Impact of Human Capital Endowments on Inequality of Outcomes in Cameroon

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Abstract:
This paper sets out to evaluate the impact of human capital endowments on measured inequality using the 2007 Cameroon household consumption survey. In particular, the paper (1) estimates determinants of household economic well-being using the control function econometric approach in which human capital endowments are considered as endogenous effort-related regressors, while controlling for exogenous circumstance-related variables; (2) simulates alternative counterfactual distributions of household economic well-being: one in which human capital endowments are equalized; and the other in which variations are entirely attributable to the unobservable terms, and (3) compares inequality in the factual distribution of household well-being with inequality in each of the simulated distributions. The results show that human capital endowments (education and health) correlate positively and significantly with household economic well-being. Direct and indirect exogenous opportunity-inducing circumstances are inequality-augmenting, whereas human capital endowments are inequality-reducing. Education and health interventions would, therefore, be primordial in driving well-being and mitigating inequality. Thus, leveling the playing ground for individuals to have equitable exposure to health, education, professional training and labour market participation irrespective of gender or region of origin is required for a low-income country like Cameroon to enhance equity and sustainable household economic growth.

Keywords: Human Capital, Well-being, Inequality of opportunities, Inequality of Outcomes, Household Surveys, Cameroon

1. Introduction

Mass mobilization of citizens calling for more social and economic justice, political participation and openness led to the ousting of leaders in about four African countries in 2011. Such aspirations for greater social cohesion, with fair chances for everybody in society is ingrained in the concepts of equity, fairness and social justice – which constituted the theoretical underpinnings of the 2011 UNDP Human Development Report (UNDP, 2011). Early ideas of equity postulated that individuals should be rewarded according to their contribution to society (Homans, 1961; Blau, 1964; Adams, 1965). Used interchangeably with fairness, equity has come

to refer primarily to distributive justice, which draws a distinction between just and unjust inequalities between people.

The incessant embezzlement and corruption in low-income countries, and the intergenerational transmission of wealth has generated a growing concern in both the policy and academic circles to compare inequality of outcomes with inequality of opportunities emanating from circumstances that are largely derived through inheritance and other environmental characteristics. As portrayed by Dias (2008), this extension is the consequence of developments in political philosophy, introduced by Rawls (1971), popularized by Sen (1980), formalized by Dworkin (1981), and subsequently modified by Arneson (1989) and Cohen (1989). Dworkin (1981) argues that justice requires equality of endowments (resources), and that preferences are irrelevant, in the sense that they are within the individual responsibility. Meanwhile for Cohen (1989) and Arneson (1989), the relevant cut is not between resources on the one hand and preferences on the other, but rather between factors outside and within the individual control. More recently, equality of opportunity has prompted a series of theoretical modeling (Roemer 1998; 2002) and empirical applications (Bourguignon et al., 2007; Lefranc et al., 2008).

Inequality of outcomes can be considered a composite indicator comprising inequality of exogenous circumstances, to which an individual may not be held responsible and inequality of endogenous effort, to which an individual can largely be held responsible. Moreover, popular sentiments might probably support the equalization of outcomes insofar as they are different because of the influence of heterogeneous circumstances, but not insofar as they are due to differences in the effort exerted by individuals. Although it may be hard to separate the exact influence of circumstance or effort variables on inequality of outcomes, to address the impact of equalizing some opportunities on inequality of outcomes, proximate classifications into circumstance-base and effort-base variations have been attempted in the literature (Dias, 2008; Lefranc, et al. 2008).

Most empirical implementations of the Roemer (1998) model of measuring inequality of opportunity have embarked on schemes that attempt to equalize circumstance-related variables to generate distributions in which the influence of circumstance-inducing opportunities have been eliminated. Inequality measurements from such schemes are then compared with inequality of outcomes to figure out inequality of opportunities (Bourguignon et al., 2007; Nunez and Tartakowsky, 2007). In such studies, the quality of econometric analysis is important to correctly assign causality between the effort-based variables and the outcome variable. Most studies that use econometric analysis so far to distinguish between just and unjust inequalities have, however, failed to correctly address inherent problems such as potential endogeneity and unobserved heterogeneity of inputs into the well-being generating process (*see*, Bourguignon et al., 2007; Nunez and Tartakowsky, 2007), thus the estimates are typically biased. In the present endeavour, we address these lacunas by tackling the potential problems of endogeneity and unobserved heterogeneity of human capital endowments via the control function econometric approach (Wooldridge, 2002; Mwabu, 2009 and Baye, 2010).

We consider human capital endowments as the fundamental determinants of household economic well-being because they complement with or substitute for exogenous circumstances

that enhance or constrain household livelihood opportunities. Inadequate human capital endowments like education and health may explain the roots of poverty in a low-income country like Cameroon. It is apparent that an initial mal-distribution of education and health inputs, as well as associated endowments should make it much harder for the poor to participate in, and gain from, the process of economic growth. This may further compromise other interventions geared at promoting inclusive growth and reducing poverty. Resolving human capital deficiencies is, therefore, expected to be instrumental in augmenting the standards of living of the population. Investment in education, health and related infrastructures leads to an increase in the labour market participation opportunities opened to economic agents and thus an essential catalyst for the national fight against poverty and inequality. Education increases the skills and productivity of poor households, enhances their employability and earnings, as well as their welfare. By the same token, access to health services contributes directly and indirectly to household utility and productivity by reducing inability to work, disability and sick days, thereby enhancing household labour market participation and welfare.

In this context, three key questions arise: what is the role of human capital endowments in the determination of household economic well-being? What is the impact of human capital endowments on measured inequality? What is the impact of both human capital and exogenous circumstance-based endowments on measured inequality in Cameroon? To address these research issues, this paper intends: (1) to estimate an income generating function in which human capital endowments are considered as endogenous; (2) to evaluate the impact on measured inequality of human capital endowments; (3) to assess the impact on measure inequality of all observed endowments in the income generating function; and (4) to discuss policy implications on the basis of the findings.

In the second case, the human capital endowments are thought to be largely effort-related, so fixing them in the counterfactual distribution is tantamount to removing the legitimate sources of variation and allowing only the illegitimate (circumstance-based) sources of variation. In the third case, all observed variables are assumed to be opportunity generating and the effort contents (indirect circumstances) are relegated to the unobservable terms. These counterfactual experiments are based on a structural model estimated using the control function econometric approach and the 2007 Cameroon household consumption survey. Comparing inequality generated from the counterfactual distributions with the inequality of outcomes would give rise to the inequality impacts under study. The rest of the paper is organized as follows: Section 2 deals with definitional issues and literature review. Section 3 dwells on the methodology. Section 4 presents the data and deals with model identification. Section 5 presents the empirical results, and conclusion and policy implications are sketched in Section 6.

2. Definitional issues and literature review

In Roemer's (1998) theory of equality of opportunity, five principal concepts are used: objective, circumstances, effort, instrument and type. The *objective* is the outcome of interest – in this paper, household well-being. *Circumstances* are attributes of the environment that are beyond the control of the individual that we loosely term exogenous factors. *Effort* is that set of choice or decision variables that are endogenous with other household decisions, which together with

circumstances determines the desired level of well-being. *Instrument* is the intervention proposed to compensate individuals with disadvantageous circumstances, in order to improve their chances of realizing an acceptably high level of well-being. The purpose of equal-opportunity policy is to level the playing field among households so that well-being should be a function only of their effort and not of their circumstances. An instrument is typically used to compensate an individual's achievement of well-being, which is sensitive only to his/her effort. Finally, a *type* is the set of individuals all of whom face the same circumstances. In this paper, we implicitly consider each household as a type. The ethics behind equality of opportunity is that inequality of outcomes due to the differential application of effort should be considered morally all right, but if it is due to differential circumstances, then it is not morally all right, thus should be compensable by society. The equal-opportunity view, therefore, holds a person responsible for his effort, but not for his circumstances.

