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Analysis and Implications of the Determinants of Healthcare Expenditure in African Countries

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Abstract. The income elasticity of health care spending in the OECD countries tends toward luxury good values. Similar studies, based on more recent data, and capable of informing macroeconomic health policies of the African countries, do not currently exist. How the health care expenditure in Africa responds to changes in the Gross Domestic Products (GDP), Official Development Assistance (ODA), and other determinants, is also relevant for health policy because health care is a necessity in the 'basic needs' theory of economic development. This paper presents econometric model findings of the determinants of per-capita health expenditure (in PPPs) for 26 African countries, using the flexible Box-Cox model regression methods and 1995 cross-sectional data (sources: WRI, UNEP, UNDP, The World Bank). The economic and other determinants, capturing 74 percent of the variations in health expenditures, include per-capita GDP (in PPPs), ODA (US$), Gini income inequality index, population dependency ratio, internal conflicts, and the percentage of births attended by trained medical workers. Income inequality dampens, while the ODA and population per health personnel raise health care expenditure. The GDP elasticity of about 0.6 signals the tendency for health care to behave like a technical 'necessity.' Implications for sustainable basic health development policies are discussed.

Keywords: African countries, health care expenditure, GDP, ODA, basic needs, health policy

1. Introduction

Practically all of the African countries that sought official development assistance (ODA) funds from international development financial institutions (IFIs), in the 1980s to early 1990s, endured stringent macroeconomic structural adjustment programs (SAP) and related 'reform' mandates (e.g., reduced government deficit, exchange rate liberalization, central government divestments, greater privatization of certain industries, etc.) of these agencies. These difficult adjustments [22] are thought to have produced net declines in the provision of essential '*basic human needs*' (food, housing, clothing, health, and education), as the pre-reform domestic government shares of these expenditures were typically large. As a result, the United Nations in 1991 developed the '*human expenditure ratio*' (the percent of GDP for priority education, health, and other social welfare) to monitor basic needs provision and avert further cuts. The benefit of targeting health as an integral aspect of the '*human development index*' (longevity, knowledge, living standards) lies in its capacity, as human capital, to spur potentially sustainable human development and economic progress [46]. The *post*-SAP era in Africa slowly began to emerge in the mid 1990s.

The objective of this paper is to construct and estimate econometric models of the socio-economic and demographic determinants of *post*-SAP health care spending for a cross-section of the developing African countries. Policy suggestions deriving from the estimated models are discussed in the light of basic health care needs in economic development. Health care demand tends to be inelastic for the affluent but elastic for the vulnerable indigent population segments [63]. The response of health care spending to changes in national resources can be a gauge of the proportionate change in health care investment arising from a given change in national income (GDP) and the external assistance (ODA) supplement. Past econometric studies using macroeconomic data and different estimation methods agree that the OECD countries spend disproportionately more on health from a given rise in GDP [18]. This is taken to imply that the marginal health spending in the aggregate, across payers (patients, insurers, governments, non-governmental organizations), in high-income countries provide more subjective 'care' than physiological 'cure'. This makes OECD health a technical 'luxury' good, a finding that tends to be robust against alternative model specifications, data sets, and the time periods studied.

The 'basic needs' approach to economic development considers health care as a 'basic need'—a necessity akin to education, shelter, and food. The estimated income elasticity of health care expenditure can inform sound policy because income is the major determinant of health care expenditure. Consequently, if health care spending in the African countries behaves similarly like a 'luxury' commodity, what are the implications for human capital investments in health and economic development for the period following structural adjustments and austerity? If African health care spending tends towards 'necessity' good values, can an extra health care spending be viewed (in contrast to the findings for OECD data) as providing 'cure' (that is, physiological benefits such

as improved HLY, or healthy life years) at the margin? A detailed literature search reveals that there is currently no study of the developing African countries using recent data period after the externally imposed SAP and an econometric model of the determinants of health spending. Our paper provides, among other contributions, regression model numerical estimates and implications of the economic (e.g., GDP, income inequality) and other determinants or shifters of health care spending in Africa.

Section 2 sets the literature review (Section 2.2) within the context of the health, health care, health expenditure, and macroeconomic policy environment constraints in the African countries (Section 2.1). Section 3 presents the theoretical model, and discusses statistical model estimation methodology and the data. Section 4 presents the empirical regression results, and addresses related policy issues- including implications of whether health care in the African environment is a technical necessity. Section 5 is the summary and conclusion.

2. The setting and context of this research

2.1. African health spending and macroeconomic sector reforms in the 1980s–1990s

The World Bank is the largest global lender in health, nutrition, and population (HNP) sectors and from 1987 to 1995 the bank lent more than $500 million annually. The share of HNP borrowings rose from 1.5 percent of the Bank's loan portfolio in 1986–88, to 5.5 percent in 1992–94, and to 8.7 percent in 1995–97 [8]. The Bank embarked on policies that liberalized loans for health-related programs at a time when the borrower countries questioned the high degree of public sector participation in health-related projects. The Bank, as preconditions for making loans, mandated stringent macroeconomic adjustments to ease debt repayments by borrower nations [27,33]. The domestic health sector policy reforms until the late 1970s concentrated on primary care, but SAP-related health goals of the 1980s to 1990s targeted the economic values of health care services- that is, structural changes in health care financing and delivery [50].

