

# **Conflict Resolution and Wealth Sharing in Sudan: Towards an Allocation Formula**

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### **Abstract:**

The objective of this paper is to suggest a framework on the basis of which a wealth allocation formula could be based in the context of the current (2003) conflict resolution efforts . The idea behind the framework is that of minimizing poverty in a two region economy (South and North) by allocating a given total of resources between the two regions. With poverty summarized by the head count ratio the resulting allocation formula depends on a number of poverty magnitudes such as the head count ratios for the two regions, the growth elasticity of poverty in each region and the elasticity of the per capita expenditure of the South to that of the North. Due to lack of information on poverty by region an indirect method of estimating the relevant poverty magnitudes is used. A major result of the paper is that Nakuru sharing formula of overall net revenue from oil (of 48% to the South) could be supported by the proposed framework and the derived formulae.

**Key Words:** head count ratio, growth elasticity of poverty, wealth sharing, allocation formula.

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## **I. Introduction:**

As is well known Sudan suffered from two civil wars during the post independence period. A first civil war that has started in 1955, but is usually classified in the literature as having started in the 1960s, and was settled in 1972 with peace duration of about ten years. The second war started in 1983 and is still going on. The fact that the Sudanese civil wars have persisted for so long does not mean that serious attempts at resolving the conflicts were not made. Several peace initiatives were made during the second democracy, following the October 1964 popular uprising that brought down the military regime (1958-64) of General Abboud. These efforts culminated in the Khartoum Round Table Conference in 1965, which was attended by representatives of exiled Southern political parties, Northern political leaders as well as leaders of the Professionals and Workers Union in addition to observers from neighboring African countries. Propelled by the atmosphere of the return to democracy, and some confidence-building measures enacted by the transitional government, this conference was viewed with a lot of optimism. Unfortunately, the optimism appeared to be unfounded and the conference ended in a dismal failure (for details of the Round Table Conference see Beshir (1968: 88-97)). The reasons for the failure of the Conference have been the subject of analysis in the literature of the Sudanese civil war (e.g. Johnson (2003), and Khalid (2003)).

In 1972 an end to the civil war was achieved as a result of the Addis Ababa peace agreement between the main insurgency movement during the first civil war (Southern Sudan Liberation Movement (SSLM)) and the second military regime of General Nimeiri that lasted for the period 1969-1985. The peace agreement, better known as the Addis Ababa Peace Accord, guaranteed the South a regional autonomy within a united Sudan with a Southern Peoples' Regional Assembly as a legislature and a High Executive Council as a Southern Regional government exercising executive powers in addition to an independent civil service commission. The Addis Ababa Peace Accord brought peace to the Sudan for about ten years (1972-83), where the South enjoyed full-fledged democratic governance in contrast to the rest of the country.

According to an overall assessment of the Addis Ababa Peace Accord over the period 1972-1981 “South Sudan enjoyed a sub-system of the Nimeri regime. The situation amounted then to an island of liberal parliamentary democracy in an ocean of one party dictatorship and the personal rule of Nimeri in the whole country. What this system lacked, or was denied, was the economic power and resources to sustain and develop the Southern Region. This was marked by the deterioration in the condition of living in the South, economic stagnation and social anarchy” (Nyaba (1997: 21)). The deteriorating “conditions of living”, “economic stagnation” and “social anarchy” in the South resulted in wide-spread Southern dissatisfaction with the political and economic arrangements put in place by the Addis Ababa peace agreement. Combined with various trigger mechanisms this dissatisfaction eventually led to the eruption of the second civil war in 1983. The implication of this overall assessment is that the post-conflict economy of Sudan over the period 1972-1983 was not capable of sustaining the Addis Ababa peace process (see also Khalid (2003: 153)).

The second civil war started in 1983. Unlike the first civil war at the outbreak of the second civil war a rebel movement, Sudan People Liberation Movement (SPLM) with an army (Sudan People Liberation Army, SPLA), was established to lead the struggle (for some of the inside stories regarding the formation of the SPLM/A see Nyaba (1997) and Akol (2001), and for supplementary information see Khalid (2003 and Johnson (2003)). According to Khalid (2003: 155) the “agenda of the SPLM/A was not the resurrection of the Addis Ababa Accord, but the liberation of the whole country from what it saw as defective political infrastructures. At the center of the SPLM’s new thinking was the salvation of all the marginalized areas of Sudan. Those areas, in comparison of the riverain North, had been for decades eking out a life without hope and mired in squalor”. Though not official this summary of the grievance discourse of the SPLM explains to a large extent the duration of the second civil war and the multiplicity of initiatives to resolve the conflict (for details of these initiatives see, among others, Khalid (2003) and Johnson (2003)).

Irrespective of the details of the recent history of peace initiatives for Sudan it is probably well known that the most active initiative is that of the Inter-Governmental Authority on Drought and Desertification (IGADD), established in the 1970s and renamed the Inter-Governmental Agency for Development (IGAD) in 1997<sup>2</sup>. IGAD mediation efforts started in 1993 and came up with a

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<sup>2</sup> Members of IGAD are Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda. According to Khalid (2003: 369) the IGAD mediation process “took place at the initiative of General Bashir himself. In an IGAD Summit held in Addis Ababa in September 1993, General Bashir invite IGAD to mediate in the Sudanese conflict”.

declaration of principles (DOP) in May 1994 that affirmed the right of self-determination of the people of the South Sudan through a referendum. The DOP also explicitly noted that “appropriate and fair sharing of wealth among the various peoples of Sudan must be realized” (for the text of the DOP see Deng (n.d.: 121-122)). In the wake of 11 September 2001 attacks, and in the context of the war on terror, the US became actively involved in the IGAD process as a facilitator, together with the UK and Norway, albeit with its own peace initiative. The IGAD process resulted in the Machakos Protocol signed on July 2002 that “was hailed as a major step towards peace, resolving issues of self-determination and state and religion” (Johnson (2003: 179)).