The novelty of the equal-opportunity approach is, therefore, the art of partitioning income differentials into two categories, the first due to differential circumstances beyond the control of individuals, and the second due to individual variation in voluntary effort. Inequality studies over the past decades have been easy to grasp as they concentrated mainly on inequality of outcomes. Nevertheless, as indicated by Lefranc et al. (2008), these measures may be criticized for not measuring the kind of inequalities that are relevant from a social, economic or moral perspective because it does not reflect the inequalities that are considered in the current intellectual and social debates. Popularized by Sen (1980), extended by Dworkin (1981) and reformulated by Arneson (1989) and Cohen (1989), these views bring personal responsibility to the forefront of the debate on equality. The argument is that economic and social policies should only try to promote equality of opportunity in order to compensate inequality stemming from factors beyond the scope of individual responsibility. This way, individuals are allowed to bear the consequences of factors for which they can be held responsible. These views have be modeled in the recent economic literature by John Roemer (Roemer, 1993; Roemer, 1998; Roemer et al., 2003)) and empirical tested by a number of researchers (Bourguignon et al., 2007; Nunez and Tartakowsky, 2007; Lefranc et al., 2008).

Since the early works of John Roemer, the concept of inequality has been extended to investigate the effects of opportunities caused by different socio-economic factors beyond individual control. In this regard, considering the even-handedness or fairness of taxation, Roemer et al. (2003) query the extent to which tax- and transfer-regimes in ten advanced countries equalize opportunities among their citizens for income acquisition. Using economic analysis inspired from contemporary political philosophy, they evaluated the performance of fiscal systems with respect to one arguably important ethical measure - equity. Results from this study indicate among other things, that a country will have equalized-opportunity if the chances of earning high (or low) income are equal for citizens from all backgrounds.

Education has been considered an important aspect in understanding how opportunities can be equalized. Despite efforts by many countries to reduce educational barriers to members of disadvantaged groups, those barriers remain effectively quite high (Shavit and Blossfeld, 1993). Indeed, researchers in sociological stratification have suggested that a low degree of income inequality fosters equalization of educational and occupational opportunities, rather than the

other way around.[1] Bourguinon et al. (2007) decompose earnings inequality into a component due to unequal opportunities and a residual term using Brazilian data. Distinguishing between circumstance-based and effort-based variables, they associate inequality of opportunities with the inequality attributable to circumstances which lie beyond the control of the individual – father's and mother's education; father's occupation; race; and region of birth. They interpret their decomposition as establishing a lower bound on the contribution of opportunities to earnings inequality. They also decompose the effect of opportunities into a direct effect on earnings and an indirect component which works through the effort-based variables.

Concerning studies on race and parental education and how they relate to opportunities in the United States, Betts and Roemer (1999) find that race is a more important partitioning variable than parental education. Page and Roemer (2001) investigate the extent to which the United States fiscal system can be seen as an opportunity equalizing device and find that the US tax system does contribute to an equalization of opportunities across socio-economic groups, but much less so across racial groups. On intergenerational mobility and how this relates to education, some authors estimate that part of schooling inequality that is explained by the characteristics of parents and assign it to inequality of opportunities, while attributing the remainder to heterogeneous individual efforts (Behrman et al., 2000; Lam, 1999).

Literature on human capital (Mincer, 1958; Becker, 1964; Schultz, 1992) indicates that education and health affect the productivity of an individual and therefore his earnings and consequently household economic welfare. For instance, education and health for which the individual is largely responsible are some examples of personal characteristics associated with household economic well-being. For instance, human capital inputs have been recognized as critical factors in achieving sustained growth in productivity in some African countries (Schultz, 2003). Education may enhance technical efficiency directly by improving the quality of labour, augmenting the ability of individuals (farmers) to adjust to idiosyncratic shocks through its effect on input utilization (Moock, 1981). Achia et al. (2010) using Demographic and Health Surveys (DHS) to study the determinants of poverty in Kenya, find that health is an important determinant of household economic welfare. Epo and Baye (2011) also find that education and health constitute key components of household economic welfare in Cameroon because they directly and indirectly affect household utility and production functions.

Most empirical works measuring inequality of opportunity have basically used the OLS estimates to simulate benchmark distributions that attempt to equalize circumstance-related variables to generate distributions in which the influence of circumstance inducing opportunities has been eliminated. Such simulated inequalities are then compared with inequality of outcomes to capture the effect of inequality of opportunities (Bourguignon et al., 2007; Nunez and Tartakowsky, 2007). By so doing, researchers fail to adequately address inherent econometric problems such as endogeneity, sample selectivity and unobserved heterogeneity. Endogeneity arises from the expectation that human capital endowments (education and health) are jointly

[1] For a thorough discussion, see Erikson and Goldthorpe, 1992; and Jonsson et al., 1996.

determined with household welfare. The unobserved heterogeneity of human capital endowments among households originates from household-specific unobserved differences in education and health resulting from genetic endowments of earlier generations. Thus, most studies that use econometric analysis to distinguish between just and unjust inequalities have typically generated biased estimates (see, Bourguignon et al., 2007; Nunez and Tartakowsky, 2007). As value addition, we deal with some of these lacunas by attempting to tackle the potential problems of endogeneity and unobserved heterogeneity of human capital endowments via the control function econometric approach (Wooldridge, 2002; Mwabu, 2009 and Baye, 2010).

A number of authors have studied inequality of outcomes or its decomposition using different indicators, dimensions and Cameroon household survey data (Baye and Fambon, 2002; Chameni, 2006; Baye, 2010; Araar, 2006; Araar, 2009). Others have studied determinants of inequality of outcomes using Cameroon data and regression-based methods (Epo et al., 2011). No study using Cameroon data has so far explored the component parts of inequality of outcomes: notably inequality due to exogenous circumstance-related variables versus inequality due to endogenous effort-related variables. This paper also attempts to fill this gap.

3. Methodology

3.1. Household economic well-being function

Following the Grossman (1972) model, we assume that the household economic well-being function is generated by two sets of inputs: a vector of exogenous variables for which the household cannot influence directly and a vector of endogenous variables for which an individual household can influence, at least partially. Following Roemer (1998; 2002), these inputs into the well-being generating function can loosely be labeled circumstance-related and effort-related variables, respectively. Indeed, effort-related factors are choice/decision variables by definition. At the household level, economic welfare is affected by the education and health status of the household head as well as a vector of other household characteristics. At the community and regional levels, household well-being is possibly affected by community and regional characteristics, which can be considered as local market characteristics. Household economic well-being is also affected by household and local market characteristics that we cannot observe or measure. Control variables therefore generally include household characteristics, local market characteristics and unobservable characteristics. In this set up, human capital (education and health) endowments are considered as endogenous or effort-related covariates of household economic well-being, thus considered separately in the household welfare generating function, which takes the structural form:

$$LnY = a_0 + \sum_{k=1}^{m} a_k C_k + \sum_{j=1}^{2} \eta_j E_j + \varepsilon_1 \qquad (1)$$

where, LnY and E, are log of household welfare and human capital endowments (education and health) held by a household. These human capital endowments are thought of as endogenous effort-related variables. This is an imperfect classification because human capital is also influence by circumstances derived or inherited from parents or derived from region of birth. Yet, it is easy to accept that the individual effort-content in human capital is likely to dominate

the traces of embodied inherited circumstances; C_k is a vector of m exogenous covariates such as other individual, household, community and regional characteristics. These exogenous factors are loosely classified as opportunity-creating circumstance variables; a_k is a vector of m parameters of the exogenous explanatory variables that correlate with the well-being generating function to be estimated; η_j (j=1,2) are the parameters of the potential endogenous explanatory variables in the economic well-being function; and ε_1 is the error term that captures both random effects and unobservable variables.

The estimation of the parameters η_j would show the effect of human capital endowments on household economic welfare. It is therefore a requirement for these parameters to be properly estimated. Since household economic well-being and human capital endowments are likely to be jointly determined, we try to purge parameter estimates of potential endogeneity. A conventional method to reduce the problem of endogeneity is to use the instrumental variables (IV) method. To do this, the reduced form of the jth human capital endowment function can take the form:

$$E_j = b_{0j} + \sum_{k=1}^{m} b_k C_{kj} + \sum_{k=m+1}^{m'} b_k C_{kj} + \varepsilon_{2j} \qquad (2)$$

where, C_k now is an augmented vector of exogenous variables, comprising of m covariates that belong to the economic welfare function (outcome equation), and a vector of $(m'-m)$ instrumental variables that affect household capital endowments, E, but have no direct influence on log of household economic welfare, LnY; b_k is a vector of m' parameters of exogenous explanatory variables in the reduced form human capital endowments equation to be estimated and ε_2 is the error term that captures both the random effects and other relevant but unobservable characteristics such as traces of embodied inherited circumstances that affect human capital endowments.