Health sector policy reforms represent an integral aspect of the macroeconomic structural adjustment programs (SAP) and public sector reforms of the LDCs. The Bank, IMF, and other international financial institutions imposed various SAP in response to the rapid rise in the external debt burdens of the LDCs and these countries' incapacity to service external debts under conditions of deteriorating internal economic performance and lagging prices of their primary exports. Health sector reforms in Africa, including privatization of health and medical facilities and commercial managed care options [51] were grudgingly undertaken domestically to satisfy compliance with the SAP mandates of the IFIs [6,20].

There are large variances in both per-capita GDP and per-capita health expenditure shares of national incomes among countries and within regions in Africa [55,56]. The disparities, along with systematic differences in demographic and socio-political structures, have also generated large variances in health status or outcomes among countries. Uganda, for example, spent 2.7 percent of her 1992 per capita GDP of $1,132) on health care and had an Under-5 infant mortality rate of 191 per 1,000 live births (hereafter, U-5IMR) in 1993. On the other hand, the health share of per capita GDP of $651 (int. $) in Burkina Faso (West Africa) was 8.8 percent and the U-5IMR was 175 per 1,000 live births in 1993. Three years later, Uganda's per capital GDP reached $1,490 (int. $), the health share of GDP averaged 3.9 percent during 1990–95, and the U-5IMR statistic fell slightly to 185 in 1995. Per capita GDP in Burkina Faso for 1995 rose to $790 (int. $), health share of the GDP averaged 5.5 percent for the 1990–95 period, and the U-5IMR fell to 164 in 1995. Caution that the international dollar values, different from the U.S. dollar values, are calculated using special conversion factors (PPPs) designed to equalize the purchasing powers of different currencies.

Thus far, the consequences of SAP for health and social reforms have not been sufficiently assessed and systematically quantified for their effects on human capital formation (education) and implications for aggregate productivity, development and growth; although, it is known to have reduced health care budgets and deteriorated many health indicators of the sub-Saharan Africans. The Republic of Benin, for example, first implemented a SAP in 1989 with further modifications in 1991. The health sector share of her GDP declined from 8.81 percent in 1987 to 3.42 percent in 1993 and throughout the 1990s. The worsening of health status (e.g., infant mortality) and falling health spending led to an infusion of external aid from 20 multilateral, bilateral, and non-governmental donors [6]. Benin's difficult adjustment was not isolated, as four African countries underwent SAP in 1982. The number of affected countries rose to 8 in 1984, 14 in 1986 and 25 (about 50 percent of the African countries) during 1989 [8]. Health expenditure as a ratio of total discretionary government spending during the SAP era fell in 15 countries (Burkina Faso, Cote d'Ivoire, Ghana, Kenya, Madagascar, Malawi, Mauritius, Niger, Nigeria, Senegal, Sierra Leone, Togo, Uganda, Zambia, Zimbabwe). Sierra Leone had the largest decline, from the *pre*-SAP 7.2 percent to 4.0 percent, *post*-SAP [48]. In Cote d'Ivoire, the poorest absorbed the bulk of the decays in basic needs supply during the SAP [22].

The SAP experience of the African states accords with a study of Mexican households, based on the 1989 Mexican National Survey of Income and Expenditures Data, revealing that the low-income uninsured families reduced out-of-pocket health spending disproportionately more than higher-income families due to economic shock [45]. Moreover, the Chilean SAP in the 1980s, which channeled expenditures towards the poor, also raised the cost of living more for the poor, increased unemployment more than 26%, reduced real wages by about 20% for about five years, and reduced 'basic needs' (health, education and housing) budgets about 20% per capita [39]. The SAP experience in Jamaica is also instructive. Handa and King [23] found that the sudden and rapid devaluation of the Jamaican currency from liberalized exchange rates "had serious repercussions for real purchasing power, poverty, general

inflation, and food prices" (p. 1125). Urban school children suffered the greatest wasting from malnutrition, because the elasticity of weight for height z-score from food price inflation of –0.86 is high and significant. McGillivray's [38] finding that the policy-based lending structural adjustments in Pakistan did not stimulate growth reinforces the grim concerns others voiced earlier [11].

2.2. *Review of literature on health expenditure models of African countries*

Only a few, formal studies of the determinants of health spending in African countries exist in the literature, and they are largely macroeconomic models because microeconomic survey data are rare. Sahn [49] used the 1974–87 data of 23 sub-Saharan African countries to evaluate the response of central governments and social services spending to changes in the GDP. Public expenditure patterns three years before and after donor-financed adjustment programs began showed no systematic changes in social sector expenditure share of the GDP. Per-capita data showed rapid population growth to overwhelm social sector spending. Changes in public health expenditures in relation to GDP were econometrically modeled using country fixed effects models. The reported GDP elasticity of health care spending was slightly elastic (1.17 for 1974–79, 1.06 for 1980–84, 1.17 for 1985–89). The aggregate expenditure elasticity of health spending was slightly below unity [inelastic, respectively 0.67 (1974–79), 0.67 (1980-84) and 0.96 (1985–89)]. The *pre*-SAP, total expenditure elasticity of health spending ranged from a low of 0.63 in low income- to a high of 0.83 in the middle- income countries. The *post*-SAP estimates were 0.93 in low-income nations and 1.13 for middle-income nations. These findings are taken to imply a unity GDP elasticity of public health spending, with a greater tendency for *post*-SAP era rise (fall) in health care expenditure to more than match proportionately the rise (fall) in the aggregate expenditures and for middle income than low income sub-Sahara African countries.