In July 2003 a “draft framework for resolution of outstanding issues arising out of the elaborations of the Machakos Protocol” was presented to the parties in the negotiations in Nakuru, Kenya. The Nakuru draft framework is composed of three parts: part one is on “power sharing”; part two is on “wealth sharing”; and part three is on “security arrangements”. There is also a Nakuru “draft framework for resolution of the three conflict areas”. In what follows we deal with the draft on the resolution of outstanding issues despite the fact that the one dealing with the “three conflict areas” embodies an allocation formula relevant to them. Moreover, focus will be on part two on “wealth sharing.

Part two on “wealth sharing” starts with specifying the “guiding principles in respect of an equitable sharing of common wealth”. Among the guiding principles for equitable sharing of the common wealth of the country are the following:

- (a) “the wealth of the Sudan must be shared equitably so as to permit each level of government discharge its legal and constitutional responsibilities and duties”;
- (b) “the sharing and allocation of wealth emanating from the resources of the Sudan shall ensure that the quality of life, dignity, and living conditions of all citizens are promoted without discrimination on grounds of gender, race, religion, political affiliation, ethnicity, or region. The sharing and allocation of wealth shall be based on the premise that all parts of Sudan are entitled to development”;
- (c) “Southern Sudan, and those areas in need of construction/reconstruction, should be brought up to the same average social/economic standard and public services as the Northern states. To achieve these objectives will take time and effort to build up local capacity – institutional, human and economic”

While these principles are acceptable they remain vague as to the relevant indicators to be used to ensure the “equitable sharing” of income and wealth between the various regions in a development context. Principle (a) emphasizes the importance of respecting the administrative constraints of the various levels of government to enable them to “discharge legal and constitutional responsibilities and duties”. Such requirements are usually reflected in government budgets. Principle (b) can be understood as emphasizing the importance of promoting non-discriminatory development, where development is broadly defined in terms of the “quality of life” and “living conditions” of all citizens. Both the “quality of life” and “living conditions” are left undefined. Principle (c) could be interpreted as embodying an objective function to guide the design of a wealth allocation formula in the form of minimizing the gap in average “social/economic standard and public services” between the South and the North. Once again the “social/economic standard” is left undefined.

A specific formula for sharing oil revenue is proposed in article 6 of part two of the Nakuru framework. The formula defines the “net revenue from oil” in a very precise way, with appropriate caveats for possible future events on the price front. In addition an “oil revenue stabilization account” is to be set up such that net oil revenue derived from sales at prices above an agreed benchmark prices (established annually in the context of the national budget) are to be deposited. After payments into the stabilization account, if any, 2% of the net oil revenue “shall be transferred to oil producing states in proportion to output produced in each state”. This percentage is applicable to “oil producing contracts current on the date of the beginning of the interim period” as well as to “contracts that are not producing oil at the beginning of the interim period, whether signed before or after that date”. The overall net revenue (i.e. after payments into the stabilization account and transfers to the producing states) from oil produced in Southern Sudan “forty-eight (48%) percent of the new balance shall be paid to the Government of Southern Sudan. The remaining balance shall be paid to the Government of the Sudan”.

As it happened the government of Sudan rejected the whole Nakuru framework as a basis for negotiations for the seventh round of peace talks that resumed on 11 August 2003 but remained stalled up to 17 August 2003. The government’s position is articulated in a document, dated 11 July 2003, entitled “comments and remarks of GOS delegation on draft framework for resolution of outstanding issues arising out of the elaborations of the Machakos protocol and other important issues”. In section 5 of the government’s document, entitled “an overview of the

wealth sharing segment”, it is noted that “it was agreed at the last round to convene a technical group meeting supported by the World Bank and IMF consultants to agree with the parties to working out the allocation based on an agreed upon framework. Instead of doing that, we have been presented with a set of figures which is far removed from what had already (been) projected, and which in our opinion defeats the principles”.

The objective of this paper is to suggest a framework on the basis of which a wealth allocation formula could be based. The framework is based on the UN Millennium Development Goal (MDG) on poverty reduction. Eight Millennium Development Goals were articulated in the UN Millennium Declaration in September 2000. According to the United Nations (UN (2002: 8)) the “development goals set out in the Millennium Declaration express the resolve of the world’s political leaders to free their fellow men, women and children from the abject and dehumanizing conditions of extreme poverty, to make the right to development a reality for everyone, and to free the entire human race from want”<sup>3</sup>. The first Millennium Development Goal (MDG) is to eradicate extreme poverty and hunger. Two major targets under this goal have been specified. The first target is to halve the proportion of people living in extreme poverty (living on less than US\$1.08 per person per day) by the year 2015. As is well known, the proportion of people living in extreme poverty is the head count ratio while the income level of US\$ 1.08 per person per day is the poverty line<sup>4</sup>.