Equation 1 is the structural equation of interest, that is, the household economic welfare function whose parameters are to be estimated. Equation 2 is the linear projection of the potential endogenous variables, E_j, on m' exogenous variables, that is, a reduced form model of household capital endowments. As will be discussed later, for instrumental variables estimation one requires exogenous variables that are correlated with the endogenous variables, uncorrelated with the error term of the structural equation, and do not affect the outcome of interest conditional on the included regressors, except through the endogenous variables.

In addition, heterogeneity of responses due to non-linear interaction of human capital endowments with unobservable variables could bias the estimated structural coefficients. The heterogeneity in household preferences or other unobserved determinants of behaviour could affect human capital endowments, whose effect on household economic well-being is captured by the interaction of education and health with their respective residuals derived from the reduced form estimates of education and health. These interaction terms could equally be thought of as interaction between the effort-related variables and the unobserved variables such as inherited circumstances that complement human capital endowments. We appeal to the control function approach to address these two potential issues (*see*, Garen, 1984; Wooldridge, 1997; Mwabu, 2009; Baye, 2010). Thus, to account for the potential endogeneity and heterogeneity of responses of unobservables that may be complementary with human capital endowments, Equation 1 can be augmented to Equation 3, which is the control function model.

$$LnY = \alpha_0 + \sum_{k=1}^{m} \alpha_k C_k + \sum_{j=1}^{2} \eta_j E_j + \sum_{j=1}^{2} \alpha_j \hat{\varepsilon}_{2j} + \sum_{j=1}^{2} \lambda_j (\hat{\varepsilon}_{2j} * E_j) + u \quad (3)$$

where, $\hat{\varepsilon}_{2j}$ (j=1,2) are residuals of the endogenous inputs derived from the reduced form model (Equation 2). The residuals, $\hat{\varepsilon}_{2j}$, serve as the control for unobservable variables that correlate with E_j, thus allowing these endogenous inputs to be treated as if they were exogenous covariates during estimation; $(\hat{\varepsilon}_{2j} * E_j)$ is the interaction of the residuals with the actual values of each of the potential endogenous explanatory variables; u is a composite error term comprising ε_1 and the unpredicted part of ε_2, and α, η *and* λ are vectors of parameters to be estimated.

The determinants of household economic well-being provide input into the simulation of the required counterfactual distributions.

3.2. Counterfactual experiments and inequality measures

3.2.1. Simulated distributions

Following Roemer (1998) and Bourguignon et al. (2007), we associate exogenous-opportunity with the impact on well-being of exogenous circumstance-related variables: determinants of well-being over which individual households are thought to have little or no control. We also follow Roemer (1998) and Bourguignon et al. (2007) in classifying the other determinants of well-being that can be influenced by households' decisions as endogenous effort-related variables. Our interest here is to assess the impact on inequality which would obtain if endogenous effort-related variables had no effect on observed inequality of well-being or, equivalently, if there were no differences in effort exerted by the citizenry. Equality of endogenous decision variables, in the sense of Roemer (1998), would obtain if the distribution of well-being were independent of effort. In this context, inequality of opportunity applies to individual households, who, having expended the same effort, achieve different outcomes due to differences in circumstances.

To obtain counterfactual benchmarks, we first write the estimated counterpart-form of Equation 3 as Equation 4.

$$Ln\hat{Y} = \hat{\alpha}_0 + \sum_{k=1}^{m} \hat{\alpha}_k C_k + \sum_{j=1}^{2} \hat{\eta}_j E_j + \sum_{j=1}^{2} \hat{\alpha}_j \hat{\varepsilon}_{2j} + \sum_{j=1}^{2} \hat{\lambda}_j (\hat{\varepsilon}_{2j} * E_j) \quad (4)$$

From Equation 4, the factual or observed household economic well-being distribution in log form can be presented as: $LnY = Ln\hat{Y} + \hat{u}$ and taking the antilog, we have $Y = Exp(Ln\hat{Y} + \hat{u})$, which is presented in full as in Equation 5.

$$Y = Exp[\hat{\alpha}_0 + \sum_{k=1}^{m} \hat{\alpha}_k C_k + \sum_{j=1}^{2} \hat{\eta}_j E_j + \sum_{j=1}^{2} \hat{\alpha}_j \hat{\varepsilon}_{2j} + \sum_{j=1}^{2} \hat{\lambda}_j (\hat{\varepsilon}_{2j} * E_j) + \hat{u}] \quad (5)$$

where $\hat{u}$ is the predicted error term from the estimation of Equation 3. Equation 5 is the factual household economic well-being distribution, which is the distribution without policy. From the

factual distribution, we can then derive counterfactual distributions in order to study inequality impacts. Two counterfactual benchmarks are derived in what follows.

Counterfactual human capital equalizing benchmark

If household heads are allocated the mean value of the endogenous human capital endowments ($\overline{E}_j$), while allowing exogenous circumstance-related variables as observed, we have the distribution of well-being $Y_{\overline{E}}$ defined as:

$$Y_{\overline{E}} = Exp[\hat{\alpha}_0 + \sum_{k=1}^{m} \hat{\alpha}_k C_k + \sum_{j=1}^{2} \hat{\eta}_j \overline{E}_j + \sum_{j=1}^{2} \hat{\alpha}_j \hat{\varepsilon}_{2j} + \sum_{j=1}^{2} \hat{\lambda}_j (\hat{\varepsilon}_{2j} * \overline{E}_j) + \hat{u}] \quad (6)$$

Equation 6 is a counterfactual distribution in which human capital endowments are equalized. In this set up, measured inequality is attributable to observed and unobserved exogenous circumstance-related variables.

Counterfactual circumstance and human capital equalizing benchmark

Very few, if any, will deny that the foundation of education and health endowments at adulthood is partly attributable to parental and environmental inputs early in life. In this case, the only source of variation in the simulated well-being distribution would arise from unobservable terms. In this context, direct and indirect effort is relegated to the unobservable terms, which as indicated by Nunez and Tartakowsky (2007) may be subsuming unobserved circumstances, sheer luck, effort at work, deviations from permanent income and potential errors in measuring well-being. However, through the use of the control function econometric approach, we purged our parameter estimates of potential endogeneity and unobserved heterogeneity thereby reducing most of the systematic tendencies in the error term. The second simulated well-being distribution equalizes both opportunity-induced circumstances and human capital endowments ($Y_{\overline{O},\overline{E}}$) as shown in Equation 7:

$$Y_{\overline{O},\overline{E}} = Exp[\hat{\alpha}_0 + \sum_{k=1}^{m} \hat{\alpha}_k \overline{C}_k + \sum_{j=1}^{2} \hat{\eta}_j \overline{E}_j + \sum_{j=1}^{2} \hat{\alpha}_j \hat{\varepsilon}_{2j} + \sum_{j=1}^{2} \hat{\lambda}_j (\hat{\varepsilon}_{2j} * \overline{E}_j) + \hat{u}] \quad (7)$$

If each of the counterfactual distributions is denoted by $Y_{\overline{A}}$, that is, the distribution with policy, the without policy distribution by Y and an inequality index represented by *I*, we can defined the impact of policy on outcome inequality denoted by Θ_I:

$$\Theta_I = \frac{I(Y) - I(Y_{\overline{A}})}{I(Y)} = \frac{\Delta I}{I(Y)} \quad (8)$$

An inequality index "with policy" ($I(Y_{\overline{A}})$) here is attributable: (1) to inequality of opportunities engendered by exogenous circumstance-related and unobservable variables because inequality due to endogenous effort-related human capital endowments has been eliminated by ($Y_{\overline{E}}$) or to inequality of unobservable terms (considered as true effort or indirect circumstances) when inequality due to both the circumstance and human capital endowments have been eliminated by ($Y_{\overline{O},\overline{E}}$). The notation Θ_I indicates that the human capital endowment share (or the explained

share) of inequality is conditional on the chosen inequality index. By the same token, the opportunity share (or the unexplained share) of inequality is given by the complement of Θ_I.