Gbesemete and Gerdtham [16] used 1984 cross-sectional data in a multiple regression model of the determinants of per-capita health care expenditure of 30 African countries. Health care expenditure was hypothesized to depend on socioeconomic and demographic variables. Per capita GNP (the most important determinant), percentage of births attended by health staff, and foreign aid received altogether explained roughly 78 percent of the variance of health care spending. The unitary GDP elasticity of health care expenditure of 1.07 (preferred model H_{G3}) reinforces the hypothesis that African countries historically spent a more than proportionate increase in their GDPs on health care. The cross-sectional elasticity finding is consistent with the results from a fixed-effects regression model using 1980–84 time-series data [49].

Okunade [42] constructed Engel expenditure models using the ILO data covering 1960–72, within-country budget survey areas for select African nations to estimate the elasticities for 'basic needs' expenditure categories (clothing, healthcare, shelter, and education). The cross-sectional regression elasticity estimates for medical care spending varied across budget survey areas within each country and across countries. The following are within-country income elasticity of medical expenditures: 0.24 (Ghana-urban), 0.25 (Ghana-rural), 1.58 (Kenya-Nairobi), 1.33 (Kenya-Mombasa), 1.25 (Kenya-Kisumu), 0.61 (Malawi-urban), 0.51 (Malawi, other areas), 0.83 (Sudan-urban), 0.72 (Sudan-semi-urban), 0.85 (Sudan-rural), 1.70 (Tanzania-urban), and 0.34 (Tanzania-mainland). These estimates support the conjecture of health spending rising faster with incomes in urban than rural areas, and that the income elasticity of health spending varies by level of analysis since national data elasticities in general exceed regional or budget area elasticities.

3. Specification of the theoretical model and discussion of the data

3.1. *Theoretical framework for modeling the determinants of health care expenditure*

Economic theory of the determinants of health care spending, with the exception of the public choice framework of Leu [35], is largely *ad hoc* [18]. Other than the GDP (see, e.g., Gerdtham, Sogaard, Anderson, and Jonsson [17], Murthy and Okunade [40], and Rivera and Currais [48]) and a few other determinants, e.g., population per doctor, urbanization and payment systems, certain non-economic factors including political transition [28,51], externally imposed reforms are fairly unimportant in studies of the developed countries. Past econometric models of health care expenditure (*HEXP*) in the OECD nations [19,35] reported significant linkages to the GNP or national income, population proportion under 15, urbanization, public finance share, direct democracy, and presence of centralized health systems. Murthy and Okunade [40], using 1960–1996 US data, found that the previously untested determinants, e.g., managed care enrollment and government budget deficits, to be statistically significant in their regression models.

3.1.1. *The GDP and supplemental official development assistance (ODA)*

The context for modeling *HEXP* of the developing African countries differs, although some of the theoretical model determinants in studies of high-income countries apply. *HEXP*, for example, regardless of the grouping for countries, is expected to increase with rising incomes because health is a normal good. The magnitude of the proportionate rise in *HEXP* due to rising income is indeterminate, *a priori*, however. Supplements to the GDP, such as Official Development Assistance (*ODA*) and foreign aid, relatively unimportant in the context of developed countries, are expected to relax macroeconomic budget constraints and increase resources for African health. Similar to foreign aid, the institutional framework in recipient countries and the creditor stipulations for ODA funds,

in addition to the possible diversions from public investment to consumption makes it difficult to predict with strong confidence the direction and effectiveness of macroeconomic health sector impact of ODA for Africa [9,31]. ODA debts in Africa are real resource inflows for health development constituting a large share of outstanding long-term debt [41] or 16 percent of their 1993–95 GDP [55].

3.1.2. Domestic, within-country income inequalities

Income inequality is detrimental to economic progress [15]. Policy experts justify some type of income redistribution as a potential remedy in the absence of 'general purpose' technical progress [1]. This suggests that increased health care spending, or improved health status of the poor [60], is unlikely to be forthcoming in regimes with greater macroeconomic instability and policy distortion [26] and income inequalities (*GINI*) when compared with those having a more balanced distribution. Countries with uneven income distribution distort health care resource allocation to emphasize curative more than preventive medicine [3].

3.1.3. Pervasive public corruption

"Corruption ... has had ... varying degrees of damaging consequences" [4]. Political and economic corruption (use of public office for private gains) in especially the public sector, when pervasive, impedes the effective deployment of resources in health and other sectors, making them less efficacious. (Certain forms of corruption may raise social welfare if policy-induced distortions preexist (p. 1322), but we ignore this unlikely result in the context of this paper.) Transparency International [57,58,59] publishes annual corruption perceptions index for 85 countries and many African nations consistently rank high over the years. Channeling public funds into inappropriate projects or private ends reduces social returns on health investments. Higher levels of GDP and ODA are expected to raise health care expenditures. Since corruption is a leakage from publicly declared budgets, official expenditures would tend to overstate actual spending and under perform relative to health outcome targets. Therefore, public sector 'rent seeking' has adverse consequences on static efficiency, investment and growth [4]. Corruption index (*CORRPT*) is thus, expected to be negatively correlated with *HEXP* and health outcomes.