On the basis of the MDG on poverty section (II) presents the proposed analytical framework. In a nutshell the idea behind the framework is that of minimizing poverty in a two region economy (South and North) by allocating a given total of resources between the two regions. With poverty summarized by the head count ratio the resulting allocation formula depends on a number of poverty magnitudes such as the head count ratios for the two regions, the growth elasticity of poverty in each region and the elasticity of the per capita expenditure of the South to that of the North. In section (III) the results are reported, where due to lack of information on poverty by regions an indirect method of estimating the relevant poverty magnitudes is used. A major issue to be explored in the results section is the condition under which the Nakuru sharing formula of overall net revenue from oil could be supported by the proposed framework and the derived formulae. Section (IV) presents a few concluding remarks.

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<sup>3</sup> See UN (2002: 8).

<sup>4</sup> For the importance of poverty in the context of development see, for example, World Bank (2000 and 1991). For a broad concept of development on the basis of which MDGs can be justified see Sen (1999). Further, for alternative concepts of the poverty line see Ravallion (1998).

## **II. Analytical Framework:**

A logical starting point for a conceptual framework is to look at an economy composed of two regions: South, denoted and variables subscripted by,  $s$ ; and North, denoted and variables subscripted by,  $n$ . Many characterizations can be invoked for such regions, but for the purposes of developing this framework a historically consistent characterization can be followed. Under this characterization the South could be taken as a low real per capita income region and North as a high real per capita income region. If real per capita income is assumed to reflect labor productivity then the framework could be taken as invoking a dual economy construct<sup>5</sup>.

In the context of such an economy poverty, as measured by the head-count ratio at the national level, is the weighted sum of the regional head-count ratios where the weights are the regional population shares. In technical terms poverty, as measured by the head-count ratio,  $H$ , is given by:

$$(1) H = \alpha H_s(\mu_s/z_s, \theta_s) + (1 - \alpha) H_n(\mu_n/z_n, \theta_n)$$

where  $\alpha$  is the share of South population in total population;  $\mu$  is per capita consumption expenditure;  $z$  is per capita poverty line;  $\theta$  is the Gini coefficient of the distribution of consumption expenditure; the subscripts  $s$  and  $n$  refer to South and North respectively and noting that the national head-count ratio,  $H$ , is given by  $H = H(\mu/z, \theta)$ .

In the context of such an economy, where per capita consumption expenditure differs between the regions, it would be natural to assume that the poverty line depends on income in such a way that the elasticity of the poverty line with respect to mean consumption expenditure, call it  $\epsilon$ , is non-negative but less than, or equal to, unity (i.e.  $0 \leq \epsilon \leq 1$ )<sup>6</sup>. With this assumption, the change in poverty over time at the national level can be shown to have two components: a growth

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<sup>5</sup> As is well known there is a vast literature on the dual economy models motivated by the pioneering work of Lewis (1954). An analytical summary of this literature is to be found in Dixit (1973). For a succinct summary of the growth patterns in dual economy models see Dixit (1970). For the use of dual economy models to study issues of changes in the distribution of income over time see Bourguignon (1990).

<sup>6</sup> Note that the case where the elasticity of the poverty line is equal to zero corresponds to the frequent assumption used in empirical work where the poverty line is held constant over time and between regions or sectors. The other extreme where the elasticity of the poverty line with respect to mean consumption expenditure is equal to unity corresponds to the European practice of choosing the poverty line as a fixed proportion of the standard of living (usually taken as median income).



component, where poverty would be expected to decline as a result of an increase in mean consumption given the state of inequality in the distribution of consumption expenditure; and a distribution component, where poverty would be expected to decline as a result of a decline in the degree of inequality in the distribution of consumption, given mean consumption expenditure. In technical terms differentiating the national head-count ratio,  $H(\mu/z, \theta)$ , logarithmically with respect to time gives:

$$(2) G(H) = (1 - \varepsilon) \eta G(\mu) + v G(\theta)$$

where  $G(x) \equiv (dx/dt)(1/x)$  is the respective growth rate of the variable and  $\eta$  and  $v$  are the elasticities of the head-count ratio with respect to mean consumption expenditure and the Gini coefficient respectively}.

It goes without saying that the change in regional poverty over time will have the same structure as the change in overall poverty with regional growth and distribution components, appropriately defined on the regional mean consumption expenditures, poverty lines and Gini coefficients. In technical terms differentiating the regional head-count ratios logarithmically with respect to time gives:

$$(3) G(H_s) = (1 - \varepsilon_s) \eta_s G(\mu_s) + v_s G(\theta_s)$$

$$(4) G(H_n) = (1 - \varepsilon_n) \eta_n G(\mu_n) + v_n G(\theta_n)$$

In the context of such an economy the regional growth components are related through a migration condition in such a way that in equilibrium there exists a gap in favor of the North region. Alternatively, the regional growth components could be related through a structural relationship with respect to the growth of the economy. In what follows major issues relating to the growth and distribution components at the national level will be discussed.