3.2.2. Inequality measures

Several measures have been proposed in the literature for characterising inequality in the distribution of living standards (Kakwani, 1980; Glewwe, 1986; Fields, 1980; Theil, 1979; Sen, 1973; Shorrocks, 1984; Litchfield, 1999). According to these authors, any appropriate measure of inequality that can conveniently facilitate welfare analysis must lend itself to five axiomatic conditions: (1) the mean independence condition, (2) the population-size independence condition, (3) the Pigou-Dalton transfer sensitivity, (4) the symmetry condition, and (5) the decomposability condition.[2]

The S-Gini Class of Indices

The popularity and attractive properties of the Gini coefficient makes it an indispensable measure in any study of inequality. The Gini coefficient tends to satisfy axioms 1-4, but will fail the decomposability condition if sub-groups of the distribution of well-being overlap. According to Donaldson and Weymark (1980) and Duclos and Araar (2006), after ordering living standards in a Lorenz consistent manner, the class of S-Gini (or "Single-Parameter" Gini) inequality indices can be shown to be equal to the covariance formula in Equation 9:

$$I(\rho) = \frac{-\text{cov}[\,Q(P), \rho(1-P)^{(\rho-1)}]}{\mu} \qquad (9)$$

where Q(P) is the level of living standard below which we find a proportion P of the population. $P \in [0, 1]$ is the proportion of individuals/households in the population who enjoy standards of living that are less than or equal to the quantile Q(P). ρ is a parameter of inequality aversion that determines our ethical concern for the deviation of quantiles from the mean at various ranks in the population. The larger the value ρ, the more weight is given to the deviation of living standards from the mean, μ, at the lower tail of the distribution. When ρ becomes very large, the index I(ρ) equals the proportional deviation from the mean of the lowest living standard. When ρ=1, the same weight is given to all deviations from the mean, which then makes the inequality index I(ρ=1) always equal to 0, regardless of the distribution of living standards under consideration.

The conventional Gini index is then obtained by letting ρ=2 (Equation 10):

[2] The Mean independence condition holds if multiplying all incomes by a constant, k, leaves the measure of inequality unchanged. The population-size independence condition holds if increasing or decreasing the population by the same amount across all income classes does not affect the measure of inequality. The Pigou-Dalton transfer sensitivity condition holds if an income transfer from a wealthier to a poorer person brings about a decrease in the measure of inequality without reversing the direction of welfare. The symmetry condition requires that the inequality measure be independent of any characteristic of households other than the welfare indicator whose distribution is being measured. The decomposability condition takes three forms: group decomposability, source decomposability and decomposability of shared household income. For a comprehensive analysis of source decomposition, see Adams, Jr and Alderman (1992), and Leibrandt et al. (1996).

$$I(\rho = 2) = \frac{2\text{cov}[Q(P), P]}{\mu} \qquad (10)$$

which is just a proportion of the covariance between living standards and their ranks. An interesting property of the conventional Gini index is that it equals half the mean-normalised average distance between all living standards. Thus, if the standard Gini index is found to be 0.3 the interpretation is that the average distance between the living standards of that distribution is of the order of 60 per cent of the mean. The Gini coefficient for ρ=2 can be portrayed graphically as twice the area lying between the lorenz curve and the 45^o line divided by the total area in such a diagram. The denominator ensures that this measure will vary between 0 (perfect equality) and 1 (perfect inequality).

The Generalised Entropy class of Inequality indices

The generalized Entropy class of inequality indices GE(θ) (see Litchfield, 1999; Duclos and Araar, 2006), expressed as in Equation 11, satisfies all the five axioms for an appropriate measure of inequality.

$$GE(\theta) = \begin{cases} \dfrac{1}{\theta(\theta-1)}\dfrac{1}{n}\left[\displaystyle\sum_{i=1}^{n}\left(\frac{y_i}{\mu}\right)^{\theta} - 1\right], & if \quad \theta \neq 0, \quad 1 \\ \dfrac{1}{n}\displaystyle\sum_{i=1}^{n}\log\left(\frac{\mu}{y_i}\right), & if \quad \theta = 0 \\ \dfrac{1}{n}\displaystyle\sum_{i=1}^{n}\frac{y_i}{\mu}\log\left(\frac{y_i}{\mu}\right) & if \quad \theta = 1 \end{cases} \qquad (11)$$

where n is the number of households in the sample, y_i is the standard of living of the i^{th} household, and $\mu = (1/n)\Sigma y_i$ is the mean standard of living. θ is the parameter of inequality aversion, which represents the weight given to distances between incomes at different parts of the distribution, and can take any real value. The values of GE(θ) range from 0 to ∞, with 0 representing an equal distribution (all standards of living identical) and higher values representing higher levels of inequality. For lower values of θ, GE(θ) is more sensitive to changes in the lower tail of the distribution, and for higher values of θ, GE(θ) is more sensitive to changes that affect the upper tail. If θ = 0, GE(θ=0) gives the gap of the logarithmic mean; if θ = 1, GE(θ=1) gives Theil's inequality index and if θ = 2, GE(θ=2) gives half of the squared coefficient of variation.[3]

4. Data and model identification strategy

[3] It may be noted here that the family of Atkinson indices is a special case of GE(θ) if we constrain θ to be no greater than 1 and let θ=1-ε. Under these conditions, if the Atkinson index GE(ε) indicates that there is more inequality in a distribution A than in a distribution B, then the index GE(θ) with θ=1-ε will also indicate more inequality in A than in B.

Data

We use the 2007 Cameroon household consumption survey (CHCS III) for the empirical analysis. The CHCS III was carried out between May and July 2007; and comprised 11391 households. Its aim was to upgrade knowledge on poverty and welfare status in Cameroon by providing indicators that capture the living standards of the local population to be able to follow up efforts made towards the implementation of the poverty reduction strategy paper (PRSP) and the realization of the MDGs. This survey covers the national territory. The two principal cities, Yaoundé and Douala, were considered as two separate urban strata. In addition, each of the 10 regions was divided into three strata - urban (large towns with at least 50, 000 inhabitants); semi-urban (small towns with at least 10, 000 inhabitants and less than 50, 000 inhabitants) and rural strata (settlements with less than 10, 000 inhabitants). In all, 32 strata were established for this survey. This was comprised of 12 urban strata (Yaoundé, Douala and the urban strata for the 10 regions that make up Cameroon), 10 semi-urban strata and 10 rural strata with each stratum for each region.

Two types of sampling designs were undertaken depending on the zone of residence. In the main cities of Yaoundé and Douala, a two-stage sampling frame was adopted. For other areas, a three-stage random sampling frame was adopted following the sequence city-primary sampling unit-household. The primary sampling units were chosen based on the stratification for the 2007 Demographic and Housing Census. Primary sampling units for urban areas were numbered 001 to 699. For rural areas, the numbering was from 700 to 900. In this survey, 12 households were visited in each primary sampling unit in Yaoundé and Douala and 18 households in each primary sampling unit in the 10 other regions that make up the country.

Based on the 2007 household survey, the following variables were selected. The dependent variable considered as a proxy for income or production or well-being was household expenditure per capita per year expressed in CFA francs. The following independent variables were considered. Household size indicated the number of people living in a particular household at a given point in time. Age indicates the age of the household head at the time of the survey. Fraction of active household members was generated as the proportion of active and working adults living in the household. Farmland ownership indicates households in which the head owns exploitable farmland and most farmland is inherited or owned communally in rural areas. For purposes of inequality measurement, we choose sector of employment (primary, secondary and tertiary) of the household head as the group variable of interest.

We also use synthetic variables for education and health constructed by the multiple correspondence analyses (MCA) method that captures the multidimensional notion of health and education. Besides, as noted by Thomas and Frankenberg (2002), it is widely recognized that health is multidimensional - reflecting the combination of an array of factors that may include physical, mental and social well-being, genotype and phenotype influences, as well as expectations and information. Education is also multidimensional and includes amount of time spent in school, nature of the curriculum, quality of schooling at each stage, extent of learning in school, post-schooling training and skill acquisition. Moreover, effort is a multi-dimensional set of behaviors, including principally the acquisition of skill and healthiness, which engender the

potential for labour market participation, income acquisition and well-being. Modalities that were used to construct each of these synthetic variables included a wide range of questions that capture their multidimensional character and translate more public policy relevant information (See, Appendix 1). The ordering of the various scores were generated and normalized to treat for the presence of negative values which may cloud the classification of observations and interpretation of results.[4] Variables selected for our empirical work alongside their sample means and standard deviations are hosted in Table 1.