3.1.4. Political conflicts and internal discords

The findings from 30 years of conflict research indicate that political conflicts from internal discords in the less developed countries intensify to civil war as poor economic performance worsens [2]. The diversion of peacetime, civilian production to military activities can raise expenditures, *all else equal*. Developing countries engaging in civil wars (*WAR*), and many were in Africa circa 1995 [25], were also expected to have greater economic growth and increased health care spending. This is Benoit's [5] hypothesis. Shieh, Lai and Chang [52] claimed this to occur on the supply side through the provision of public infrastructures, military R&D experience, private production through imitation generated by arms imports, and enhancement of human capital through education, nutrition, medical care and training. Thus, from Benoit's hypothesis [5], the *WAR* dummy, on the supply side, is *a priori* likely to raise spending on social services including health care since emergency aid is included in the measure of the dependent variable *HEXP*.

3.1.5. Health care access: population per health care personnel

Population access to health care can be captured using the percentage of births attended by health care personnel *(BATD*). Health spending is likely to increase the higher this percentage-particularly if utilization is positively correlated with being educated, fairly young, and the urbanized. Alternatively, access to health care can be captured using 'population per doctor' (*PDOC*) or 'population per nurse' (*PNURSE*) in either case the higher the ratio the lower is the expected effect on health care expenditure. Demographic differences are known to exist in the demand for health care services. The very young and the very old are dependents and consume a sizeable portion of medical care for costly illnesses. Therefore, the higher their ratio to the 15-65 age group (*LT15YR*), the greater the expected health-care spending. However, it is possible that the working age adults (*GT15YR*, ratio of adults 15 years and older to the total population) reserve for themselves the use of more formal medical facilities and decide on using informal, indigenous care for children and elderly dependents. This possibility renders the theoretical sign of *LT15YR* indeterminate, *a priori*.

3.2. Empirical regression model specification and the Box-Cox transformation methodology

Theoretical economics offers anemic guidance on the selection of an appropriate functional form model, for given data observations. Box-Cox transformation models [7] are useful for minimizing functional form bias, since the commonly assumed linear and log-log forms in *HEXP* models are nested in the generalized flexible power family of transformations model. Gerdtham and colleagues [17] applied this technique in their OECD health expenditure model, selecting the quadratic square root transformation to be the optimal. Okunade [42] earlier experimented with a limited set of functional forms (linear, log-linear, linear-log, log-log), choosing the most fitting for the 1960–72 data of each African country. Gbesemete and Gerdtham [16], using 1984 data of Africa, justified a log-log model based on the RESET model selection criterion- rather than the Box-Cox power tests.

The multiple regression model, specifying values of the response (or dependent) variable y to depend on values of a set of regressors (or independent variables) x, takes the general form

$$y = f(x, \beta), \tag{1}$$

where the data column vector $x_i (i = 1, 2, \ldots, k) \in$ matrix x (with a column of 1s for the intercept), each x_i is orthogonal to the other x_is (data columns of the independent variables

comprising the design matrix), and the model residuals ξ are normally distributed with 0 means and a finite variance σ^2. The regression parameter estimate of $\beta_i (\in \text{vector } \beta)$ captures the slope $\partial y/\partial x_i$.

Health expenditure data are generally skewed [54] and cross-sectional data model residuals are typically heteroskedastic. Therefore, health expenditure data in this study can be optimally modeled by either specifying ξ, the density of the model residuals, as belonging to a class of skewed densities (e.g., the gamma) or by assuming that y (skewed response data) is capable of transformation to symmetry using the generalized flexible Box-Cox power family of data transformations model [10]. The first approach is a generalized linear model (GLM), while the latter yields maximum likelihood estimates (MLEs) of the regression model gradients (β in equation (1) above) conditional on σ and λ (scalar power estimates, discussed below) that are naturally consistent with the observed data set. The latter estimation method is followed here.

The generalized flexible, or fully flexible, fairly parametrically rich Box-Cox transformation model (FFBCTM) has not been applied in models of African health data. The model, admitting transformation of strictly positive data values for a continuous variable y, takes the form

$$\left.\begin{aligned} y^{(\lambda)} &= [y^{\lambda} - 1]/\lambda \text{ for } \forall\lambda > 0, \\ y^{(\lambda)} &\cong \log y, \text{ as } \lambda \to 0, \end{aligned}\right\} \tag{2}$$

where the λ power is a scalar parameter that is jointly estimated with other parameters of the regression model. The power family of transformations model, also skew-correcting for the response variable *HEXP*, will be applied to the left- and right- hand side variables (excluding dummy variable *WAR*), to permit different λ power transformations of each variable in the *HEXP* model.