In view of the discussion in the previous two sections, a behavioral assumption that the state of income distribution, as summarized by the Gini coefficient, is a function of the mean consumption expenditure can now be made. Recalling the behavioral assumption on the poverty line as a function of mean consumption expenditure, the poverty measure will now be a function

of mean consumption expenditure with a net growth elasticity of poverty that takes into account changes in the distribution of expenditure. In technical terms the head-count ratio at the national level can now be looked at as being a function of per capita consumption expenditure,  $H = H(\mu/z(\mu), \theta(\mu)) = H(\mu)$ , where  $\mu$ ,  $z$ , and  $\theta$  are respectively mean consumption expenditure, the poverty line and the Gini coefficient. With the assumptions on  $z$  and  $\theta$ , the percentage change in the head-count ratio over time,  $G(H)$ , is given by:

$$(5) G(H) = [\eta(1 - \varepsilon) + \nu \kappa] G(\mu) = \gamma G(\mu)$$

where  $\eta$  is the elasticity of the head-count ratio with respect to mean consumption expenditure (which is negative),  $\varepsilon$  is the elasticity of the poverty line with respect to mean consumption expenditure (which is non-negative and equal to , or less than, unity),  $\nu$  is the elasticity of the head-count ratio with respect to the Gini coefficient (which is positive), and  $\kappa$  is the elasticity of the Gini coefficient with respect to mean consumption expenditure (which could be of any sign depending on the stage of development of the economy: at an early stage we would expect it to be positive while at a later stage we would expect it to be negative). The expression  $[\eta(1 - \varepsilon) + \nu \kappa]$ , which is denoted by  $\gamma$ , is the growth elasticity of poverty.

Despite the growing empirical literature that attempts to understand the determinants of growth across countries, it is generally agreed that growth at the national level is largely driven by the investment rate in the economy (investment as a ratio of GDP) and technological progress. Assuming, therefore, that mean consumption expenditure is a function of investment, it would seem relevant that a government interested in poverty reduction would care about the allocation of investment between the two regions to achieve the poverty reduction objective. For short periods of time, like the six-year transitional period, the government can be assumed to have a given total of resources devoted to investment that can be allocated to the two regions (without confusion with standard notation we may denote the total amount of investment resources available to the government as  $K$ ). In the context of Nakuru's framework  $K$  could be taken as "overall net revenue from oil".

The relevant policy question is how should these resources be allocated between the regions in order to reduce poverty. This is a standard optimization problem with an objective function and a constraint. In this case the objective function is given by the head-count ratio that needs to be minimized and the constraint is given by the requirement that the investment resources allocated

to the regions should not exceed the total resources available to the government. Given the property of the head-count ratio as an additively separable poverty measure, the head-count at the national level,  $H$ , is a weighted sum of the regional head-count ratios with weights given by the population shares; that is:

$$(6) H = \alpha H_s(\mu_s) + (1 - \alpha) H_n(\mu_n)$$

where  $\alpha$  is the share of the population of the South in total population.

In such standard problems the requirement for an optimal solution is usually expressed in terms of equating the ratio of investment in the South to that in the North to some magnitude given by the parameters of the problem<sup>7</sup>. In technical terms the problem is of the form where we formulated the constraint in per capita terms:

$$(7) \text{ minimize by choice of } k_s \text{ and } k_n, H = \alpha H_s(\mu_s) + (1 - \alpha) H_n(\mu_n)$$

$$(8) \text{ subject to the constraint that } \alpha k_s + (1 - \alpha) k_n = k \text{ and } \mu_i = \mu_i(k_i).$$

To solve this problem use can be made of the constraint to appropriately choose investment in the South to minimize the head-count ratio. Doing this it is an easy matter to show that the first order condition for an internal solution of minimizing  $H$  by choice of  $k_r$  is given by:

$$(9) dH/d k_s = 0 = [\alpha H_s(\mu_s)\gamma_s E(\mu_s)/ k_s] - [\alpha H_n(\mu_n)\gamma_n E(\mu_n)/ k_n]$$

where use has been made of the fact that  $dk_n/d k_s = - [\alpha/(1 - \alpha)]$  and where  $E(\mu_i) = (d\mu_i / dk_i)$  ( $k_i / \mu_i$ ) is the percentage change in regional mean consumption expenditure as a result of percentage change in the resources allocated to the sector. In a sense this elasticity can be understood as a regional growth rate. Thus the optimal allocation formula requires that:

$$(10) \quad k_s / k_n = [H_s(\mu_s)\gamma_s E(\mu_s)] / [H_n(\mu_n)\gamma_n E(\mu_n)]$$

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<sup>7</sup> For a similar problem in the context of aid effectiveness see Collier and Dollar (2000). Note however that Collier and Dollar formulate the objective as the sum of rates of poverty reduction in developing countries and do not exploit the additive property of the head-count ratio.

That is, the optimal allocation formula would depend on the relative shares of the regions in total poverty, the relative sensitivity of regional poverty with respect to growth as captured by the regional growth elasticity of poverty and on the relative regional growth rates. Indeed, using the constraint, an overall regional allocation formula would require allocating the total available resources such that each region would get a share depending on an overall regional response of poverty to growth relative to an overall response of poverty to growth at the national level. In technical terms substituting for  $k_n$  from the above allocation ratio in the constraint will give rise to the optimal investment in the South and North respectively as:

$$(11) \quad k^*_s = \{ [H_s(\mu_s)\gamma_s E(\mu_s)] / [H_s(\mu_s)\gamma_s E(\mu_s) + H_n(\mu_n)\gamma_n E(\mu_n)] \} k ,$$

$$(12) \quad k^*_n = \{ [H_n(\mu_n)\gamma_n E(\mu_n)] / [H_s(\mu_s)\gamma_s E(\mu_s) + H_n(\mu_n)\gamma_n E(\mu_n)] \} k.$$

