop V

```

```

if(`nn1' == 5) {
  mat V = (.9 ^ (`parameter'-1) \/*
    *.7 ^ (`parameter'-1) \/*
    *.5 ^ (`parameter'-1) \/*
    *.3 ^ (`parameter'-1) \/*
    *.1 ^ (`parameter'-1))
}
else if(`nn1' == 10) {
  mat V = (.95 ^ (`parameter'-1) \/*
    *.85 ^ (`parameter'-1) \/*
    *.75 ^ (`parameter'-1) \/*
    *.65 ^ (`parameter'-1) \/*
    *.55 ^ (`parameter'-1) \/*
    *.45 ^ (`parameter'-1) \/*
    *.35 ^ (`parameter'-1) \/*
    *.25 ^ (`parameter'-1) \/*
    *.15 ^ (`parameter'-1) \/*
    *.05 ^ (`parameter'-1))
}
else {
  noi di as err "Invalid Welfare groups Variable. Please group into 5 or 10 categories." _n
  exit
}
cap mat drop v
matsum V, col(v)
// Mean value of vector V
cap mat drop meanv
mat meanv = v[1,1] / rowsof(V)
sca meanv = meanv[1,1]
//Weights
if ~mi("`weight'") {
  loc we `weight'
  loc chara " . : - & % # @ $ ^ & * ? ~ , \ / ( < > { } _ [ ] ` ' " "
  foreach i of local chara {
    cap loc we = subinstr("`we'", "i", " ", .)
  }
  loc wel
  foreach i of local we {
    cap u `i' using `data1'
    if _rc ~= 0 {
      noi di as err "'i' not found in `data1'"
    }
    else {
      cap assert mi(`i')
      if _rc == 0 {
        noi di as err "'i' is all missing in `data1'"
      }
      else loc wel `wel' `i'
    }
  }
  cap u `i' using `data2'
  if _rc ~= 0 {
    noi di as err "'i' not found in `data2'"
    exit
  }
  else {
    cap assert mi(`i')
    if _rc == 0 {
      noi di as err "'i' is all missing in `data1'"
    }
    else loc wel `wel' `i'
  }
}
loc wel: list uniq wel
}
// Welfare groups
u `welfarevar' `wel' using `data1'
cap mat drop W1
ta `welfarevar' `weight' `if' `in', sort matcell(W1)
loc n = rowsof(W1)
u `welfarevar' `wel' using `data2'

```

```

cap mat drop W2
ta `welfarevar' `weight' `if' `in', sort matcell(W2)
cap mat drop W
forv i = 1 / `n' {
    mat W = nullmat(W) \ `=(el(W1,`i',1)+el(W2,`i',1))/2'
}
mat drop W1
mat drop W2
cap mat drop w
matsum W, col(w)
cap mat drop meanw
mat meanw = w[1,1] / rowsof(W)
sca meanw = meanw[1,1]
// Constructing matrice of covariance
cap mat drop Z
forv i = 1 / `n' {
    mat Z = nullmat(Z) \ `=(el(V,`i',1) - meanv)*`=(el(W,`i',1) - meanw)'
}
cap mat drop z
matsum Z, col(z)
// Covariance value of matrice Z and V
cap mat drop meanz
mat meanz = z[1,1] / rowsof(Z)
sca meanz = meanz[1,1]
foreach var of local oklist {
    // Data 1
    u `var' `welfarevar' `wel' using `data1'
    levelsof `var', l(1)
    if "`1'" ~= "0 1" {
        noi di as err "'var' not dichotomic 0/1."
        noi di as err "Please supply dichotomic variables. Use tab,g() or levelsof and generate"
        exit
    }
    // Target variable
    cap mat drop A
    ta `welfarevar' `var' `weight' `if' `in', row nof matcell(A) m
    loc r = rowsof(A)
    loc c = colsof(A)
    mat A1 = A[1...,1]
    if `c' > 1 {
        mat A2 = A[1...,2]
        mat A3 = A1 + A2
    }
    else {
        mat A2 = A1
        mat A3 = A1
    }
    // Building up the matrice
    forv i = 1 / `c' {
        cap mat drop A`i's
        forv j = 1 / `r' {
            mat A`i's = nullmat(A`i's) \ `=(el(A2,`j',1) / el(A3,`j',1))'
        }
    }
    mat drop A
    mat drop A1
    mat drop A2
    mat drop A3
    mat A11 = A2s
    mat drop A2s
    // Data 2
    u `var' `welfarevar' `wel' using `data2'
    levelsof `var', l(1)
    if "`1'" ~= "0 1" {
        noi di as err "'var' not dichotomic 0/1."
        noi di as err "Please supply dichotomic variables. Use tab,g() or levelsof and generate"
        exit
    }
    // Target variable
    cap mat drop A

```

```

ta `welfarevar' `var' `weight' `if' `in', row nof matcell(A) m
mat A1 = A[1...,1]
if `c' > 1 {
    mat A2 = A[1...,2]
    mat A3 = A1 + A2
}
else {
    mat A2 = A1
    mat A3 = A1
}
// Building up the matrice
forv i = 1 / `c' {
    cap mat drop A`i's
    forv j = 1 / `r' {
        mat A`i's = nullmat(A`i's) \ `= (el(A2,`j',1) / el(A3,`j',1))'
    }
}
mat drop A
mat drop A1
mat drop A2
mat drop A3
mat A12 = A2s
mat drop A2s
// Difference
forv j = 1 / `r' {
    mat A2s = nullmat(A2s) \ `= (el(A12,`j',1) - el(A11,`j',1))'
}
mat drop A11
mat drop A12
cap mat drop a2
matsum A2s, col(a2)
cap mat drop mean2
mat meana2 = a2[1,1] / rowsof(A2s)
// Mean value of matrice A2s
sca meana2 = meana2[1,1]
// Building the covariance matrice
cap mat drop Y
forv i = 1 / `n' {
    mat Y = nullmat(Y) \ `= (el(V,`i',1) - meanv)*`= (el(A2s,`i',1) - meana2)'
}
cap mat drop y
matsum Y, col(y)
// Covariance value of matrice A2s and V
cap mat drop meany
mat meany = y[1,1] / rowsof(Y)
sca meany = meany[1,1]
// Computing the MGIE
loc denom = meanz / meanw
loc num = meany / meana2
sca mgie = `num' / `denom'
mat G = nullmat(G) \ mgie
}
}
mat coln G = "MGIE on Grouped data"
mat rown G = `oklist'
noi di _n
noi di in g "Final matrice of Marginal Gini Income Elasticities on Grouped Data."
if "" format "" ~="" {
    mat li G, noh format(`format')
    di _n
}
else {
    mat li G, noh
    di _n
}
ret mat mgie = G, copy
foreach i in G y A2 A2s A3s A1s z Z w W v V {
    mat drop `i'
}
foreach i in meany meana2 meanz meanw meanv mgie {

```



```
    sca drop `i`  
  }  
  cap restore  
end  
exit
```

THE END