The chi-square (or χ^2) likelihood ratio test statistic, applied to the log-likelihood function values of the FFBCT *versus* each of the restricted regression models is used to guide selection of the optimal functional form from among the parametrically more restrictive, competing models (extended Box-Cox, Box-Tidwell, classic Box-Cox, linear-linear, linear-log, log-linear, log-log) that are nested in our more general FFBCT model specification. (Detailed hypotheses test results available on request). The research goal of the FFBCT model is to fit the appropriate functional form model to the observed data in order to reduce specification bias that could arise from the fitting of the *a priori* restrictive functional form models. The expected relationship of each determinant to *HEXP* in a FFBCT regression model estimation of the type $y^{(\lambda_0)} = x^{(\lambda_1)}\beta + \xi$, where β is the slope vector, y is *HEXP*, x is matrix of independent variables, and ξ the residual vector, is as follows:

$$\begin{aligned} HEXP^{(\lambda_0)} = {} & \beta_0 + \beta_1 GDP^{(\lambda_1)} + \beta_2 ODA^{(\lambda_2)} + \beta_3 INEQ^{(\lambda_3)} \\ & + \beta_4 CORRPT^{(\lambda_4)} + \beta_5 BATD^{(\lambda_5)} \\ & (or\, PDOC^{(\lambda_6)} \text{ or } PNURS^{(\lambda_7)} + \beta_8 WAR \\ & + \beta_9 LT15YR^{(\lambda_9)} + \xi \end{aligned} \tag{3}$$

where, in accordance with *a priori* theoretical expectations, $\beta_1, \beta_2, \beta_5 > 0$; $\beta_3, \beta_4 < 0$; and the signs of β_8, β_9 and β_0 are indeterminate.

3.3. Data sources, calibration, and definition of variables

Data were obtained from *The World Resources* [55,56], except when otherwise indicated. The data are for the following African countries that had complete data to implement the proposed model: Angola, Benin, Botswana, Burkina Faso, Cameroon, Chad, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Kenya, Liberia, Malawi, Mali, Mauritius, Morocco, Mozambique, Nigeria, Rwanda, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Uganda, and Zimbabwe. The institutional structure for health care financing and deliveries are generally similar across these countries, being less developed and heavily subsidized by their governments and foreign donors. More recently, their health care markets are beginning to experiment with a number of private sector reforms (e.g., introduction of user fees, increased private provider participation) to raise efficiency and reduce moral hazards).

Definition of the variables is listed in table 1. Due to the widely acknowledged paucity of data on developing countries, published data sometimes report period averages or estimated values from a number of reliable sources. For example, per-capita GDP at market prices in international dollars Purchasing Power Parities (or PPPs) is for 1995, whereas data on the percent of births attended by trained health personnel data (BATD) are reported as 1990–1996 averages. Nevertheless, the dependent variable *HEXP*, per-capita health spending, is the total of public and private sector outlays for preventive and curative services, population and nutritional activities, and emergency aid for health, divided by the population. Since these countries lack consistently and separately reported data on health care spending in private and public sectors, it was impractical to model them separately for richer policy insights. Data on total health expenditure as a share of the GDP were more commonly reported, however. Applying this share to the GDP and dividing by the country's population yields the per capita health care expenditure data. Per capita *GDP* for 1995 (p. 236) are measured in PPP.

Per capita *ODA* in 1995 (US$) are funds from development assistance agencies of the OECD and OPEC, grants and loan concessions from multilateral development agencies and ODA from other developing countries if known. Per capita ODA in 1995 are calculated using the year's ODA estimates and United Nations Population Division population data. The *GINI* coefficient of income inequality data (with 0 suggesting perfect income equality and 100 reflecting perfect inequality), measuring the degree to which actual income distribution differs from a perfect equality, came from the surveys conducted during the mid- and late- 1980s to early- 1990s.

The corruption perception index (*CORRPT*) for 1996 came from Transparency International [57,58,59]. Data on civil war (*WAR*), taken from Regan [46], are a 0-1 dummy designation, with '1' if country in war during 1995 and '0' otherwise.

Table 1
Definition and mean values of the variables in the health expenditure model.

Variable label	Description	Mean
Dependent variable		
HEXP	Per-capita total health care expenditure, computed as the product of health expenditure as a percentage of GDP and GDP (PPP, 1995 Int. $)	$82.27
Independent variables		
GDP	Per-capital GDP at market prices, in GDP (PPP, Int. $),1995	1,904.42
GINI	Gini coefficient of income distribution, circa 1990	45.74
LT15YR	Dependency ratio of population, 100(< 15 yrs. + > 65yrs.)/(15–65 yrs), 1995	87.17
GT15YR	Percent of population >15 years, 2000 estimate	57.00
PDOCNURS	Population per doctor + population per nurse, 1990–1993 average	17,033.91
PDOC	Population per medical doctor, 1990–1993 average	13,651.64
PNURS	Population per nurse, 1990–1993 average	3,382.29
U5-IMR	Under 5 years of age infant mortality rate per 1,000 live births, 1995	152.48
URB	Percent of urbanized population, 2008 estimate	38.00
ODA	Per capita Official Development Assistance in US$, 1995	50.54
BATD	Percent of births attended by trained health care personnel, 1990–1996 average	47.10
CORRPT	Corruption Index, where 10 = no corruption and 0 = maximum corruption (e.g., Zimbabwe = 8.75, S. Africa = 8, Angola = 8,66, Cameroon = 7, Ivory Coast = 6, Kenya = 4.5, Ghana = 3.66, Nigeria = 3, Liberia = 2.66, Zaire = 1, ...)	
WAR	Intra-country conflict (civil war) during the 1990s (yes = 1, 0 = other)	

Data on the percentage of births attended by trained medical personnel (*BATD*) relate to births attended by physicians, nurses, midwives or primary health care workers with midwifery skills. Population dependency ratio (*LT15YR*) is the population of those 15 years and younger divided by working age adult population 15 through 65 years. Finally, demographics effects on *HEXP* could alternatively be captured using the variable *GT15YR*, the adult population ratio defined as adult population 15 years and older divided by total population in a country.