It is perhaps clear that the above formula can be generalized for a country with more than two regions. These poverty reduction regional investment shares could form the basis for the design of a resource sharing formula for Sudan. Before applying the formulae it may be useful to note that the ratio  $[E(\mu_s)]/E(\mu_n)$  gives the elasticity of the income of the South with respect to that of the North which may be denoted as  $E(\mu_{sn})$ . Appropriate normalization of (11) and (12) would give the formulae in terms of this new elasticity as:

$$(13) \quad k^*_s = \{ [\gamma_s H_s(\mu_s) E(\mu_{sn})] / [\gamma_s H_s(\mu_s) E(\mu_{sn}) + \gamma_n H_n(\mu_n)] \} k$$

$$(14) \quad k^*_n = \{ [\gamma_n H_n(\mu_n)] / [\gamma_s H_s(\mu_s) E(\mu_{sn}) + \gamma_n H_n(\mu_n)] \} k.$$

Without trying to claim too much for the above sharing formula it is suggested that it has a number of attractive features important among which is that it is based on a transparent objective of reducing poverty in the country. Such an objective is dear to the two parties in the conflict and is consistent with the UN MDGs. A second attractive feature is that it takes account of the spread of poverty as measured by the head count ratio thus taking into account not only the population weight of each region but also the weight of those who live below the relevant poverty line. A third feature is that it accounts for the structural nature of the responses of poverty to economic development in each region as captured by the growth elasticity of poverty. A fourth feature is that it accounts for the differential growth performance of the two regions as captured by the elasticity of the per capita income of the South with respect to that of the North. On the basis of

these observations it is suggested that such an allocation formula could provide a justification for sharing of wealth in the country that respects the grievance discourse of the main liberation movement.

### **III. Data and Results:**

At the outset it needs to be noted that relevant poverty information to apply the formulae in equations (13) and (14) is not available for Sudan. As such, therefore, resort will be made to indirect methods of estimation and calculation of the variables in question. Such methods are frequently invoked in the study of poverty for the developing countries precisely because of lack of data (see, for example, Karshenas (2001)).

We start by looking for an estimate for regional per capita income and expenditure. In this respect we note that at independence, Sudan's GDP was estimated as amounting to Ls.284 million (US\$795 million). Per capita GDP amounted to Ls.28 or about US\$78 classifying Sudan among the poorest countries in the world. The distribution of GDP over regions is given in table (1).

**Table (1):**

**GDP and Population of Sudan by Region in 1956**

Region	Provinces	GDP (Ls. 000)	GDP Share (%)	Population	Population Share (%)	GDP per Capita (Ls.)
North-East	Northern, Kassala, Khartoum	75786	26.67	2319021	22.60	32.68
Blue Nile	Blue Nile	86032	30.27	2069646	20.17	41.59
North-West	Kordofan, Darfur	83777	29.48	3090733	30.11	27.11
South	Bahr El Ghazal, Equatoria, Upper Nile	38610	13.59	2783136	27.12	13.87
Total		284205	100.00	10262536	100.00	27.69

Source: based on Balamoan (1981: 244, table 39).

The table shows that the Blue Nile region, the heart of agricultural development during the colonial period, was relatively better than other regions of the country with a per capita GDP that amounted to about LS.42 (US\$118), followed by the North-East region, which includes the capital city of Khartoum, with a per capita GDP of about Ls.33 (US\$92) and the North-West region with a per capita GDP of Ls.27 (US\$76). Overall the GDP per capita for the North amounted to Ls. 32.83 (\$91.53). The South fared much worse than the northern regions with a per capita GDP of about Ls.14 (US\$39) reflecting years of neglect and marginalization during the colonial period. The poorest northern sub-region has almost twice the per capita of the South. The ratio of per capita GDP of the South to that of the North is equal to about 0.43. It is this ratio that will be used in what follows.

Real GDP per capita in Sudan in 2000 is reported as US\$ 976 in 1985 purchasing power parity (PPP)<sup>8</sup>. According to official information the share of the population of the South in 2000 was about 15.6% (Bahr Al-Ghazal 7.3%; Upper Nile 4.3%; and Equatoria 4%)<sup>9</sup>. Using the ratio of per capita GDP for the South to that for the North together with the population share of the South, per capita GDP for the South in 2000 could be taken as US\$ 461 in PPP. This is equivalent to a per capita GDP per month of about US\$ 38.4 in PPP, slightly higher than the international poverty line of US\$32 per person per month. GDP per capita for the North is US\$ 1071 in PPP. Alternatively, using the 1955 population share of the South (of 0.2712) per capita GDP for the South would be US\$497 in PPP while that of the North would be US\$1155 in PPP. Note, however, that the relevant standard of living for poverty analysis is per capita consumption expenditure. According to national income estimates private consumption expenditure averaged about 0.85 of GDP during the 1990s. This implies that per capita consumption expenditure in Sudan in 2000 amounted to US\$ 830 in PPP. Applying the same procedure used to obtain GDP per capita for the South it is an easy matter to establish that per capita consumption expenditure in the South amounted to about US\$394 in PPP using population share of 2000 and US\$422 using 1955 population share. These are equivalent respectively to US\$1.07 and US\$1.17 per person per day. Thus per capita consumption expenditure in the South using 2000 population share is almost equal to the international poverty line. The per capita consumption expenditure for the North is US\$911 using the population share of 2000 and US\$982 using the population share for 1955. These, it is suggested, are reasonable estimates that

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<sup>8</sup> As is well known working with purchasing power parity figures allows comparison between regions and time periods.