Model identification strategy

Estimating how exogenous changes in human capital (education and health) that are uncorrelated with other household preferences or constraints depend on our specifying relevant, strong and valid instrumental variables for education and health. To predict education and health outcomes and the conditions under which public policies might be justified to modify human capital inputs, one requires a basic understanding of its determinants as well as its socioeconomic consequences. At the microeconomic level of the household, human capital is found to be closely associated with other household choices, including labour market participation, production and consumption decisions that affect the household's economic well-being. However, to assess the magnitude of the effects of human capital, there is need to first specify exogenous factors (not choice variables) that affect human capital but leave other constraints on household choices and outcomes unaffected except through human capital endowments.

In other words, exclusion restrictions or valid instruments are needed to account for some part of the variation in human capital that is independent of household choices and constraints. Otherwise, the effects of human capital on household economic well-being may not be causal and cannot be expected to occur when social policies increase (or reduce) access and/or returns to human capital. Information access variables such as television and radio sets, as well as per capita space for habitation, all captured as cluster means using cluster characteristics will affect household economic well-being only through access and returns to human capital endowments such as education and health. Since access to television, radio and per capital living space is captured at cluster levels, they are uncorrelated with household choices or unobserved determinants of other household outcomes except through their effects on human capital. In addition, any variable captured at the cluster level automatically becomes exogenous and circumstance-related if the unit of measurement is the household.

These information technology-based (television and radio) cross-effects of human capital on household economic well-being may help explain how policies that promote human capital accumulation and/or returns to human capital can facilitate household economic well-being through production and consumption decisions. Thus, understanding that education and health are endogenous to other household choices challenges us to measure these potentially important causal connections, and thereby provide a sounder basis for evaluating how public policies affect the social allocation of resources.

[4] A more complete discussion of the procedure and results of the MCA indices for education and health used in this paper are found in Epo and Baye (2011).

However, as portrayed by Murray (2006), the cloud of uncertainty that hovers over instrumental variable estimates is never entirely dispelled. We recognize, therefore, that although we use both formal tests and intuition to select our instruments, even if these formal tests are passed and intuition is satisfied, how much credence other researchers might give to an instrumental variables study like this one can legitimately be different and arriving at a consensus is usually an exception rather than the role. This is probably the main reason why experimental approaches to identification of the structural parameters have become popular in development economics literature (Schultz, 2008). Notwithstanding, we subjected our candidate instruments to intuitive, theoretical and empirical scrutiny to reduce the risk of using invalid instruments.

5. Empirical results

5.1. Descriptive statistics

Some descriptive statistics are outlined in Table 1. The statistics identify that in 2007, 35% of the total population were urban dwellers. The average age of household head was 44 years. On average, one-fifth of household members were active and working. The averages for the synthetic variables for education and health were 1.0125 and 0.6970. Along urban-rural settings these were 1.307 and 0.87 for education and 0.72 and 0.64 for health. To attenuate the potential endogeneity of decision variables we captured variables such as household ownership savings, farmland, television, radio and number of rooms at cluster levels. The cluster mean for these variables were 0.27; 0.57; 0.29; 0.49 and 2.49, respectively. The factual and the two counterfactual means of our welfare indicator were 327435.6 CFA francs, 333442.8 CFA francs (equalizing human capital endowments), and 319831 CFA franc (equalizing all observed independent variables). Household poverty status was 39.89% of the total population.

5.2. Reduced form estimates for education and health

Results of the reduced form for education and health are reported in Table A1 in Appendix 2. Variables that negatively and significantly relate to education (Table A1, Column 1) were number of rooms, ownership of farmland, age of household head, household size, household size squared and fraction of active household members. For the positively and significant variables we identify owning a television, radio, ownership of savings and urban residency. Variables that positively and significantly related to health included radio, ownership of savings, age and the square of household size (Table A1, Columns 2). On the contrary, the variables household size, gender, fraction of active household members, urban residency and ownership of farmland negatively related to the synthetic variable for health (Table A1, Columns 2).

Relevance, strength, validity and exogeneity of instruments

The first-stage F statistic and the partial R^2 convey vital information as to the relevance and strength of instruments in the case of a single endogenous variable (Shea, 1997). In this paper we have two instrumented variables – education and health. The first-stage F statistic on excluded instruments for the reduced form education estimates is 279.24, p-value = 0.000 (Table A1 Column 1) and for health is 34.51, p-value = 0.000 (Table A1 Column 2). This is preliminary evidence that the excluded instruments are relevant and may not be weak. According to the weak identification tests in the lower panel of Table 2, the Cragg-Donald statistics of 28.563 is much

greater than Stock-Yogo weak ID test critical value of 13.43 (Column 3 of Table 2). This indicates that the hypothesis of weak identification can be rejected.

Table 1: Weighted Descriptive statistics

Variables	Obs.	Population	Mean	Std. Dev.
Outcome Variable				
Total Expenditure per head in CFA francs **(LnY)**	11391	17878688	12.4270	0.6914
Potential Endogenous Variable (*E*)				
Education	11391	17878688	1.0251	0.38
Education (urban subsample)	6365	6313548	1.3071	0.2136
Education (rural subsample)	5026	11565141	0.8712	0.3561
Health	11391	17878688	0.6790	0.39
Health (urban subsample)	6365	6313548	0.7427	0.3908
Health (rural subsample)	5026	11565141	0.6442	0.3818
Exogenous Included Variables (w_1)				
Ownership of Savings (cluster mean)	11391	17878688	0.27	0.23
Age of household head in years	11391	17878688	44.40	14.28
Household Size	11391	17878688	6.48	3.99
Household size squared	11391	17878688	57.84	107.23
Gender (Male=1)	11391	17878688	0.79	0.41
Fraction of household members employed	11391	17878688	0.21	0.19
Urban residency (urban=1)	11391	17878688	0.35	0.48
Farmland ownership (Cluster mean)	11391	17878688	0.57	0.35
Instruments of Endogenous inputs (w_2)				
Household own Television (cluster mean)	11391	17878688	0.29	0.31
Household own Radio (cluster mean)	11391	17878688	0.49	0.21
Number of rooms (cluster mean)	11391	17878688	2.49	1.19
Derived Variables				
Education residual	11391	17878688	1.7e-11	0.27
Health residual	11391	17878688	-1.92e-10	0.37
Education times its residual	11391	17878688	0.0721	0.2607
Health times its residual	11391	17878688	0.1381	0.3151
Policy relevant Variables				
Factual household economic well-being	11391	17878688	327435.6	331093.8
Counterfactual household economic well-being, ($Y_{\overline{E}}$)	11391	17878688	333442.8	349798.4
Counterfactual household economic well-being, ($Y_{\overline{O},\overline{E}}$)	11391	17878688	319831	313453.3
Poverty Status of included household	11391	17878688	0.3989	0.49

Source: Compiled by the authors from the 2007 Cameroon Household Survey (CHCS III)

Since we have two endogenous regressors and 3 identifying instruments, there is a need to check whether the extra instrument is uncorrelated with the structural error term (the disturbance term of the well-being equation). As shown at the bottom of Table 2, at the 5 per cent level of significance, the Sargan Chi-sq test statistic of 0.007 (p=0.9327) casts no doubt on the validity of the three instrumental variables. Diagnostic tests in the bottom of Table 2 also show that the

composite variables for education and health are indeed endogenous in the income generating function (Durbin–Wu–Hausman Chi-square Statistic =735.79, p-value = 0.000). This points-out that the OLS estimates are not reliable for inference. This finding is confirmed by the significance of the reduced form residuals of the composite variables for education and health (Columns 3 and 4 of Table 2).