4. Empirical regression findings and policy implications

4.1. Statistical assessments of the estimated models

The Ordinary Least Squares (OLS) estimation of regression models yields a consistent estimator of the parameters, even if residual variances are unstable. However, because heteroskedastic tend to pose inference problems in cross-sectional regression models, White's [62] general test ($H_0 : \sigma_i^2 = \sigma^2 \forall i \, v/s \, H_a$: not H_0) was performed to identify model specification bias due to omitted higher-order power of an independent variable in the specification. The competing specifications of the *HEXP* model (table 2) could not reject the null except for model (*iv*). Also, each model's F statistic, significant at the $\alpha = 0.01$ level, and reinforcing the R^2 of each model specification, means that a statistically significant portion ($\cong$ 65 percent) of the variance in *HEXP* is jointly explained by the model's independent variables.

Some independent variables, such as *CORRPT* and *ODA*, indicated linear combinations, as measured by the 'condition index', a collinearity diagnostics, in preliminary regression runs. [Collinearity of *CORRPT* and *ODA* supports the contention of some observers that ODA *may* foster poor governance, slow growth performance and incubate corruption [21,30,32,36,53]. Thus, alternative regression estimates are presented, accommodating at most five sufficiently orthogonal regressors. The results in table 2 excluded Somalia data, as Cook statistic indicated high leverage. Data sensitivity analysis was performed using the 'one-delete' resampling plan [43] to test the leverage of each country's data point on parameter estimates. This experiment indicating no significant changes in the regression slope estimates reinforces our earlier comment on Somalia data. Therefore, the regressions used complete data of 26 countries excluding Somalia. Statistical tests of the FFBCTM confirmed that an approximate log-log transformation is optimal, and so the *HEXP* model coefficient estimates are interpreted as the elasticity estimates at data means.

Choice among the competing models of *HEXP* (table 2) lacking specification error can be based on the explanatory power, statistical significance and consistency of the model coefficient signs with *a priori* theoretical expectations and the inclusion of policy-related variables of interest to study. The *GDP* is both correctly signed and highly significant across specifications. Remarkably, the remaining independent variables, *ODA* funds, *GINI*, *WAR*, *LT15YR*, *GT15YR*, and *PDOC* are also correctly signed across specifications in which they appear although their statistical significance varies. Specification (*ii*), which includes *ODA* and *GINI*, is interesting for inferences on the efficacy of *ODA* and the impact of income inequality on health expenditures. Model (*v*) includes demographic dependency ratio of interest for addressing the health care access of the vulnerable pediatric and geriatric population segments. The model specification (*vi*) has the highest explanatory power ($R^2 = 0.74$) of all the specifications, and it includes a measure of the supply of health care personnel (*BATD*) to women of

Table 2
Box-Cox Regression estimates of the health expenditure (*HEXP*) model, for $\hat{\lambda} \cong 0$.

Regressor variable	β *(i)*	*t-ratio*	β *(ii)*	*t-ratio*	β *(iii)*	*t-ratio*	β *(iv)*	*t-ratio*	β *(v)*	*t-ratio*	β *(vi)*	*t-ratio*
Const.	2.698	0.96	3.317	1.21	−1.828	−1.18	−1.106	−0.50	−0.705	−0.40	−8.987	−0.86
GDP	0.591	3.67***	0.700	4.24***	0.577	3.39***	0.662	3.76***	0.496	2.57***	0.540	2.94***
ODA	*excl.*		0.152	0.98	*excl.*		0.075	0.46	0.093	0.60	*excl.*	
GINI	−1.232	−1.91**	−1.340	−2.07***	excl.		excl.		excl.		1.106	−1.58
WAR	0.557	1.33*	*excl.*		0.566	1.28*	*excl.*		*excl.*		0.877	1.82**
BATD	0.657	1.29*	0.134	0.33	0.636	1.18	0.147	0.34	0.197	0.47	0.705	1.41*
LT15YR	*excl.*		*excl.*		*excl.*		*excl.*		−0.017	−1.75+	*excl.*	
GT15YR	*excl.*		*excl.*		*excl.*		*excl.*		*excl.*		2.848	1.16
n (countries)	26		26		26		26		26		25	
R^2(adj. R^2)	.70 (.64)		.69(.63)		.64(.60)		.62 (.57)		.67(.61)		.74 (.67)	
MSE	0.30		0.31		0.34		0.36		0.34		0.29	
Overall *F*	12.10***		11.48***		13.33***		12.08***		10.69***		10.88***	
White $\chi 2(df)$	16.63(13)		16.47(14)		6.02(8)		14.14(9)		13.03(14)		15.18(18)	