<sup>9</sup> According to CBS and UNFPA (1999) the share of the population in the South of the country for census years was as follows: 19.9% in 1973, 25.6% in 1983 and 16.8% in 1993. Thus taking the two illustrative population shares in

can be used in the context of the proposed formulae. Table (2) summarizes these results in a transparent manner where per capita GDP and consumption expenditure are in US\$ in 1985 purchasing power parity. Without causing any confusion in what follows we subscript estimates using the population share for the year 2000 by one (e.g.  $u_1$  for per capita GDP and  $\mu_1$  for capita consumption expenditure) and estimates using population share for 1955 by 2 (e.g.  $u_2$  and  $\mu_2$ ).

**Table (2):**

**Estimates of Regional Per Capita GDP and Consumption Expenditure for 2000**

Region	Population Share in 2000	Per Capita GDP ( $u_1$ )	Per Capita Consumption Expenditure ( $\mu_1$ )	Population Share in 1955	Per Capita GDP ( $u_2$ )	Per Capita Consumption Expenditure ( $\mu_2$ )
South	0.156	461	394	0.2711	497	422
North	0.844	1071	911	0.7289	1154	982
Sudan	1.000	976	830	1.0000	976	830

Source: own calculations.

In addition to the above GDP and consumption expenditure estimates the application of the proposed formulae requires knowledge of regional poverty shares, the growth elasticity of poverty for each region and the elasticity of South's income with respect to that of the North. In general such knowledge can be obtained in a direct fashion if the required information on the distribution of wealth, income or consumption expenditure is available<sup>10</sup>. In the case of Sudan such data is not available especially for the South<sup>11</sup>. As a result resort can be made to indirect methods. One such method is to use estimates of poverty measures from cross-country studies for regions where countries are judged to be comparable to Sudan in terms of the stage of development. The Sub-Saharan Africa (SSA) region suggests itself as an obvious region.

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the text would amount to representing maximum and minimum shares.

<sup>10</sup> For grouped data the POVCAL program, developed in the World Bank and can be freely downloaded from its web site, automatically calculates these elasticities for the FGT measures of poverty.

<sup>11</sup> As is well known high quality data for Sudan is available only for 1968 in international data sets such as that of Deininger and Squire (1996).

For a sample of 18 Sub-Saharan countries poverty measures were calculated based on a poverty line that changes with per capita consumption expenditure. A poverty equation is then estimated where the natural logarithm of the head count ratio is the dependent variables and per capita consumption expenditure and the Gini coefficient (percentage points) are the explanatory variables. Such a formulation is preferred to the double logarithm format because it allows the elasticity of the head count ratio with respect to each of its determinants to vary with the determinant. The resulting estimated equation for the headcount ratio, with White heteroscedasticity adjusted absolute t-values in brackets, is given below:

$$(15) \quad \text{Ln } H = 4.1732 - 0.00163 \mu + 0.0124 \theta ; \text{ adjusted R-squared} = 0.94;$$

(34.36)      (15.96)      (5.40)

where H is the head-count ratio,  $\mu$  is real per capita consumption expenditure in 1985 purchasing power parity dollars, and  $\theta$  is the Gini coefficient in percentage points. The relevant partial elasticities of the head-count ratio are readily obtainable from the above equation as  $\eta_H = [-0.00163\mu]$  and  $v_H = [0.0124\theta]$  and can be calculated once information for  $\mu$  and  $\theta$  is available. Note that in view of the fact that the equation is estimated on the basis of a poverty line that changes with the level of consumption expenditure the partial elasticity  $\eta_H$  is inclusive of the elasticity of the poverty line with respect to consumption expenditure.

In the above estimated equation knowledge of the Gini coefficient,  $\theta$ , is important for the estimation of the head-count ratio. Such information can also be obtained by an indirect method. The method depends on an estimation of a Kuznets' equation reported in Ali (1998)<sup>12</sup>. The estimation is based on a sample of 50 countries: 33 developing countries (12 Latin American, 9 Asian and 11 African) in addition to 17 advanced countries. Instead of the usual quadratic form, the functional form proposed by Anand and Kanbur (1993) was estimated where the Gini coefficient (measured as a ratio) is regressed on mean income and its reciprocal. The result of the estimation, with an African dummy (Afdum), is reported in equation (17) below where figures between brackets are t-values:

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<sup>12</sup> As is well known Kuznets (1955) argued that in a dual economy inequality tends to increase with an increase in per capita income before it declines. Increases in per capita income are taken to represent the stage of development of countries. Thus, at early stages of development (i.e. low per capita incomes) countries are expected to be on the rising portion of the inequality-development relationship. This relationship has given rise to a lot of controversy but empirical results confirming its existence are to be found in, among others, Barro (2000), Bulir (1998), Jha



$$(17) \theta = 0.5121 - 0.0000203u - 49.8037(1/u) + 0.06927 (\text{Afdum}); R^2 = 0.329$$

$$(13.41) \quad (-3.625) \quad (-2.199) \quad (2.078)$$

Where  $u$  is GDP per capita in 1985 PPP. Given the existence of a Kuznets' relationship according to equation (17) the implied turning point for the Kuznets' relationship is \$1566 per person per year in 1985 PPP. Thus for countries with per capita GDP below this turning point the Gini would be expected to increase as GDP per capita increases. For the purposes at hand, it will be expected that the South would display a lower degree on inequality than the North.

Recall that in applying equation (17) to the case of Sudan for prediction purposes the intercept term will be 0.58137 on account of the fact that Sudan belongs to Sub-Saharan Africa and as such the variable ( $\text{Afdum}$ ) will take the value of one. Predicted regional Gini coefficients will of course depend on the population shares used. Indeed, using the GDP figures reported above it is an easy matter to confirm that for 2000 the predicted Gini coefficients are 0.491 for the South, 0.5403 for the North and 0.5375 for the country using the population share of 2000, and 0.4979 for the South and 0.5418 for the North using the population share for 1955. These predicted Gini coefficients are much lower than those currently reported for Sudan albeit that the current Gini coefficients are based on household survey results confine only to the North.