5.3. Determinants of well-being

5.3.1. Effects of endogenous variables on household economic well-being

The main objective here is to evaluate the effects of education and health on economic well-being, while controlling for other correlates. Table 2 displays estimates of structural forms of the well-being function under different assumptions. In particular, Columns 1 hosts the OLS estimates of the structural parameters of Equation 1. These estimates could be troubled by potential endogeneity bias originating from the composite variables for education and health. Column 2 gives the IV estimates accounting for potential endogeneity bias, but these estimates could still be suffering from biases due to unobserved heterogeneity of inputs in the generation of economic well-being.

Columns 3 and 4 of Table 2 are control function estimates: Column 3 is indeed the 2SLS estimates correcting for potential endogeneity, and Column 4, the 2SLS estimates correcting for both potential endogeneity and unobserved heterogeneity, which is captured by the non-linear interaction between unobservable variables and the endogenous correlates of household economic well-being. In this regard, four new generated regressors (residuals of endogenous variables and their interaction with the endogenous variables) are included via the control function (Equation 3) to account for correlations of household economic well-being with unobservables (Column 4).

The results in Table 2 show that education is positively and significantly associated with household economic well-being. The OLS estimate of the synthetic variable for education is 0.206 (Column 1). This OLS estimate is likely to be bias and inconsistent. Accounting for endogeneity, the 2SLS estimate jumps to 1.729 (Columns 2 and 3). Accounting for endogeneity, as well as heterogeneity of unobservatbles, the estimate on education shifts slightly upwards to 1.772 (Column 4), which is about 9 times the OLS estimate (Column 1).

Table 2 also shows that the synthetic variable for health is positively and significantly related to household economic well-being. The estimated coefficient of health also differs in magnitude across specifications. When endogeneity is corrected the coefficient increases to 1.11 (Columns 2 and 3) compared to the OLS estimate of 0.180 (column 1). When both endogeneity and heterogeity of unobservable variables are accounted for, the estimate stabilizes downwards at 1.074 (Column 4), which is about 6 times the OLS estimate (Column 1). The indirect effects of education and health are captured by the interaction of these inputs with unobservable variables. Since these interaction terms are highly significant in explaining household economic well-being, the control function estimates in Column 4 of Table 2 are to be preferred. The positive coefficients on the interaction terms indicate that the unobservable variables are complementary to education and health in explaining household economic well-being.

Table 2: Well-being Generating Function: Dependent variable is Log of total expenditures per adult (Robust t-statistics in

parentheses, except otherwise specified)				
Variables	Method of estimation			
	OLS (1)	2SLS (Correcting only for endogeneity) (2)	Control function approach without the interaction term (3)	Control function approach with the interaction term (4)
Potential Endogenous Variables (*E*)				
Education	0.2063***	1.729***	1.729***	1.772***
	(12.52)	(14.72)	(23.42)	(23.79)
Health	0.1798***	1.11***	1.11***	1.074***
	(14.73)	(5.13)	(8.17)	(7.91)
Exogenous Included Variables (w_1)				
Ownership of savings (cluster mean)	0.3003***	-0.4173***	-0.4173***	-0.4217***
	(13.74)	(-7.16)	(-11.39)	(-11.52)
Age of household head in years	0.000854**	0.004081***	0.004081***	0.00424***
	(2.5)	(3.79)	(6.04)	(6.27)
Household Size	-0.06794***	-0.06189 ***	-0.06189***	-0.06325***
	(-21.15)	(-12.46)	(-19.84)	(-20.23)
Household size squared	0.001516***	0.001382***	0.001382***	0.001444***
	(14.94)	(8.46)	(13.47)	(14.0)
Gender (Male=1)	0.0977***	0.1809***	0.1809***	0.1779***
	(8.42)	(5.80)	(9.23)	(9.09)
Fraction of household members employed	0.6975***	0.8133***	0.8133***	0.8099***
	(20.48	(15.34)	(24.42	(24.34
Urban residency (Urban=1)	0.2634***	0.06955***	0.06955***	0.06764***
	(17.69)	(2.52)	(4.01)	(3.91)
Farmland ownership (Cluster mean)	-0.5687***	0.2067***	0.2067***	0.2118***
	(-26.78)	(3.75)	(5.96)	(6.11)
Controls for Unobservable Variables				
Education residual			-1.627***	-1.844***
			(-21.53)	(-20.56)
Health residual			-0.9445***	-1.058***
			(-6.92)	(-7.46)
Education times its residual				0.1938***
				(4.53)
Health times its residual				0.1789***
				(3.28)
Constant	12.33***	9.698***	9.698***	9.639***
	(326.09)	(59.21)	(94.24)	(93.11)
R^2	0.5090		0.5407	0.5419
F-Stat [df; p-val]	1179.57 [10, 11380]	518.51 [10; 11380]	1116.15 [12, 11378; 0.000]	961.33 [14, 11376; 0.000]
Diagnostic statistics of instrumentation				
Weak identification test: Cragg-Donald F-Stat [Stock-Yogo weak ID test: 10% maximal IV size]		28.563 [13.43]		
Sargan statistic (overidentification test of all instruments): Chi-sq [df; p-value]		0.007 [1; 0.9327]		
Durbin–Wu–Hausman Chi2 test for exogeneity of the potential endogenous variables [df; p-value]		735.79 [2; 0.000]		
Number of observations	11391	11391	11391	11391
Source: Computed by the authors using the 2007 Cameroon Household Survey (CHCS III) and Stata 10.1. Notes: ***,** and * indicate 1%, 5% and 10% levels of significance, respectively.				

Enhancing endowments in education would increase household welfare through better employment opportunities, practices and income spending strategies in the household (Becker, 1967). This finding corroborates the result obtained by Awoyemi and Adekanye (2003) for Nigeria and Epo et al. (2011) for Cameroon. Health subsumes modalities associated with better health outcomes. Economies of scales generated from good health in terms of quality labour

market participation and subsequent income would likely enhance well-being. This result is in line with the view that health is an important aspect of human capital (Grossman, 1972).

Other correlates of household economic well-being

Other variables that correlate positively with household well-being are age, household size squared gender (male), share of active household members, urban residency, and farmland ownership. For the share of active household members, it is reasonable to believe that an increase in the number of individuals in a given household undertaking income generating activities will imply greater income generation and enhanced well-being. This result is similar to that obtained by Yuko et al. (2006) for farm households in Korea. The significantly and positive correlation of age with household welfare is similar to the results obtained by Babatude et al. (2008) on the determinants of poverty in South-Western Nigeria. As expected, ownership of savings is negatively and significantly related to household well-being. Household size is inversely related to economic well-being, but there appears to be a critical size above which household size is positively related to well-being. This is reflected in the positive and significance of the coefficient of household size squared, although the magnitude is rather small.

The positive coefficient of farmland ownership is indication that proceeds from the farm can enhance well-being through auto-consumption and potential savings that can be redeployed to other expenses or income acquired from sales of farm produce can be used to acquire other household endowments. Households living in urban areas generally have more income generating opportunities than rural dwellers, which may explain why poverty levels appear lower in urban regions. Male headed households tend to have higher welfare as indicated by their positive and significant influence on household well-being. This is probably because men are more likely than women to access jobs or the discrimination bias in favour of men in the job market. Similar results have been registered by Alayande (2003) for Nigeria.

5.4. Impact of equalizing human capital endowments on Inequality

The factual distribution of well-being, Y, was depicted in Equation 5 and the counterfactual human capital equalizing distribution of well-being, $Y_{\bar{E}}$, was derived in Equation 6. In the latter case, households are allocated the mean value of the endogenous human capital endowments, while allowing exogenous circumstance-related variables as observed to simulate the counterfactual distribution of well-being. Inequality due to human capital (education and health) endowments is therefore eliminated from the counterfactual distribution. This implies that inequality in this counterfactual distribution of well-being is largely attributable to exogenous observed and unobserved circumstance-related variables. The variability in the factual distribution of well-being depends on the endogenous-related human capital endowments, and the observed and unobserved exogenous circumstance-related endowments, whereas variation in the counterfactual distribution of well-being is attributable largely to the exogenous observed and unobserved circumstance-related variables.