regressor variable	β *(vii)*	*t-ratio*	β *(viii)*	*t-ratio*	β *(ix)*	*t-ratio*	β *(x)*	*t-ratio*
Const.	−9.256	−0.84	−18.69	−2.14***	−18.36	−1.98***	9.322	1.41*
GDP	0.602	2.97***	0.460	2.52***	0.507	2.58***	0.605	3.07***
ODA	0.132	0.84	*excl.*		0.078	0.50	*excl.*	
GINI	−1.108	−1.42*	excl.		excl.		−1.001	−1.36*
WAR	*excl.*		0.770	1.56*	*excl.*		0.513	1.24
BATD	0.074	0.18	0.637	1.24	0.103	0.24	*excl.*	—
LT15YR	*excl.*		*excl.*		*excl.*		−0.928	−0.44
GT15YR	3.11	1.20	4.418	1.91**	4.613	1.90***	*excl.*	—
PDOC	*excl.*		*excl.*		*excl.*		−0.17	−0.71
n (countries)	25		25		25		25	
R^2 (adj. R^2)	.71 (.63)		.71(.65)		.68(.61)		72(.64)	
MSE	0.32		0.30		0.34		0.31	
Overall *F-Ratio*	9.16***		12.07***		10.42***		9.64***	
White $\chi 2(df)$	17.89(20)		10.16(13)		15.33(14)		19.28(17)	

***, **, and * indicate statistical significance at the 0.05 or better, 0.10, and 0.20 levels, respectively.

childbearing age and how internal conflicts (*WAR*) had shifted health spending of the affected countries.

Greater national incomes raised health expenditure less than the pre-SAP era

The GDP coefficient (see table 2), positively signed as theoretically expected, is highly statistically significant consistently across the alternative models. The cross-sectional income elasticity of about 0.57 for the 26 countries, although comparatively smaller in magnitude, is remarkably inelastic as reported for cross-sectional data regressions of the advanced countries. While this means that less than a given percentage rise in national income is spent on health the context for Africa differs from those of the OECD countries. Only one earlier study on African countries using cross-sectional aggregate data placed the GDP elasticity of health expenditures at around 1.07 for 1984 [16]. Since the real GDPs of African countries have risen in the ten years following 1984, one would expect allocation of a rising proportion of national incomes to the health sector, *all else equal*. The findings here suggest that countries with higher GDPs tend to spend relatively less on health care per person in 1995 compared with 1984.

Health care: a normal good, a basic need, and a technical necessity in African countries

Consistent with the 'basic needs' theory of development [61], specification (*ii*) reveals that health care in Africa is both a normal good ($\partial HEXP/\partial GDP > 0$) and a technical necessity ($\partial \ln HEXP/\partial \ln GDP = \hat{\beta}_1 {}^* GDP^{\hat{\lambda}_1}/HEXP^{\hat{\lambda}_0} = 0.70$, when evaluated at the data means). According to the standard interpretation in this line of research, this suggests that the marginal spending on health care goes to the creation of 'physiological' health (human capital), and reinforces Mayer's [37] finding that a permanent rise of from 0.8% and 1.5% annual income leads to old age health benefits in 18 Latin American countries. The *ODA*, while not highly significant, shows a positive association with health spending as expected. The lack of significance for *ODA* (in this and competing specifications), constituting 26 percent of *GNP* on average, may mean that most *ODA* funds are for sectors other than health, or the management and coordination of *ODA* funds are less than sterling -perhaps also related to official corruption (highly correlated with *ODA* and omitted from this specification), or there is a misalignment of the project objectives and the ODA lending policies.

The study finding here that health care in Africa behaves as a technical 'necessity' should add to the relevance of the UN need to continue monitoring of health care provision as a basic good to avert further decays and to raise public sector participation in primary health care provision. Such a policy change becomes more relevant because anecdotal evidence suggests that health-related SAP policies succeeded in cutting basic and necessary care to the poor but preserved the more expensive, luxury care for the rich through the privatization of African health services. Our finding also echoes the UNICEF mandate for the IMF and the Bank to focus more on poverty reduction and human concerns, particularly for the vulnerable groups, in its structural adjustment and related policies and adopt "adjustments with a human face" [29]. Helleiner, Cornia and Jolly [24] suggest the "application of flexible conditionality, coordination among all donors and financial institutions, ..." (p. 1823). One alternative, but less practical interpretation of our finding a declining health share of the GDP during the SAP era could be that it succeeded in tightening of wasteful public health spending.

Intra-country, unequal income distribution reduced health spending

The *GINI* inequality, significant as expected, suggests that a reduction in income inequity (e.g., through the tax codes) is likely to increase health care spending and by implication yield improved health status and productivity for the especially disenfranchised. Deaton's [12] comment, in an exhaustive and rich multidisciplinary research on health, inequality and economic development, remarked that since "income inequality, or other social inequities with which it is correlated, may be directly hazardous to individual health, ... tax and transfer policies that affect the distribution of income would have effects that work, not only through the usual mechanisms, ... , but also through individual levels of health" (pp. 113, 115). He then affirms that "if income has a nonlinear effect on health, ..., redistribution of income toward the poor will improve their average health by more than the loss of health among the rich" (p. 115). The *GINI* could reflect the possibility for lack of representation or voice for the poor in the budgetary process, leading to a much reduced (more) allocation of the health care budgets for prevention (cure) in rural (urban) areas.

Access to clinically trained health care personnel increased health care expenditure

BATD indicates a positive association with *HEXP* as expected, but is statistically insignificant. Interestingly, *BATD* was a highly significant variable in an earlier model of 1984 cross-sectional data of African countries [16]. One reason for the apparent lack of statistical significance of *BATD* for the 1995 data could be that the many years of austerity that SAP ushered in stretched the creativity of the population, leading a large number of health care consumers to resort to using low cost, traditionally-trained attendants, home remedies and experienced relatives [44].