The estimated coefficients are used to derive a Kuznets' elasticity, a component of the growth elasticity of the head-count ratio. From equation (17) it is an easy matter to show that the Kuznets' elasticity is given by the following expression:

$$(18) [d \log \theta / d \log u] = \kappa = [- 0.0000203 u + 49.8037 (1/u)] / \text{Gini}$$

where the Gini in the formula is the predicted Gini. Using per GDP figures reported above it is an easy matter to show that the Kuznets' elasticity using 2000 population share for the South is about 0.21 (0.19 using 1955 population share), that for the North is 0.048 (0.038 using 1955 population share) and that for the country is about 0.061. Table (3) provides the results in a transparent fashion.

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(1996) and Sarel (1997).

**Table (3):**

**Estimates of Regional Gini Coefficients and Kuznets Elasticity**

Region	Population Share in 2000	Per Capita GDP $u_1$	Gini Coefficient $\theta_1$	Kuznets Elasticity $\kappa_1$	Population Share in 1955	Per Capita GDP $u_2$	Gini Coefficient $\theta_2$	Kuznets Elasticity $\kappa_2$
South	0.156	461	0.4640	0.2127	0.2711	497	0.4711	0.1913
North	0.844	1071	0.5131	0.0483	0.7289	1154	0.5149	0.0383
Sudan	1.000	976	0.5105	0.0612	1.0000	976	0.5105	0.0612

Source: own calculations.

Using the results in tables (2) and (3) in equation (15) it is possible to estimate regional poverty magnitudes including the growth elasticity of poverty. It is to be recalled that in using equation (15) the Gini coefficient needs to be substituted in percentages and that the relevant measure of the standard of living is per capita consumption expenditure. The required information and the results are reported in table (4) where the growth elasticity of poverty will be calculated on the basis of the following formula:

$$(19) \quad \gamma = [-0.00163\mu] + [0.0124\theta]\kappa$$

**Table (4):**

**Estimates of Regional Poverty and the Growth Elasticity of Poverty**

Region	Per Capita Consumption Expenditure $\mu_1$	Gini Coefficient $\theta_1$ (%)	Head Count Ratio $H_1$ (%)	Growth Elasticity of Poverty $\gamma_1$	Per Capita Consumption Expenditure $\mu_2$	Gini Coefficient $\theta_2$ (%)	Head Count Ratio $H_2$ (%)	Growth Elasticity of Poverty $\gamma_2$
South	394	46.40	60.72	-0.5198	422	47.11	58.53	-0.5761
North	911	51.31	27.79	-1.4542	982	51.49	24.80	-1.5762
Sudan	830	51.05	31.61	-1.3142	830	51.05	31.61	-1.3142

Source: own calculations.

The results in table (4) should be understood as average predictions rather than true descriptive magnitudes<sup>13</sup>. The spread of poverty in the Sudan in the year 2000 is known to be much wider than 31.6% of the total population falling below the appropriate poverty line. Similarly, the head count ratios for the two regions are clearly underestimates. What is important to note is that the spread of poverty in the South is about 2.2 times that in the North. Taken as a measure of relative deprivation such ratio could be used for illustrative purposes and may be considered as reasonable. The growth elasticity of poverty for the two regions seem to be of reasonable magnitudes compared to Sub-Saharan Africa.

A remaining parameter that is needed for the calculations of the allocation formula is the elasticity of the per capita consumption expenditure of the South with respect to that of the North. Lack of appropriate time series data on regional per capita expenditure, or income, prevents a direct estimation of the elasticity in question. A reasonable proxy for this use can be made of the elasticity of the mean consumption expenditure of the poor with respect to that of the rich. In view of the earlier comparison of the per capita expenditure in the South with the international poverty line the suggested proxy seems justified.

For a sample of 48 developing countries the following relationship is estimated where  $\mu_p$  and  $\mu_r$  are the per capita consumption expenditure of the poor and the rich respectively and where (afdum) is a dummy for Sub-Saharan Africa and where figures between brackets are absolute t-values:

$$(20) \quad \text{Ln } \mu_p = 0.6347 + 0.5842 \text{and } \mu_r - 0.2009 (\text{afdum}); R\text{-squared} = 0.78$$

(2.13)      (10.27)      (2.11)

The above equation gives a constant elasticity of the mean consumption expenditure in the South to that of the North of about 0.58 implying that it will be expected for the consumption expenditure in the South to increase by about 0.6 of a percentage point increase in that of the North.

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<sup>13</sup> In an unpublished report by the Ministry of Manpower (1997: 52) based on a migration and labor survey for the year 1996 hard core poverty is estimated as 49.9% for the country, 61.7% for the rural areas and 24.4% for the urban areas. These results are similar to the projected head count ratios above despite the difference in the definition of the sectors. Reported overall poverty, however, is much higher than these hard core estimates. It needs to be noted that the 1996 migration and labor survey does not constitute a high quality data set.