Table 3: Gini inequality impacts of equalizing human capital endowments

Group Variable	Gini Index		Inequality Impact: $\Delta I\left[\Theta_I\%\right]$
	Factual	Counterfactual	

Sector of Employment			
Primary	0.3303	0.4292	-0.0989*** (0.0104)
	(0.0065)	(0.0099)	[-29.94]
Secondary	0.3711	0.4237	-0.0526*** (0.0151)
	(0.0116)	(0.0115)	[-14.17]
Tertiary	0.3795	0.4413	-0.0618*** (0 .0094)
	(0.0077)	(0.0082)	[-16.28]
Undefined	0.3935	0.4486	-0.0551 (0 .0159)
	(0.0121)	(0.0134)	[-14.00]
Cameroon	0.4077	0.4357	-0.028*** (0.0093)
	(0.0057)	(0.0069)	[-6.87]

Source: Computed by authors using the 2007 Cameroon Household Survey (CHCS III), especially regression results from Column 4 of Table 2 and descriptive statistics from Table 1 and DASP 2.1 in Stata 10.1. Note: (.) denote standard error and [.] denote relative contribution/impact. The counterfactual distribution is the well-being distribution in which the human capital endowments are equalized at the mean values. ΔI is absolute change in inequality.

As posted in Table 3, measured inequality as captured by the Gini coefficient is found to be 40.7 % for the factual distribution and 43.6% for the counterfactual distribution of welfare. The indication is that overall inequality increases significantly by 2.8 percentage points when inequality due to human capital endowments is eliminated and the overall relative impact of human capital endowments on outcome inequality is 6.9%. The absolute (relative) impacts of human capital on measured inequality in the primary, secondary and tertiary sectors of employment are 9.9 points (29.9%), 5.3 points (14.2%), and 6.2 points (16.3%), respectively (Table 3). These results show that observed human capital endowments have inequality mitigation tendencies overall and in the various sectors of employment. Results by the generalized entropy class of inequality measures shown in Table 4 are basically transmitting similar messages overall and for each sector of employment. A general result is that inequality increases from the primary to the tertiary sectors in both the factual and counterfactual distributions.

Inequality comparisons based on the Gini coefficient (Table 3) and on the generalized entropy class of inequality measures (Table 4) show that, irrespective of the inequality measure used, when human capital endowments are equalized, inequality in the counterfactual distribution increases significantly and overwhelmingly compared to observed or factual inequality. Thus, the general observation is that human capital endowments have inequality reducing effects, while exogenous circumstance-related variables register inequality augmenting effects. These observations are true overall and for the primary, secondary, tertiary and undefined sectors of employment. As shown in Tables 3 and 4, the inequality reducing influence of human capital endowments on measured inequality is significantly more potent in the primary sector than other sectors of employment.

The findings in Tables 3 and 4 suggest that since factual inequality is perceived as a composite index of endogenous effort-related and exogenous circumstance-related variables, factual inequality is overly accounted for by direct and indirect circumstance-related variables. The implication of this observation is that measured inequality in Cameroon is generally caused by factors beyond the control of the individual household and hence mainly unjustified. This requires policy attention to provide a level playing field. Since education and health endowments are found to be inequality reducing, they appear to be important candidates for intervention in order to significantly augment well-being and reduce well-being inequalities.

Table 4: Generalized entropy inequality impacts of equalizing human capital endowments			
Inequality index/Group Variable	**Factual**	**Counterfactual**	**Inequality Impact:** $\Delta I\ [\Theta_I\%]$
Generalized Entropy ($\theta = 0$)			
Sector of Employment			
Primary	0.1745	0.3237	-0.1492*** (0.0151)
	(0.0071)	(0.0152)	[-85.50]
Secondary	0.2253	0.3053	-0.0800*** (0.0203)
	(0.0141)	(0.0167)	[-35.51]
Tertiary	0.2396	0.3336	-0.094*** (0.0135)
	(0.0099)	(0.0126)	[-39.23]
Undefined	0.2604	0.3460	-0.0856 (0.0246)
	(0.0167)	(0.0220)	[-32.87]
Cameroon	0.2720	0.3289	-0.0569*** (0.0135)
	(0.0077)	(0.0106)	[-20.92]
Generalized Entropy ($\theta = 1$)			
Sector of Employment			
Primary	0.2013	0.3243	-0.123***(0.0175)
	(0.0107)	(0.0198)	[-61.10]
Secondary	0.2504	0.3300	-0.0796*** (0.0268)
	(0.0178)	(0.0228)	[-31.79]
Tertiary	0.2668	0.3647	-0.0979*** (0.0182)
	(0.0133)	(0.0176)	[-36.69]
Undefined	0.2814	0.3685	-0.0871*** (0.0283)
	(0.0210)	(0.0260)	[-30.95]
Cameroon	0.3081	0.3423	-0.0342** (0.0167)
	(0.0104)	(0.0135)	[-11.10]
Generalized Entropy ($\theta = 2$)			
Sector of Employment			
Primary	0.3045	0.4811	-0.1766***(0.0537)
	(0.0287)	(0.0706)	[-58.00]
Secondary	0.3693	0.5389	-0.1696** (0.0738)
	(0.0391)	(0.0668)	[-45.92]
Tertiary	0.4273	0.6611	-0.2338*** (0.0735)
	(0.0375)	0.0772 ()	[-54.72]
Undefined	0.4317	0.5977	-0.166** (0.0708)
	(0.0572)	(0.0727)	[-38.45]
Cameroon	0.5111	0.5502	-0.0391 (0.0525)
	(0.0305)	(0.0482)	[-7.65]

Source: Computed by authors using the 2007 Cameroon Household Survey (CHCS III), especially regression results from Column 4 of Table 2 and descriptive statistics from Table 1 and DASP 2.1 in Stata 10.1. Note: (.) denote standard error and [.] denote relative contribution/impact. The counterfactual distribution is the well-being distribution in which the human capital endowments are equalized at the mean values. ΔI is absolute change in inequality.

Table 5 shows that when all observed variables are equalized, overall Gini inequality augments very marginally by less than 1 percentage point in absolute terms. Inequality increased more in the primary sector than other sectors of employment (23%), whereas the secondary sector registers an increase of only about 5%. The unobservable variables are revealed as marginally augmenting inequality, while the observable variables as inequality reducing overall and in all sectors of employment. Since Tables 3 and 4 indicate that human capital endowments are inequality reducing, while the direct and indirect exogenous circumstance-inducing opportunities are inequality augmenting, the inequality augmenting effect of the counterfactual distribution in Table 5 is dampen by the observed circumstance-based variables that are equalized. The general observation is that since exogenous circumstance-inducing opportunities are inequality

generating, the indication is that much of the measured inequality would have been unjustified but for the inequality dampening effects of human capital endowments.

Table 5: Gini inequality impacts when all observed variables are equalized

Group Variable	Gini Index		Inequality Impact: $\Delta I\ [\Theta_I\%]$
	Factual	Counterfactual	
Sector of Employment			
Primary	0.3303	0.4063	-0.076***(0.0123)
	(0.0065)	(0.0127)	[-23.01]
Secondary	0.3711	0.3911	-0.02 (0.0153)
	(0.0116)	(0.0116)	[-5.39]
Tertiary	0.3795	0.4083	-0.0288*** (0.0092)
	(0.0077)	(0.0087)	[-7.59]
Undefined	0.3935	0.4333	-0.0398*** (0.0151)
	(0.0121)	(0.0130)	[-10.11]
Cameroon	0.4077	0.4086	-0.0009 (0.0099)
	(0.0057)	(0.0081)	[-0.22]

Source: Computed by authors using the 2007 Cameroon Household Survey (CHCS III), especially regression results from Column 4 of Table 3 and descriptive statistics from Table 1 and DASP 2.1 in Stata 10.1.
Note: (.) denote standard error and [.] denote relative contribution/impact. The counterfactual distribution is the well-being distribution in which the human capital endowments are equalized at the mean values. ΔI is absolute change in inequality.

6. Conclusion and policy implications

This paper attempted to assess the impact of human capital endowments on measured inequality in Cameroon using the 2007 Cameroon household consumption survey. In essence, the paper: (1) estimated an income generating function in which human capital endowments were endogenized applying the control function econometric approach; (2) constructed a counterfactual distribution in which human capital endowments were equalized to study the impact on inequality measured be the Gini and the generalized entropy class of inequality indices; and simulated an alternative distribution in which all variations are attributable to unobservable terms in the income generating function to elicit the impact on inequality measured by the Gini index. Econometric results depicted human capital endowments as correlating positively and significantly with household economic well-being. Other variables that related positively and significantly with the income generating function included: age, gender (male), proportion of working household members, urban residency and farmland ownership. Variables that associated inversely and significantly with household economic well-being were ownership of savings and household size.