More informal health care the for dependent children reduced formal sector care costs

The significant role demographic variable *LT15YR* plays in model specification (*v*) is instructive from a policy perspective. The *pre*-SAP health policies of the African countries made 'preventive care' a priority. The SAP policy mandated privatization of the health sector. The health needs of children and the elderly became more burdensome and 'food' on the table for the dependents took on priority during SAP. Rising demographics of the dependents is thus negatively associated with *HEXP*, particularly in view of availability of the less costly, traditional alternatives such as home remedies and spiritual healers. Leonard [34] recently reaffirmed the reliance of the indigenous African on traditional healers who use and enforce outcome-contingent contracts. This supports the claim that during fiscal retrenchments, patients prefer traditional healers to modern health facilities due to the inherent advantages of outcome-contingent contracts that include delivery of high quality care. Hahn [31], in a model fitted to SAP-era data, earlier reported a negative and statistically significant association between demographic dependency and health care spending, while Gbesemete and Gerdtham [16] reported a negative and statistically insignificant (t-ratio $= 0.16$) coefficient.

Internal conflicts raised, but also changed the composition of health spending

Finally, insights from model specification (*vi*) are interesting for testing the health policy implications of heightened military spending (*WAR*). This is because the spillover or externality effect of developing countries engaged in civil wars is increased health care spending, confirming Benoit's hypothesis on the capacity for military spending to raise expenditures on population nutrition, medical care, and training. Careful clarification of this finding is in order. First, it does not suggest that war is good for the African countries. Second, rather than targeted at development, the composition of positive shifts in health care spending during war is necessarily channeled to alleviating health-related negative spillover effects that armed conflicts impose on the population. This means that the type of health spending in times of war is compositionally different from that arising from peacetime, deliberate budgets for health investments designed to raise sustained development and growth.

5. Summary conclusions and implications

This study assessed the policy implications of an econometric model of the determinants of health expenditure in African countries, using 1995 *post*-SAP cross-sectional data of 26 nations for which full data are available. The GDP (and its supplement, the ODA), commonly found to be the most significant determinant, yielded an elasticity estimate of about 0.65 in relation to health expenditure. Other statistically significant determinants, first entertained here in this line of research, include the *GINI* income inequality and Benoit's hypothesis tests, among others. These contributions of this paper aside,

future research on health spending in Africa might consider methods for incorporating informal health care sector spending into the analysis.

Consistent with the 'basic needs' theory of economic development, the health commodity is a technical necessity, and the marginal spending appears to produce 'physiological' health rather than 'subjective' care. This claim should be tempered with the caveat that past studies reporting higher values of the *GDP* elasticity of *HEXP* used slightly different sets of countries and fitted models other than the Box-Cox with a different set of controls. Real GDP has risen since 1984 during which the GDP elasticity of health expenditure was roughly unity, compared with about 0.65 in 1995 in this study. One possible interpretation that SAP policies had succeeded in trimming wasteful health care spending is not consistent with observed declines in a number health status measures (e.g., healthy life years) in the affected African countries as recorded by the UN's *post*-SAP concept and measurement of the 'human expenditure ratio.' One alternative interpretation of the decline in health care spending as a ratio of the GDP is that the health budgets decayed significantly during the SAP era. Many anecdotal observations, empirical evidence, and country-specific policy briefs have borne out this interpretation. Policy analysts, earlier in Africa and reluctantly later at The Bank and the IMF, concur that the SAP mandates may have played some role in the deterioration of not only health, but many other basic needs as housing, education and food. One recent analysis of African demographic and health surveys on the dismal progress made so far concludes that 'dramatic changes in the rates of improvement in most measures of living standards' must occur to meet the ambitious goals [50]. The SAP reform goals included increased cost sharing, competitive markets, and expanded private sector (profit, non-profit) initiatives in medical care markets. During the SAP period, the public sector's share of health financing and provision in many sub-Saharan African countries in the 1990s therefore, fell consistently. Since the difficult adjustments [22] have led to net declines in the provision of 'basic needs' in the borrower countries, the UN has designed the 'human expenditure ratio' (priority health share of the GDP) to monitor basic needs provision for possible decays [13].

Productivity-based increase in the mean income of the poorest countries of the world are linked to significantly higher life expectancy. Therefore, the immediate policy challenge is to steadily raise *post*-SAP basic needs supply through more stable finance for population health and productivity improvements in Africa. Private sector cooperation with the government and non-governmental organization (NGO) providers of health services is essential to improving delivery systems, access, and retention of trained medical workers in the developing African countries. The dismal tragedy of the AIDS epidemic, malaria, and other diseases, is realigning health-related NGOs in Africa (and elsewhere) towards health improving strategies based on human resources rather than the historical tradition of constructing physical infrastructures. Finally, because four of the seven UN 'millennium development goals in Africa' relate to human health and the rest target poverty alleviation, children education, and gender issues, sound policies can focus on within country optimal public revenue allocation [14], reduction of income inequalities, and increasing real incomes to raise health status, and national productivity [12]. These are fundamentally essential for sustainable human development and economic progress.

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