The elasticity of the income of the poor with respect to mean income was made famous by Dollar and Kraay (2002) who argued that there is a proportional relationship between the two incomes with the elasticity in question being equal to unity. The unitary elasticity result is based on the definition of the head-count ratio as the lowest quintile of the population for each country. Ali and Elbadawi (2001) have shown that such a result does not hold if the head count ratio is defined on the basis of a relevant poverty line and that the elasticity in question is less than unity in a statistically significant fashion<sup>14</sup>. Nonetheless, in what follows use will be made of the unitary elasticity on the understanding that it is possible for the growth rate of per capita income of the South to be equal to that of the North.

In addition to the above possibilities it is also reasonable to explore elasticity magnitudes that are in excess of unity implying a growth rate for the South greater than that for the North. The justification for such a possibility is to be found in the famous convergence hypothesis of neoclassical growth theory where it is expected that poor countries (or regions) to have growth rates higher than rich countries on their way to the steady state. The countries, or regions, in question are assumed to the same production technology as summarized by a standard neoclassical production function. Thus, for example, Barro and Sala-I- Marin (1995: 26) state the absolute convergence hypothesis as “regions or countries with lower starting value of capital/labor ratio have higher per capita growth rates and tend thereby to catch up or converge to those with higher capital/labor ratios”.

Collecting the relevant results and applying the formula in equation (13), table (5) reports the results for the possible share of the South on the assumption that the objective is to reduce poverty in the country. Two sets of results are reported as noted earlier where results subscripted by 1 are those based on using the population share of the year 2000 and those subscripted 2 are those using the 1955 population shares. Recall also that in these calculations per capita income, and consumption expenditure, of the South is assumed to be 0.43 of that of the North as per the national income accounts of 1955. For alternative 1 the head count ratios are 0.6072 for the

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<sup>14</sup> Ali and Elbadawi (2001) provide direct calculations and regression results for the elasticity of the income of the poor with respect to mean income of society for a sample of 48 developing countries and sub-groups of countries (18 Sub-Saharan African countries). From direct calculations the elasticity in question is 0.46 for Africa (significantly different from unity with a t-value of 23.48) and is 0.47 for the sample (significantly different from unity with a t-value of 26.5). Similar results are reported from regression analysis with semi-log and quadratic in logs that allow the elasticity to change with per capita income. The result in equation (20) of the text is based on the whole sample.

South and 0.2779 for the North; and the growth elasticity of poverty is  $-0.5198$  for the South and  $-1.4542$  for the South. For alternative 2 the head count ratio is 0.5853 for the South and 0.248 for the North; and the growth elasticity of poverty is  $-0.5761$  for the South and  $-1.5762$  for the North. The results are reported for alternative values of the elasticity of the per capita consumption expenditure of the South with respect to that of the North. The share of the North is obviously the complement of that of the South.

**Table (5):**  
**The Share of the South in the Wealth of Sudan (percentages)**

Elasticity of Income of South with respect to that of North: $E(\mu_{sn})$	0.58	1.00	1.50	2.00	2.50	3.00
Alternative 1	31.18	43.85	53.95	60.97	66.13	70.09
Alternative 2	33.35	46.31	56.41	63.31	68.83	72.13

Source: own calculations.

The table, it is suggested, reports a set of interesting results. The share of the South increases with an increase in the elasticity of the per capita consumption expenditure of the South with respect to that of the North for the two alternatives. Note, however, that the increase in the share of the South declines as the elasticity increases. The increase at the lower end of the elasticity is about 13 percentage points for the two alternatives and about 4 percentage points for alternative 1 and about 3 percentage points for alternative 2 at the upper end. Alternative 1, which uses the population share of the South for the year 2000, gives lower shares than alternative 2, but the difference between the two alternatives does not exceed 3 percentage points. What is more significant is that the table clearly shows that the proposed formula is capable of reproducing the shares proposed in the Nakuru framework for the allocation of the net revenue from oil of 48% for the South and 52% for the North. For both alternatives this allocation obtains for an elasticity of the expenditure in the South with respect to that of the North in excess of unity but less than 1.5. This implies that the Nakuru formula envisages convergence to take place between the two regions but at a very slow pace.

#### **IV. Concluding Remarks:**

In this paper a framework for the design of an appropriate allocation of wealth between the South and the North regions of Sudan is proposed. It is claimed that the framework should be acceptable to both parties in view of the fact that it is derived from the internationally agreed upon MDG on poverty reduction. The results show that the Nakuru proposal of 48% of net oil revenue to be allocated to the South can be justified on the basis of the framework. Despite this, however, it is acknowledged that any allocation formula to be based on the framework requires adequate knowledge of the poverty parameters involved. These poverty parameters depend, among other things, on precise knowledge of the distribution of population between the two regions. In this respect the ultimate application of the proposed framework requires a population census to be conducted. Unfortunately, this time around the census instrument needs to be designed in such a manner as to seek the determination of the ethnic composition of the population. This in turn requires agreement on the definition of who is a Southern Sudanese.

Further, the ultimate application of the proposed formula would require a high quality household budget survey to be conducted. This is vital in view of the guiding principles (b) and (c) “in respect of an equitable sharing of common wealth” that emphasize comparative living standards in the two regions. As this paper has shown the relevant information on living standards does not exist at present and as such any design of the sharing formula would be subject to criticism as being ad hoc. Standards for high quality data for use in income, and expenditure, distribution and poverty studies have been explored by, among others, Dininger and Squire (1996: 567-571). The requirements are (i) that the data be based on actual observation of individual units drawn from household surveys; (ii) that the data “even if drawn from household surveys, be based on a representative sample covering all of the population”; and (iii) that income data should be based “on a comprehensive coverage of different income sources as well as of population groups”.

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