Inequality has become and remains a sensitive issue in many countries, especially the low-income ones and access to human capital (education and health) endowments continue to play an undeniably important role in advancing household economic well-being and mitigating inequality outcomes. Simulated results indicated that exogenous circumstance-related variables are inequality-augmenting, whereas human capital endowments are inequality-reducing. The

implication of these findings for advocates of equality opportunities is that policy actions should seek to equalize the effect of circumstances that generate heterogeneous individual livelihood capabilities and then accept the resulting level of inequality of outcomes that would emerge from endowments that are largely governed by individual choices and preferences. This means leveling the playing ground for equitable exposure to health, education, professional training and labour market participation irrespective of gender, race, or region of origin. This notwithstanding, interventions may be accompanied by remedial actions to enable some disadvantaged persons or groups to be able to equitably access opportunities.

Human capital related interventions appear to be the most appropriate candidates for leveling the playing field for equal opportunities. In developed countries, tax systems may be efficient in redistributing resources because revenues are largely derived from direct taxes and economic agents function mainly in formal settings. In low-income countries like Cameroon, fiscal revenue is largely derived from natural resources and indirect taxes that can hardly permit fiscal policy to be used to redistribute resources. This has led development economists to favour relatively simple systems of resource reallocation based on the effect of public egalitarian expenditures on education, nutrition, and health in lieu of progressive taxation. Moreover, in low-income countries, income taxes are often costly to collect and are subject to tax evasion, especially as the informal sector is generally larger than the formal sector.

The results registered in this paper heralded the uniqueness of human capital endowments in enhancing well-being and mitigating inequality. This is indication that educational and health interventions are primordial in driving well-being and extenuating inequality. Since rural areas relative to urban settings and female relative to male heads are disadvantaged in terms of poverty and inequality, a bias in favor of rural areas and women in the distribution of educational facilities in order to bridge disparities is to be encouraged – an example could be the provision of lodging to rural female primary school teachers. Educational investments can create opportunities for rural residents and women to empower themselves in terms of know-how and labour market participation. Ameliorating rural hard and soft infrastructures may offer a possibility of curbing rural exodus and enhancing the well-being and inequality reducing effects of human capital endowments. Welfare gaps would be reduced if rural communities were to be linked by transport and telecommunication services, which can allow rural residents to easily access urban markets or urban residents to access rural markets.

Empowering rural dwellers, especially women through affordable education and health services increases the chances for rural residents to ameliorate their incomes and livelihood capabilities in general. Improving access to education, training and health services by increasing the density of schools, health centres and related infrastructures to reduce time and distance taken to access services will also empower women and rural residents by enabling them accumulate assets or increase returns on existing assets. Empowered household heads, especially women, would trigger inter-generational transmission of welfare as chances for educating their children are improved, thus guaranteeing them better opportunities as they start working in future.

The decreeing by the government of Cameroon of free primary education for all since 2001 is in harmony with the concept of educational access for all that we recommend. Its application is,

however, stifled by practices that drive up cost of sending children to school. These practices include corruption, indirect registration fees such as parent-teachers association levies, poorly trained/paid teachers, and late arrival of the "minimum package" for the smooth running of these primary schools. In the same spirit, the introduction of free uncomplicated malaria treatment for the under-five year old children in 2011 is in line with the concept of health access for all. The success of this intervention is, however, yet to be established.

Access to family planning services is worth improving in order to match fertility rates with the human capital investments in terms of education, health, nutrition and decency. These would enhance acquisitions that household heads or their offspring may use to impact positively on future poverty and inequality reduction. In spite of efforts made by the government of Cameroon in sensitizing the population on the benefits of family planning, the demographic growth rate has not changed significantly for decades. Effective family planning and sensitization programmes should be culture sensitive, specific to each locality and communicated through community radio and television media. This way, encouraging the rural child to acquire education increases her knowledge of benefits from family planning services.

Endowments in health make people happy and directly influence the quality of household labour market participation. An increase in health stock implies an increase in market and non-market productivity. This is possible because health can also act as an investment input because good health increases healthy hours at work and therefore earnings, as well as non-market hours for other activities. Healthy household heads will increase household income by working more effective hours and making savings on medical expenditures. In this regard, policies that promote access to health and healthy practices should be encouraged. The working conditions of health personnel need to be improved. Rural health services and equipments need to be upgraded and distributed more densely and evenly because once health is acquired; it becomes difficult to be redistributed. There is need to provide affordable and flexible health insurance systems for primary, secondary and tertiary sector workers.

Farming is the mainstay in rural Cameroon. Primary assets such as land ownership are a requirement to carry out this activity. In this view, improving access to rural financial services, know-how and health services will increase farmland productivity, generate more income and consequently household welfare. The downside is that the poor storage facilities and state of farm-to-market road infrastructure prevent a sizeable chuck of produce from gainfully reaching the buoyant urban markets. Improving access to farmland is also important in this context. Some sensitization is required to relax cultural barriers that prevent women from accessing farmland on a permanent basis. In addition, the family code currently being reformulated in Cameroon could include clauses that improve access to land and other resources irrespective of gender and region of origin. In this context, the authorities are urged to continue adhering to international conventions that promote equity and sustainability.

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Appendices

Appendix 1 Modalities used to construct the synthetic variables for education and health

Dimension 1: ***Education and related inputs***
Knowing how to read and write
Already attended schools
Distance to go to the nearest public primary school (0,1,2,3,4,5 or 6km and more.)
Distance to go to the nearest private primary school (0,1,2,3,4,5 or 6km and more.)
Required Time to go the nearest primary public school
(0-5min/6-15min/16-25min/26-35min/36-45min/ 46min or more)
Required Time to go the nearest private public school
(0-5min/6-15min/16-25min/26-35min/36-45min/ 46min or more)

Dimension 2: ***Health and related inputs***
Sector of consultation
Type of sanitary centre
Appreciation of health status
Distance to go to the nearest sanitary centre (0,1,2,3,4,5 or 6km and more.)
Required Time to go the nearest sanitary centre
(0-5min/6-15min/16-25min/26-35min/36-45min/ 46min or more)

Appendix 2: Reduced form estimates of education and health

Table A1: Reduced-form Estimates for Education and Health (Robust t-statistics in parentheses, except otherwise specified)

Explanatory variables	Dependent variables	
	Education (1)	Health (2)
Variables excluded from structural equation		
Household own Television (cluster mean)	0.3951***	0.007227
	(23.69)	(0.31)
Household own Radio (cluster mean)	0.09338***	0.1931***

	(6.78)	(10.13)
Number of rooms (cluster mean)	-0.01058***	0.000618
	(-4.85)	(0.2)
Variables included in outcome equation		
Ownership of savings (cluster mean)	0.2293***	0.2001***
	(18.67)	(11.77)
Age of household head in years	-0.00393***	0.002878***
	(-21.29)	(11.27)
Household Size	-0.00324*	-0.00023
	(-1.82)	(-0.09)
Household size squared	-3.5E-05	0.000205***
	(-0.62)	(2.63)
Gender (Male=1)	0.01652***	-0.1164***
	(2.59)	(-13.18)
Fraction of household members employed	-0.05503***	-0.0046
	(-2.92)	(-0.18)
Urban residency (Urban=1)	0.006764	-0.02422*
	(0.71)	(-1.84)
Farmland ownership (Cluster mean)	-0.2704***	-0.1063***
	(-21.18)	(-6.01)
Constant	1.176***	0.5505***
	(62.85)	(21.26)
R-squared	0.4908	0.0818
F-Stat [df; p-value]	997.10 [11, 11379]	92.16 [11, 11379]
Partial R-squared (of excluded instruments)	0.0686	0.0090
Test of excluded instruments: F-stat [df, p-value]	279.24 [3, 11379; 0.000]	34.51 [3, 11379; 0.000]
Observations	11391	11391
Source: Computed by the authors using the 2007 Cameroon Household Survey (CHCS III) and Stata 10.1. Notes: ***,** and * indicate 1%, 5% and 10% levels of significance, respectively.		